



## **UTTAR PRADESH METRO RAIL CORPORATION LIMITED**

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing And Commissioning Of Heavy Duty Machine Room Less Elevators And Heavy Duty Escalators Including Maintenance During 02 (Two) Years Defect Liability Period (DLP) And 01 (One) Year Comprehensive Annual Maintenance Beyond DLP Period For Lucknow, Kanpur & Agra Mass Rapid Transport System Project Under The Contract LKE(02)-02”.**

### **TENDER NO: LKE(02)-02**

#### **TENDER DOCUMENTS**

#### **VOLUME 3**

#### **EMPLOYER’S REQUIREMENTS**

- A. General**
- B. Functional**

**UTTAR PRADESH METRO RAIL CORPORATION LTD.  
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Lucknow-226010, Uttar Pradesh**



## **TENDER NO: LKE (02)- 02**

### **TENDER DOCUMENTS**

#### **EMPLOYER'S REQUIREMENTS – GENERAL**

**Design, Manufacturing, Supply, Installation, Testing And Commissioning Of Heavy Duty Machine Room Less Elevators And Heavy Duty Escalators Including Maintenance During 02 (Two) Years Defect Liability Period (DLP) And 01 (One) Year Comprehensive Annual Maintenance Beyond DLP Period For Lucknow, Kanpur & Agra Mass Rapid Transport System Project Under The Contract LKE(02)-02**

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## CHAPTER 1

### 1. GENERAL

#### 1.1 Application of the General Specification (GS)

- 1.1.1 The provisions contained in the Particular Specification (PS) and the Employer's Drawings shall prevail over the provisions contained in this GS.
- 1.1.2 The provisions contained in the GS shall prevail over the provisions contained in International Standards, European Standards, British Standards, Indian Standards, British Standard Codes of Practice and similar standard documents stated in the Contract.
- 1.1.3 This GS shall be read in conjunction with the other documents constituting the Contract.

#### 1.2 Abbreviations

Common abbreviations used in the GS and in the PSs shall have the following meanings:

ACB	: Air Circuit Breaker
AMS	: Auxiliary Main Sub Station
ASS	: Auxiliary Sub Station
BCC	: Backup Control Centre
BCU	: Bay Control Unit
BS	: British Standard
BEC	: Buried Earth Conductor
BMS	: Building Management System
CADD	: Computer Aided Design and Drafting
CAR	: Corrective Action Request
CMV	: Catenary Maintenance Vehicle
CNP	: Construction Noise Permits
COTS	: Commercial Off the Shelf
CPM	: Critical Path Method
CV	: Curriculum Vitae
DG	: Diesel Generator
DLP	: Defects Liability Period
UPMRC	: Uttar Pradesh Metro Rail Corporation
ECS	: Environment Control System
E&M	: Electrical & Mechanical
EMC	: Electromagnetic Compatibility
EMIP	: Environmental Mitigation Implementation Plan

EMP	: Environmental Management Plan
EMSD	: Electrical and Mechanical Services Department
EMU	: Electric Multiple Unit
EN	: Euro-Norm (European Standards)
EPD	: Environmental Protection Department
ETI	: Employer's Training Instructors
FAI	: First Article Inspection
FAT	: Factory Acceptance Test(s)
GCC	: General Conditions of Contract
GS	: General Specification (this document)
HV	: High Voltage
IEC	: International Electro-technical Commission
IEE	: The Institution of Electrical Engineers
IED	: Intelligent Electronic Device
IP	: Ingress Protection
IS	: Indian Standards
ISO	: International Standards Organisation
ITT	: Instructions To Tenderers
ITU	: International Telecommunications Union
LV	: Low Voltage
MCB	: Miniature Circuit Breaker
MMI/ HMI	: Man/Human -Machine Interface
MTR	: Mass Transit Railway
NSR	: Noise Sensitive Receivers
OCC	: Operations Control Centre
OPC	: Overhead Protection Cable
OSR	: Operational Safety Report
OSR(S)	: Operational Safety Report (Software)
P3	: Primavera Project Planner
PLC	: Programmable Logic Controller
PPE	: Personal Protective Equipment
PS/TS	: Particular Specification
PVC	: Polyvinyl Chloride
QA	: Quality Assurance
RAMS	: Reliability, Availability, Maintainability and Safety

RC	: Return Conductor Cable
ROCS	: Rigid Overhead Conductor System
RSS	: Receiving Sub Station
RTU	: Remote Terminal Unit
SAR	: Special Administrative Region
SAT	: Systems Acceptance Test(s)
SCADA	: Supervisory Control and Data Acquisition System
SCC	: Special Conditions of Contract
SIL	: Safety Integrity Level
SQAP	: Software Quality Assurance Plan
SRR	: Submission Review Request
SWA	: Steel Wire Armoured
T/C	: Time Chainage
TRIP	: Track Related Installation Programme
TSS	: Traction Sub Station
TVS	: Tunnel Ventilation System
UPS	: Uninterrupted Power Supply

**Table 1-1 General Abbreviations**

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

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

### **1.3 Definitions**

Words and phrases defined in the GCC or SCC shall retain the same meaning within the GS and PS unless specifically redefined within this GS or under the provisions of clause 1.1.1 above for the purpose of a particular clause or group of clauses.

- (1) "Access Dates" are dates that are to be achieved by other than the Contractor and which are considered to be essential to the successful completion of the Contract to the original planned schedule. A list of the activities completion of which are considered to give rise to an Access Date are included in the PS/TS. (To be checked about access dates )
- (2) "Commissioning" means the process of setting to work the complete transportation system through a series of integrated tests

that demonstrate the installation and performance in accordance with the specified criteria.

- (3) "Day" means calendar day unless expressly stated otherwise.
- (4) "Defined Area" means an area within which Works Trains will be operated and the Employer's defined area working safety rules will apply.
- (5) "Factory Acceptance Tests" means the tests to be performed at the Contractor's factories prior to delivery to the Site to verify compliance with the Specification and quality standards
- (6) "Installation Tests" means the tests to be performed to verify the conformity of completion of an installation/assembly to the design documents previously reviewed without objection by the Employers Representative prior to the start of Commissioning. Installation Tests do not form part of the Tests on Completion to be performed by the Contractor in order to achieve Employer's Taking Over of the Works or any Section however they must be successfully completed before the Tests on Completion can commence.
- (7) "Key Dates" are dates which are to be achieved by the Contractor and which are considered to be essential to the successful completion of the project to the original planned schedule. A list of the activities, completion of which gives rise to a Key Date, is included in the PS.
- (8) "Partial Acceptance Tests" means the functional tests to be performed on components and parts of systems to meet the specified criteria. Partial Acceptance Tests form part of the Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.
- (9) "Service Trial" means the phase after completion of the System Acceptance Tests where the training and operating procedures are validated through the running of the trains to the published timetable. Service Trial form part of the Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.
- (10) "Quality Control Point" means a point in time when a notice or other document is to be submitted to the Employer's Representative in accordance with the Contract before the Contractor can commence, proceed with or terminate an activity
- (11) "Quality Hold Point" means a point in time when a notice of no objection by the Employer's Representative is required.
- (12) 'S' curve" means the graphical relationship between the planned (and actual where appropriate) quantity of completed work (or resources) and time. The curve produced is to be illustrated on an accumulative basis where the slope of the line indicates the rate of undertaking the work or rate of expenditure of the resources.
- (13) "Specification (the)" means the aggregate sum of the documents and any amendments thereto, issued to Tenderers by Employer as



part of the Tender process before the final date for submission of Tenders. This shall include but not be limited to; Employer's Requirements, Employer's Tender Drawings, Preliminary Operating Plan and Clarification of Tender Documents issued in accordance with the ITT but shall not include the ITT itself nor any minutes of meetings.

- (14) "Specification (this)" means the particular document within which the reference is made.
- (15) "System Acceptance Tests" means those tests that demonstrate the performance of the installation/equipment to the specified requirements as detailed in the PS. SATs form part of the Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.
- (16) "Integrated Testing and Commissioning" means those tests that demonstrate the integration of the complete transport system meeting the requirements of the Specification in an operating environment. Integrated Testing and Commissioning form part of the Tests on Completion to be performed by the Contractor in order to achieve Employer's Taking Over of the Works or any Section.
- (17) "Validation" means the process of confirmation by examination and provision of objective evidence that the application produced achieves the particular requirements specified.
- (18) "Verification" means the process of confirmation by examination and provision of objective evidence that the specified requirements have been incorporated.

## **1.4 Glossary of Terms**

- 1.4.1 Words and expressions to which meanings are assigned in any paragraph of the GS shall have the same meanings in other paragraphs of the GS except when the context otherwise requires.
- 1.4.2 Utilities are electricity, lighting, traffic control, telephone and other communication cables, gas, water, sewage and drainage pipes and ducts, including all associated protection, supports, ancillary structures, fittings and equipment.

## **1.5 Submission for Review**

- 1.5.1 Reference in the GS and PS to any submission made by the Contractor to the Employer's Representative having been reviewed without objection by the Employer's Representative shall mean the issue of a notice of no objection by the Employer's Representative issued in response to a submission made by the Contractor. Documents, drawings, specifications, calculations, technical papers, material samples, methods of construction and any other matters which have been reviewed without objection by the Employer's Representative shall not be changed without further submission for review to the Employer's Representative of the proposed changes.
- 1.5.2 Clause 4.2 below prescribes the process to be adopted for submissions of documents, material samples and any other items to the Employer's

Representative. Schedules of items that are to be submitted to the Employer's Representative for review are contained within this GS and/or the PS.

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

## **1.6 Standards, Codes of Practice**

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

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

- 1.6.3 Permanent Works, Temporary Works, Contractor's Equipment, hardware, firmware, software, apparatus of all kinds, and, where appropriate, materials and workmanship shall be in accordance with the Standards quoted in the Specification and the requirements identified in the PS or, where no Standard is identified, the Contractor shall make a proposal which shall be subject to review by the Employer's Representative meeting equal or superior quality or performance.

Bidders must use international standards and specifications such as those issued by the International Standard Organization, wherever these are applicable and appropriate, and apply them consistently across the tender documents. If particular standards, national or other, are adopted, the tender documents must state that standards guaranteeing a level of quality or performance equivalent or superior to those indicated will also be accepted.

## **1.7 Employer's Drawings**

- 1.7.1 The Employer's Drawings assist in describing the scope of the Works in general and clarify constraints, interface arrangements and the conceptual nature of the finished structures/system outline.
- 1.7.2 The Contractor shall carefully check all Employer's Drawings and advise the Employer's Representative of discrepancies, omissions, errors or ambiguities should any be found.
- 1.7.3 The Contractor shall note that any drawings included but marked "For information only" do not form part of the Contract.
- 1.7.4 Dimensions shall not be obtained by scaling from the Employer's Drawings. Dimensions that are not shown or are not calculable from dimensions shown on Employer's Drawings shall be obtained from the Employer's Representative.

## **1.8 Specifications in Metric and Imperial Units**

- 1.8.1 Specifications in imperial units shall not be substituted for specifications in metric units stated in the Contract without the prior consent of the Employer's Representative.
- 1.8.2 Conversion of metric units to imperial units and of imperial units to metric units shall be in accordance with the Standard International Practice.

## **1.9 System Safety**

### **1.9.1 Safety philosophy**

- 1.9.1.1 Safety of passengers, staff and the general public is paramount for railway operation. Prime consideration shall be given to all issues that can have an effect on safety.
- 1.9.1.2 During the construction phase the safety of all staff involved in the Works and any members of the general public affected by the Works shall be the prime feature of all working methods, including storage and transport to site as well as all temporary works not incorporated into the final construction.

### **1.9.2 Safety Management**

The Contractor shall implement the Contract Systems Safety Management Requirements, as referenced in the Project Safety Manual and elsewhere in the Specification, in consultation with the Employer's Representative.

### **1.9.3 Prescriptive Safety Criteria**

- 1.9.3.1 The Contractor shall identify and list all applicable statutory and regulatory requirements and codes of practice relevant to the Works and to work within the constraints and limitations imposed by the requirements and codes.
- 1.9.3.2 The safety of the Contractor's supplied systems and equipment shall be developed by the Contractor in accordance with the requirements contained in clause 3.4.5 below and the PS.

## **1.10 Not used**

## **1.11 Suitability for Purpose**

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

### **1.11.1 Interference and Compatibility**

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

### **1.11.2 Planning for introduction to service**

The Permanent Works shall be constructed in such a manner that they can be installed, tested and commissioned without adversely affecting the operation or safety of the Project. The Permanent Works shall be constructed so that, where appropriate, considering the operating procedures adopted by the Employer, they can be brought into operational use during non-traffic hours

and if necessary during a single night following maintenance, repair or overhaul during the life of the Permanent Works, equipment and systems.

## 1.12 Climatic Condition / Operating Environment

### 1.12.1 General

1.12.1.1 The following information on climatic conditions in Lucknow shall be taken into account by the Contractor when constructing any part of the Permanent Works. The Contractor shall ensure that due allowance is made for more severe local conditions when Permanent Works are required to operate, for example, with restricted ventilation that may lead to higher local ambient temperatures, and any other factors that may affect the operating environment in any way.

- (1) Unless specific figures are provided elsewhere, the Permanent Works will generally be required to function at its rated value with the values of ambient temperature and relative humidity appropriate to the location of the equipment within the classifications shown in Table 1-2. Certain parts of the Permanent Works may need to be rated for more or less onerous conditions as required by the PS.
- (2) Clause 1.12.2 below gives the different classifications of environment to be encountered. For any type of item, examples of which are installed in more than one environmental class, all examples of the type shall be suitable for installation in the most severe environmental class conditions encountered by any example of the type.
- (3) The Contractor's attention is drawn to the more severe environmental conditions that may exist during the construction period and shall take adequate measures to protect the Permanent Works against any deleterious effects of such conditions during the time between installation and final completion of the Project.
- (4) Air throughout the Project will contain considerable moisture content and the atmosphere will be corrosive. The Permanent Works shall be tropicalised and vermin proof.

### 1.12.2 Classification of Equipment Environment

The locations at which equipment may be installed have been divided into four environmental classes as shown in Table 1-2. The classes of environment are considered to become more extreme from A to 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 underground station or structures.
C	Outdoors

**Table 1-2 Classes of Environment**

The following are the minimum requirements for equipment to be installed in each class of environment. Where any class does not have a value for a

parameter the most extreme value quoted for the lesser class environments should be used.

### 1.12.3 Requirements for Class A

Minimum Temperature -	5°C
Ambient Temperature -	25 °C
Maximum Temperature -	35°C
Relative Humidity -	Minimum 0%, Nominal 65%, Maximum 95% (Non Condensing)
Electrical Noise -	High Frequency to 1MHz, 1kV damped to 50% after 6 cycles. Radio Frequency field strength 10 V/m, UHF & VHF bands.

### 1.12.4 Requirements for Class B

Ambient Temperature -	30°C
Maximum Temperature -	45°C
Relative Humidity -	Nominal 70%, Maximum 100% (Non Condensing)
Air Quality -	Polluted and dusty - SO <sub>2</sub> : 80-120mg/m <sup>3</sup> Suspended Particulate Matter: 360-540mg/ m <sup>3</sup>
Electrical Noise -	Impulse 1kV, 1.2/50 rise/decay, 500Ω source impedance, 0.5 J source energy. Radio & High frequency as Class A.

### 1.12.5 Requirements for Class C

#### 1.12.5.1 Temperature

All equipment shall be tested in accordance with the given figured allowing a margin of at least 10% greater and 2°C less than the limits recorded. All equipment shall work within the enclosures proposed with the specified environment outside the enclosure; particular attention shall be paid to the possibility of solar gain as referred to in clause 0 below.

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

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

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

Winter	Nov	Dec	Jan	Feb
	°C	°C	°C	°C
Max:	29.2	23.9	22.3	25.5
Min:	12.5	8.2	7.7	10.3

<b>Summer</b>	March	Apr	May	June
	°C	°C	°C	°C
Max:	31.9	37.9	41.7	40.7
Min:	15.5	21.5	26.5	28.9

<b>Rainy</b>	Jul	Aug	Sep	Oct
	°C	°C	°C	°C
Max:	35.3	33.2	34.0	34.0
Min:	26.8	25.7	24.3	19.1

#### 1.12.5.2 Rain Fall

Maximum recorded rainfall in any month : 281.3 mm (August 2012)  
Monthly average total rain fall (during rainy season)

June	July	August	September
55.7 mm	203.3 mm	243.2 mm	129.7 mm

#### 1.12.5.3 Wind Pressure

The system is to give satisfactory service for a wind pressure up to 150 kgf/m<sup>2</sup>

#### 1.12.5.4 Sunshine

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

#### 1.12.5.5 Relative Humidity

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

	<b>Max</b>	<b>Min</b>
Winter	72%	28%
Summer	48%	16%
Rainy	77%	35%

### 1.12.6 Electromagnetic Compatibility (EMC)

Electronic equipment in a railway environment shall be immunised against the usual electromagnetic influences to be expected from the rail operations. For this, the following EMC classification in accordance to IEC 801 or similar, for the equipment rooms shall be achieved:

#### 1.12.6.1 Electrostatic discharge

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

- 1.12.6.2      Electromagnetic fields
- The electronic equipment rooms shall be constructed in accordance to class 2 of IEC 801-3 or similar.
- 1.12.6.3      Fast transient interference (Burst)
- The electronic equipment rooms shall be constructed in accordance to class 2 of IEC 801-4 or similar.
- 1.12.6.4      High energy transient interference
- The electronic equipment rooms shall be constructed in accordance to class 2 of IEC 801-5 or similar.
- 1.12.6.5S      Switching processes in high-voltage installations
- The location of computer systems in the neighbourhood < 1m of high-voltage installations, such as medium voltage or transformer stations as well as direct parallel exposure of power and data cables should be avoided.
- 1.12.6.6      Magnetic fields
- The following magnetic field strengths at the place of installation of cathode ray tube (CRT) based visual display units (VDU) should not be exceeded:
- DC fields:                      10 A/m or 12  $\mu$ T
- AC fields:                      1 A/m or 1,2  $\mu$ T
- If the image quality is impaired by values exceeding the above the Contractor shall provide any necessary shielding or alternative corrective measures to restore the picture quality. Note flat screen VDU using LED technology or similar may be acceptable if a sufficiently high resolution and image size can be obtained.
- 1.13              Survey and Site Investigations**
- 1.13.1      For reference to surveys external to the Contract, the Contractor shall refer all Levels to Mean Sea Level (MSL) Datum, which is that generally used throughout Lucknow.
- 1.13.2      The datum used for the Contract shall be Mean Sea Level Datum.
- 1.13.3      The Contractor shall carry out all further site investigations necessary for the construction of the Permanent Works and to enable the determination of the methods of construction and the nature, extent and design of Temporary Works.
- 1.13.4      The Contractor shall investigate environmental factors also to determine suitable methods of manufacture and installation, both for Temporary and Permanent Works. In particular the Contractor shall ensure that the dusty environment of Lucknow has no detrimental effect to the functionality, reliability or long term maintainability of the Permanent Works.



## **CHAPTER 2**

### **2. PLANNING, PROGRAMME AND PROGRESS MONITORING**

#### **2.1 Planning**

- 2.1.1 The Contractor shall develop in detail, a logical method of executing the Works taking into account their complex nature and different phases and shall provide programmes which reflect the detailed planning undertaken.
- 2.1.2 The programmes, shall start with the Commencement Date of the Works as day one, are to be realistic, achievable and shall be accompanied by the detailed supporting Plans referred to in Chapter 3 below.

#### **2.2 Programming General Requirements**

- 2.2.1 Programme activities shall be discrete items of work, which when combined, produce definable elements, components, Milestones, Stages and Sections of the Works and clearly identify the completion obligations of the Contractor.
- 2.2.2 Access Dates and Key Dates shall be an integral part of all programmes and all activities, and sequencing and interrelationships required to achieve each completion obligation shall be shown. Milestones shall not impose constraints that in any way affect the programme logic and float or limit the achievement of Key Dates. Milestones shall not be introduced into any programme as constrained dates.
- 2.2.3 The critical path shall be clearly identified in the programme and fully described in the accompanying programme narrative.
- 2.2.4 Activity descriptions shall clearly convey the nature and scope of the Works. Programmes shall take into account the activities of precursor, concurrent, adjacent and follow on Project Contractors as well as utility service diversions, new utilities and connections and any other activity that may affect the progress of the Works.
- 2.2.5 The Contractor shall also incorporate the Employer's Representative's requirements for additional activities, to further explain or subdivide complex or long duration tasks, without affecting completion dates.

#### **2.3 Progress Monitoring**

The Contractor shall monitor its and its subcontractors' performance and against programmes to ensure its compliance with its obligations under the Contract. Monitoring of the Works shall include direct, daily monitoring of the progress of the Works and the preparation of written and computerised reports to be submitted to the Employer's Representative. The reports shall include all necessary supporting data to apprise the Employer's Representative of the status of the completion of the Works as described in clause 2.17 below.

#### **2.4 Works Programme**

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



## **2.4.1 Submission Dates**

### **2.4.1.1 Not Used**

2.4.1.2 Within 60 days of the Commencement Date of the Works, the Contractor shall submit for review by the Employer's Representative the proposed full version of the Works Programme.

2.4.1.3 Should the Contractor fail to submit the in full versions of the Works Programme within the time scales nominated above the Employer may nominate the Outline Works Programme as the first issue of the Works Programme required under the Contract.

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

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

## **2.4.2 Content**

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

2.4.2.2 The Contractor shall provide the Employer's Representative with substantiation for each constraint whether target start, target finish or mandatory constraint entered by the Contractor into the Works Programme. The number of constraints shall be kept to an absolute minimum in order that the CPM networks developed can be freely analysed.

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

- (1) all work comprising the Permanent Works;
- (2) preparation, submission and review of Documents showing all items where review by the Employer's Representative is required;
- (3) Intentionally left blank;
- (4) procurement of all major materials and items of Contractor's Equipment for the Works, including the dates orders are to be placed,

manufacture period and the expected delivery date to the Site for each item;

- (5) any software development requirements and Validation time frames;
- (6) all manufacture or prefabrication of materials or components;
- (7) intentionally left blank;
- (8) all activities associated with the securing of necessary permits and other statutory approvals for the Works;
- (9) access and availability dates for all Project Contractors;
- (10) all interfaces related to the Project that may affect the progress of the Works;
- (11) testing and commissioning activities which demonstrate an understanding of the interfaces and requirements of Chapter 9 below; and
- (12) Training

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

- (1) Procurement and manufacturing programme;
- (2) Installation Programme;
- (3) Testing and Commissioning Programme; and
- (4) Training Programme

2.4.2.5 The submission of the full version of the Works Programme shall include the, Procurement and Manufacturing Programme and a preliminary version of the Installation Programme and the Testing and Commissioning Programme identifying all major installation, testing activities and associated interfaces.

2.4.2.6 In addition, the contractor shall submit any other programmes as required by the employer's Representative from time to time.

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

- (1) all programmes shall be computerised Critical Path Method (CPM) networks developed using the Precedence Diagramming Method (PDM), and submitted in both hard copy and electronic data format;
- (2) all programmes shall be prepared using the latest version of CPM scheduling software Primavera Project Planner;
- (3) unless consent is otherwise obtained from the Employer's Representative, all programmes shall be accompanied by a Programme Analysis Report as described in clause 2.19 below;
- (4) a standard Gregorian calendar shall be used for planning and execution of the Works. All programme submissions shall include details of the Contractor's allowance for Public Holidays and non-work periods. If a Key Date or falls on a Public Holiday or non-work day, it shall be effective the next working day;

- (5) the planning unit for the duration of all programme activities shall be the day. Any activity having a duration of more than thirty (30) days shall be divided into sub-activities that shall not exceed (30) days;
- (6) CPM programmes shall reflect status using remaining duration and percent complete;
- (7) all programmes shall be fully resource loaded as appropriate or required by the Employer's Representative covering all stages and aspects of the Contract and shall include, but not be limited to:
  - (a) major manpower for installation ;
  - (b) number of items of Contractor's Equipment ;
  - (c) number of drawings and other deliverables ;
  - (d) principle quantities of components or parts ;
  - (e) principle quantities of bulk materials inclusive of cabling, pipe, ductwork and equipment items, etc.

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

## **2.5 Submission Programme**

- 2.5.1 The Contractor shall, within 30 days of the Commencement Date of the Works, submit a Submission Programme covering all proposed submissions to the Employer's Representative.
- 2.5.2 The Submissions Programme shall include the proposals for vendor approvals and procurement activities of all sub-contractors and suppliers.
- 2.5.3 The Submissions Programme shall include each submission for every item listed in the Specification, as being required to be submitted.
- 2.5.4 The Submissions Programme shall ensure that all submissions are properly co-ordinated with the Contractor's overall Works Programme, particularly in respect of the following:-
  - (i) progress of, manufacture, installation and testing work;
  - (ii) co-ordination with other Contractors; and
  - (iii) including due allowance for the Employer's Representative's review process to be undertaken, including the time needed for any re-submissions.

## **2.6 Procurement and Manufacturing Programme**

- 2.6.1 Within 60 days of the Commencement Date of the Works, the Contractor shall submit for review by the Employer's Representative Procurement and

Manufacturing Programme that shall be an integrated part of the overall Works Programme.

- 2.6.2 The Procurement and Manufacturing Programme shall show the interdependencies between engineering disciplines as well as between the Contractor and its sub-contractors and suppliers. This programme shall demonstrate compliance with the requirements of the Submissions Programme in clause 2.5 above. The procurement and Manufacturing Programme shall include the proposals for vendor approval. The contractor is required to submit proposals for vendor approvals for all equipments, assemblies, sub-assemblies spare parts, M&P and any other item required for the project. Inter alia the details should include design, manufacturing and testing facilities available with the vendor. Quality Assurance Plans adopted by the vendor and its sub-vendors shall also be submitted for employer's review. The contractor is also, required to submit the details of turnover of the vendor for last 5 years and turnover in respect of the equipment proposed to be supplied by the vendor. In case of off shore vendors the contractor is required to submit details regarding facilities available in India and the experience in training of the vendor proposed. The proposal should also include training and other technical support to be provided by the vendor. In case of off shore vendors, the proposed scope of training shall also be included. The Contractor should ensure that the equipments/systems proposed for elevated/at-grade/ underground sections shall be, as far as possible, similar to the ones approved. In case this is not possible the proposed equipment/system should have been used for at least 5 years on any metro system.
- 2.6.3 The Contractor shall submit a weighted bar chart of the Contractor's, procurement and manufacturing activities. Each activity weight shall normally not be more than 5% of the total man-hour content or value of the respective work.
- 2.6.4 The Procurement and Manufacturing Programme shall include a separate breakdown, supported by the Material Control Schedule, which shall be a complete amplification of the Contractor's programme and equipment list, including those items which are subject to long lead time or component parts which are manufactured from countries outside the country of assembly and testing.
- 2.6.5 The Material Control Schedule shall be automated, and shall detail the following information for each permanent major and minor material and significant component. The format of such a schedule shall include:
- (1) name, description, supplier/sub-supplier details;
  - (2) drawing information (where appropriate), title, drawing status, submission dates, shop drawings/ fabrication drawing preparation, etc.;
  - (3) Employer's Representative's inspection, delivery schedules;
  - (4) Deleted
  - (5) Deleted
- 2.6.6 The Contractor shall continuously maintain this schedule and report upon the status of each item as part of the Contractor's regular progress reporting.

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

2.6.8 The Contractor shall submit, as part of the, Procurement and Manufacturing Programme, a Factory Testing Programme that shall support all aspects of the Factory Testing Plan. This Programme shall clearly demonstrate the logic and include the topics listed in clause 3.5.1 below.

2.6.9 Deleted

2.6.10 Deleted

2.6.11 Deleted

## **2.7 Installation Programme**

2.7.1 The Installation Programme shall be submitted as stated in the PS or as directed by the Employer's Representative. The Installation Programme shall comply with the requirements of clause 2.4.2.7 above.

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

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

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

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

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

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

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

- (1) the Contractor shall not have exclusive access to any part of the Site except by the specific consent of the Employer's Representative;
- (2) the Contractor shall take note that concurrent time allocations for certain areas may be given to more than one contractor. The Contractor shall co-ordinate the Contractor's work in such areas with that of Project Contractors through the Employer's Representative;

- (3) the absence of a programme date or installation period for the Contractor in a specific area shall not prejudice the right of the Employer's Representative to establish a reasonable programme date or installation period for that area;
- (4) the Contractor shall comply with the identified Key Dates. The Contractor shall also comply with the Access dates identified in the; and
- (5) the Contractor shall deliver all Contractor's Equipment and Permanent Works for stations and ventilation shafts by road and via temporary access openings unless otherwise reviewed by the Employer's Representative.

## **2.8 Testing and Commissioning Programme**

- 2.8.1 The Testing and Commissioning Programme shall be submitted as stated in the PS or as directed by the Employer's Representative and shall comply with the requirements of clause 2.4.2.7 above.
- 2.8.2 The Contractor shall submit the Testing and Commissioning Programme that shall fulfil all the on-Site testing and commissioning requirements of clause 9.3.2.2 below. The Testing and Commissioning Programme shall clearly demonstrate the logic and highlight the topics listed in the On-Site Testing and Commissioning Plan in clause 9.3.2.2 below.
- 2.8.3 The Testing and Commissioning Programme shall be fully detailed, with activities individually identifying all tests for which a certificate will be issued, and shall include activities for preparation, submittal and review of the test procedures.
- 2.8.4 The Testing and Commissioning Programme shall demonstrate the logical dependencies between the individual tests of the Works, and shall also show the interfaces and dependencies with all of the Project Contractors' tests required to commission the Works and support the Commissioning Plan.

## **2.9 Training Programme**

- 2.9.1 The Contractor shall, within 180 days of the Commencement Date of the Works, submit for review by the Employer's Representative, a Training Programme covering all proposed formal training courses, delivery of training equipment and accesses by the Employer's personnel for informal 'hands on' training . The Training Programme shall also detail specific Training features as required by the Specification and proposed by the Contractor.
- 2.9.2 The Training Programme shall be developed to the Training Plan as required under clause 3.7.4 below.
- 2.9.3 The Training Programme shall be sufficiently detailed that the Employer can ensure the availability of staff for all the courses required under clause 10.1.6 below.
- 2.9.4 The Training Programme shall include the requirements of Chapter 10 below, including the Training activities of all sub-contractors and suppliers.



**2.10 Not used**

**2.11 Not used**

**2.12 Time Chainage Programme (T/C)**

2.12.1 Deleted

2.12.2 Deleted

2.12.3 Deleted

**2.13 Track Related Installation Programme (TRIP)**

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

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

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

**2.14 Programme Submissions**

2.14.1 The Contractor shall submit all programmes described in this Chapter in conjunction with the Management Plans described in Chapter 3 below to the Employer's Representative for review.

**2.15 Programme Review**

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

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

**2.16 Works Programme Revisions**

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

impact of changed work or changed conditions on the Works and Project Contractors and their works.

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

## **2.17 Monthly Progress Report**

- 2.17.1 The Contractor shall prepare Monthly Progress Reports covering all aspects of the execution of the Works. Such Monthly Progress Reports shall be in writing and shall be delivered to the Employer's Representative by the 5th day of the month following the month of the Monthly Progress Report. The Monthly Progress Report shall take account of work performed up to and including the last day of the month to which the Monthly Progress Report relates.
- 2.17.2 The Monthly Progress Report shall include an executive summary and contain clear and concise statements in respect of every significant aspect of the Works including, without limitation, the requirements specified in this Specification.
- 2.17.3 The Monthly Progress Report shall contain evidence that documents and supports the progress of the Works, as stated in the Interim Payment Certificates, to the satisfaction of the Employer's Representative.
- 2.17.4 The reports, documents and data provided shall be an accurate representation of the current status of the Works and of the work to be accomplished and shall provide the Employer's Representative with a sound basis for identifying problems and deviations from planned work and for making decisions.

## **2.18 Programme Analysis Report**

- 2.18.1 Deleted
- 2.18.2 Deleted

## **2.19 Key Date and Access Date Report**

- 2.19.1 The Key Date and Access Date Report shall be prepared in a format reviewed by the Employer's Representative and identify and state the status of: -
- (1) all Key Dates and Access Dates that were planned to be achieved in the reporting period or earlier but have not been achieved;
  - (2) all Key Dates and Access Dates that have been achieved in the reporting period;
  - (3) all Key Dates and Access Dates that are planned to be achieved in the next reporting period; and
  - (4) any future Key Dates and Access Dates that appear unlikely to be achieved on time.



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

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

## **2.20 Not used**

## **2.21 Progress Meetings**

2.21.1 The Employer will chair progress meetings every month with the Contractor. These meetings will be held at dates and times to be advised by the Employer's Representative. Progress meetings shall not be later than 10 days after the issue of the Contractor's Monthly Progress Report.

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

2.21.3 All meetings shall be convened in Lucknow unless directed otherwise by the Employer's Representative. Meetings shall be attended by senior personnel from the Contractor who shall arrive properly briefed for all aspects of the meeting and shall be empowered to make executive decisions in respect of the execution of the Works.

## **2.22 Quarterly Review Meetings**

2.22.1 The Employer's Representative may convene Quarterly Review Meetings in Lucknow at approximately three monthly intervals. The Employer's Representative will notify the Contractor the date of such Quarterly Review Meetings not less than 28 days before they are to be held.

2.22.2 Quarterly Review Meetings shall be held over a period of up to 3 days in order to review the overall progress of the Works in the context of the Project as a whole and to address and resolve any issues relevant to the execution and progress of the Works. Such Quarterly Review Meetings will be chaired by Senior official of the Employer or his delegate. The Contractor shall have in attendance one senior representative of Director level from each of the companies comprising the Contractor (together with the Managing Director of the company acting as leader or sponsor of the Contractor if it is a joint venture, consortium or partnership whenever necessary and required by the Employer's Representative).

2.22.3 The Contractor shall submit names of the persons whom the Contractor proposes to attend each Quarterly Review Meeting to the Employer's Representative for review not less than 7 days prior to each Quarterly Review Meeting.

## CHAPTER 3

### 3. MANAGEMENT PLANS AND SUBMISSIONS

#### 3.1 General

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

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

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

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

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

#### 3.2 General Organisation

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

##### **Project Management Plan**

- **Contractor's Project Plan**
- **Interface Management Plan**

##### **Systems Assurance Plans**

- **Quality Plans**
- **Safety Plans**

##### **Procurement and Manufacturing Plan**

- **Factory Testing Plan**
- **Procurement, Manufacturing and Delivery Plan**

#### **Construction and Installation Management Plan**

- **Construction and Installation Plan**
- **Health and Safety Documentation**
- **Not used**

#### **Completion Management Plan**

- **Commissioning Plan**
- **Operation and Maintenance Manuals Plan**
- **Training Plan**
- **Defects Liability Management Plan**

### **3.3 Project Management Plan**

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

#### **3.3.1 Contractor's Project Plan**

- 3.3.1.1 The Contractor's Project Plan shall provide a clear overview of the Contractor's organisation, management systems and methods to be used for the complete execution of the Works.
- 3.3.1.2 The Contractor's Project Plan shall include a summary description of each and every stage of implementation of the Works, clearly showing the principal organisational interfaces both within the Contractor's own organisation (including sub-contractors of every tier) and with Other Contractors and Relevant Authorities, defining how each of these interfaces is to be managed and controlled. An organisation chart shall be produced to illustrate the subdivision of the work into elements for effective technical and managerial control, the reporting structure and the interface relationship among all parties involved. Names, addresses, telephone and fax numbers of all principal contacts shall be listed.
- 3.3.1.3 The Contractor's Project Plan shall contain structured organisation charts showing the hierarchical relationship of the Contractor's organisation (including sub-contractors of every tier). The organisation charts shall be produced as a "family" such that the basic chart shows the overall organisation structure supported by subsidiary charts detailing the internal structure of the various departments or sections of the overall organisation.
- 3.3.1.4 The Contractor's Project Plan shall include full details of the qualifications, experience, authority and responsibility of the personnel assigned to all key positions of the Contractor's organisation (including sub-contractors of every tier). As a minimum, this shall include all levels down to senior managers and shall include the personnel responsible for each individual department and functional group. A clear reference shall be given as to the location of staff

(e.g. Site resident or factory based, etc.). Names, addresses, telephone and fax numbers of all principal contacts shall be listed.

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

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

3.3.1.6 Particulars of agent

- (1) The Contractor shall give and provide all necessary supervision during the execution of the Works as long as the Employer's Representative considers necessary for the proper fulfilment of the Contractor's obligations under the Contract.
- (2) The Contractor shall ensure that he is at all times represented on the Site by a competent and authorised English/Hindi speaking agent who shall be deemed to have been reviewed without objection by the Employer's Representative provided such agent is not expressly objected to by the Employer's Representative in writing within 14 days from the service of a notice upon the Employer's Representative by the Contractor of the

appointment of such agent. Such agent shall be constantly on the Site and shall give his full time to the superintendence of the Works.

- (3) The Employer's Representative shall have the authority to withdraw his notice of no objection to the agent at any time. If such notice of no objection is withdrawn the Contractor shall remove the agent from the Site forthwith and shall not thereafter employ him again on the Site in any capacity and shall forthwith replace him by another competent English/Hindi speaking agent reviewed without objection by the Employer's Representative.
- (4) Such authorised agent shall receive on behalf of the Contractor directions and instructions from the Employer's Representative.
- (5) The following particulars of the proposed agent shall be submitted to the Employer's Representative for review:-
  - (i) name;
  - (ii) copy of Identity Card;
  - (iii) details of qualifications, including copies of certificates; and
  - (iv) details of previous experience.
- (6) The particulars of the agent shall be submitted 30 days before the agreed scheduled start of that part of the Works. Except in the case of a replacement agent (as provided for in clause 3.3.1.6.(3) above), in which case the said particulars shall be submitted forthwith.
- (7) The agent shall possess relevant academic or professional qualification and have at least 10 years experience in relevant engineering works. The Employer's Representative reserves the right to call upon the Contractor to prove such qualifications/experience to the satisfaction of the Employer's Representative.

### **3.3.2 Interface Management Plan**

- a) The Contractor shall interface and liaise with other Contractors in accordance with the requirements of clause 16.3 below.
- b) Within 60 days of notification from the Employer's Representative of the identity of each Other Contractor, the Contractor shall develop and submit to the Employer's Representative an Interface Management Plan that is mutually acceptable to both the Contractor and the other Contractors. The Interface Management Plan shall:
  - (1) identify the sub-systems as well as the civil works and facilities with interfacing requirements;
  - (2) define the authority and responsibility of the Contractor's and other Contractors' (and any relevant sub-contractors') staff involved in interface management and development;
  - (3) identify the information to be exchanged, together with the management and technical skills required for the associated development work, at each phase of the Contractor's and other Contractors' (and any relevant sub-contractors') project life-cycles;
  - (4) include considerations of the Interface Hazard Analysis;

- (5) specify the configuration and version control procedures in accordance with the Contractor's and other Contractors' (and any relevant sub-contractors') quality management system; and
  - (6) address the supply, installation, testing and commissioning programme of the contracts to meet the key dates of each contract, and highlight any programme risks requiring management attention.
- c) Once the Interface Management Plan has been reviewed without objection by the Employer's Representative, the Contractor shall execute the Works in accordance with the Interface Management Plan. The Contractor shall advise the Employer's Representative immediately of any difficulty in developing a mutually acceptable Interface Management Plan.
  - d) Within 90 days of notification from the Employer's Representative of the identity of each Other Contractor, the Contractor shall develop and submit to the Employer's Representative for review a Detailed Interface Document for each Other Contractor that is mutually acceptable to both contractors. The Detailed Interface Document shall address in detail how the dates identified in the Interface Management Plan shall be achieved and shall identify the data required by the interfacing other Contractors to meet the requirements of the PS.
  - e) The Detailed Interface Document shall specify the proposed method and schedule for verifying the interface integrity, the individual equipment/system performance and the combined system performance. The Detailed Interface Document shall include a programme of tests to demonstrate the performance and integrity of the integrated systems. The Interface Specification appended to the PS shall form the basis of the Detailed Interface Document, but does not relieve the Contractor's obligation to identify any new interface to meet the Contract requirements. Any revision to the Detailed Interface Document shall be mutually acceptable by contractors and submitted to the Employer's Representative for review.

### **3.4 Systems Assurance Plans**

3.4.1 The Systems Assurance Plans shall submit for review to the Employer's Representative in Preliminary and Final forms.

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

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

#### **3.4.4 Quality Plans**

The Contractor shall submit for review by the Employer's Representative quality plans in accordance with the requirements of clause 5.2 below.

### **3.4.5 Safety Plans**

#### **3.4.5.1 Site Safety Plan**



3.4.5.1.1 The Contractor shall prepare a Site Safety Plan incorporating the requirements of the Project Safety Manual and designed specifically for the various sites (including storage and overseas sites) on which work under the Contract is carried out.

3.4.5.1.2 The Site Safety Plan shall form a part of the Health and Safety Documentation referred to in Chapter 18 below.

### **3.4.5.2 RAMS Plan**

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

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

- a) The Contractor shall submit for review by the Employer's Representative the Contractor's Systems Safety Plan. The System Safety plan shall address all the factors referenced in this Specification and as required by the PS.
- b) The Contractor shall submit for review by the Employer's Representative the Contractor's Reliability Plan and Maintainability Plan.

## **3.5 Procurement and Manufacturing Plan**

The Procurement and Manufacturing Plan shall be configured as a family of "stand-alone" plans and associated documents each covering one of the subjects listed below. The plans shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organisation, sequencing of activities, etc. and shall show how these combine together to assure that the Works fully meet the requirements of the Specification in respect of the subjects listed.

### **3.5.1 Factory Testing Plan**

3.5.1.1 Deleted

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

- (1) the plan for the production and submission of the inspection and test procedures to the Employer's Representative for review including the submission of the inspection and test reports and records; and
- (2) Type Tests, Routine Tests, First Article Inspections and any other tests constituting the Factory Acceptance Tests.

3.5.1.2 The Contractor shall arrange for all equipment and systems manufactured for incorporation into the Permanent Works to undergo a Factory Acceptance Test (FAT) before shipment from the place of manufacture. Any particular requirements for inspection and testing at the place of manufacture are prescribed in the PS.

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

- 3.5.1.4 Inspections and tests that are to be witnessed by the Employer or the Employer's Representative shall be sensibly grouped and scheduled so that as many inspections and tests as possible may be witnessed during a single visit.
- 3.5.1.5 Type Tests as detailed in clause 9.2.6 below shall be performed on all items of equipment to be installed as part of the Permanent Works under the Contract.. The Type testing shall be based on the environmental class of the sites into which the equipment will be installed. Refer to clause 1.12.2 above for the different environmental classifications or otherwise as required in the PS.
- 3.5.1.6 For all production items a First Article Inspection shall be undertaken as detailed in clause 9.2.6.8 below. Routine production testing methods shall be detailed for review by the Employer's Representative. Routine testing shall ensure that all samples of a production item are within the tolerances required for complete interchangeability.
- 3.5.1.7 The Contractor shall prepare two copies of an inspection or test report immediately after the completion of each inspection or test whether or not witnessed by the Employer or the Employer's Representative. If the Employer or the Employer's Representative has witnessed the inspection or test, he will countersign the inspection or test report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) contained therein. If the Employer or the Employer's Representative has not witnessed the inspection or test (i.e. if a waiver has been granted, or the Employer or the Employer's Representative has not witnessed the inspection or test for some other reason in accordance with the Contract), the Contractor shall forward two copies of the inspection or test report without delay to the Employer's Representative. The Employer's Representative will countersign the report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) and return one copy to the Contractor. Where the results of the inspection or test do not meet the requirements of the Specification, the Employer or the Employer's Representative may call for a re-inspection or re-test.
- 3.5.1.8 For standard equipment, which is serial or bulk manufactured, manufacturer's type test certificates (or equivalent) may, subject to review by the Employer's Representative, be accepted. It is to be ensured that type test should not be more than 5 years old.
- 3.5.1.9 Deleted
- 3.5.1.10 Materials and equipment shall not be released for shipment until all applicable inspections and tests including Factory Acceptance Tests have been satisfactorily completed.

### **3.5.2 Procurement, Manufacturing and Delivery Plan**

- 3.5.2.1 The Contractor shall prepare procurement, manufacturing and delivery plans in respect of all items and goods. Separate parts of the plan shall be prepared for Contractor or sub-contractor off-Site activities. Each plan shall identify the scope of work to be applied. In relation to such scope of work, it shall, without limitation, define:
- a) the purchasing of items and goods and ensuring they comply with the requirements of the Specification, including (without limit) purchasing documentation and specific Verification arrangements for Contractor/Employer's Representative inspection of material or manufactured product prior to release for use;
  - b) the manufacturing process so as to ensure compliance with the design;



- c) the manufacturing process so as to ensure clear identification and traceability of material and manufactured parts;
- d) the inspection and testing of incoming materials, in process and final product so as to ensure specified requirements for the material and/or manufactured product are met;
- e) the identification of the inspection and test status of all material and manufactured products during all stages of the manufacturing process to ensure that only products that have passed the required inspections and tests are dispatched for use and/or installation;
- f) review and disposal of non-conforming material or product so as to avoid unintended use;
- g) the assessment and disposal of non-conforming material and manufactured product and approval for reworking or rejection as scrap;
- h) the identification of preventive action so as to prevent recurrence of similar non-conformance; and
- i) the handling, storage, packaging, preservation and delivery of manufactured product.

3.5.2.2 Deleted

3.5.2.3 Deleted

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

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

### **3.6 Construction and Installation Management Plan**

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

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

### **3.6.1 Construction and Installation Plan**

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

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

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

- (1) Deleted
- (2) Deleted
- (3) the interfacing or co-ordination required with the Contractor's other related plans;
- (4) the specific methods of construction and installation to identify any relevant method statements and develop those method statements to a sufficient degree of detail reviewed by the Employer's Representative;
- (5) a detailed method statement which shall include but not be limited to:
  - a) description of main operations and sub-operations;
  - b) sequence of sub-operations;
  - c) quantities of the work and production rates to be achieved;
  - d) resources to be employed; and
  - e) quality checks to be carried out, supervision being exercised and safety precautions to be employed;
- (6) the list of procedures and work instructions to manage and control the quality of construction and installation works, including without limitation:
  - a) Deleted
  - b) Deleted
  - c) the construction processes including Temporary Works so as to ensure compliance with drawings and Specification. In addition, any software to be used in the construction, installation and commissioning process shall be identified and details of the Verification and Validation processes for the software application shall be given;
  - d) the construction and installation process so as to ensure clear identification and traceability of material and manufactured product;
  - e) the identification of the inspection and test status of all material and manufactured products during all stages of the construction and installation process to ensure that only products that have passed the required inspections and tests are despatched for use and/or installation;
  - f) review and disposition of non-conforming material or product so as to avoid unintended use/installation;
  - g) the assessment and disposition of non-conforming material and product and approval for reworking or rejection as scrap;

- h) the identification of preventive action so as to prevent recurrence of similar non-conformance; and
  - i) the handling, storage, packaging, preservation and delivery of product; and
- (7) the security control of the Site and the works area for Contractor's accommodation, storage, car park and other works facilities, etc. in accordance with clause 15.10 below.
- 3.6.1.4 Deleted
- 3.6.1.5 Where all or part of the Works is within the Employer Protection Zone, the Contractor shall follow the guidelines issued by the Employer's appropriate authority. The Contractor shall submit to the Employer's Representative for review his construction method statement and detailed design of any Temporary Works proposed to be erected within this zone adjacent to Employer properties.
- 3.6.1.6 The following particulars shall be submitted to the Employer's Representative for review within 14 days of the Commencement Date of the Works:
  - (i) drawings showing the layout within the Site of the Employer's Representative's and Contractor's accommodation, Project signboards, access roads and major facilities required early in the Contract;
  - (ii) drawings showing the layout and the construction details of the Employer's Representative's accommodation; and
  - (iii) drawings showing the details to be included on Project signboards.
- 3.6.1.7 Drawings showing the location of stores, storage areas, work areas and other major facilities shall be submitted to the Employer's Representative for review as early as possible, but in any case not later than 28 days before construction of the facilities.
- 3.6.2 Health and Safety Documentation**
- 3.6.2.1 The Contractor shall submit Health and Safety Documentation to fully comply with the requirements of the Project conditions and proposed work activities in accordance with Chapter 18 below.
- 3.6.2.2 The Contractor shall submit to the Employer's Representative the Health and Safety Documentation for review within 30 days of the Commencement Date of the Works.
- 3.6.3 Not used**
- 3.7 Deleted**
- 3.7.1 Deleted
- 3.7.2 Commissioning Plan**
- 3.7.2.1 The Contractor shall ensure the timely preparation of the Commissioning Plan in a format and to a level of detail in accordance with clause 9.3 below. The Contractor shall submit the first draft of the Commissioning Plan to the Employer's Representative within 180 days of the Commencement Date of the Works.
- 3.7.2.2 The Commissioning Plan shall consist of the following:
  - a. Deleted
  - b. On-Site Testing and Commissioning Plan

(i) **Installation Tests Schedule**

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

(ii) **Partial Acceptance Tests Plan**

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

(iii) **System Acceptance Tests Plan**

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

(iv) **Integrated Testing & Commissioning Plan**

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

**3.7.3 Operation and Maintenance Manuals Plan**

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

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

**3.7.4 Training Plan**

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

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

**3.7.5 Not Used**

**3.7.6 Defects Liability Management Plan**

The Contractor shall submit for review by the Employer's Representative a Defects Liability Management Plan to repair, replace and perform any remedial item upon the Works identified by the Employer's Representative during the Defects Liability Period (DLP). The first submission of this plan is required upon issuance of the Taking Over Certificate for the Works. The Contractor shall:

- (a) endeavour to complete all necessary work in a timely responsible manner;
- (b) not proceed with any remedial work without the consent of the Employer's Representative;
- (c) submit a plan that details the methods and timing of any proposed work; and
- (d) update the plan monthly, showing progress of the work and the time to completion.

**3.7.7 Not used**

## CHAPTER 4

### 4. DOCUMENTS SUBMISSION AND REVIEW

#### 4.1 Documents, Submissions and Correspondence

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

#### 4.2 Submissions to the Employer's Representative

##### 4.2.1 General requirements

4.2.1.1 All submissions shall be made to the Employer's Representative in a format reviewed without objection by the Employer's Representative and in accordance with the requirements in:

- (1) the Contract;
- (2) the Computer Aided Design & Drafting (CADD) Manual; and
- (3) the Document Submittal Instructions to Consultants and Contractors.

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

4.2.1.3 The following software (versions quoted or higher) compatible for use with Intel-Windows based computers shall be used, unless otherwise stated, for the various electronic submissions required:

<u>Document Type</u>	<u>Electronic Document Format (latest versions of)</u>
Text Documents	MS Word
Spread Sheets	MS Excel
Data Base Files	MS Access
Presentation Files	MS PowerPoint
Programmes	Primavera for Windows
AutoCAD Graphics	CorelDraw / AutoCAD
Photographic	Adobe Photo Shop
Desktop Publishing	QuarkXPress
CADD Drawings	Micro Station

##### Media for Electronic File Submission

All submittal shall be accompanied with a CD containing the submittal.

##### Internet File Formats/Standards

Deleted

4.2.1.4 Deleted

4.2.1.5 If required, two copies of all internal and external orders placed by the Contractor for equipment or materials required for the Works shall be forwarded to the Employer's Representative at the time of issue. All orders shall state the Employer's Representative's requirements for inspection and

testing, shall bear the Contract reference, Contractor's name and address and shall indicate, where applicable, the sub-section of the Works for which the equipment or material is required.

4.2.1.6 Deleted

4.2.1.7 The Contractor shall have the obligation to upgrade, at his own cost, all the relevant software to the latest version upon instruction by the Employer's Representative, after the new version of the relevant software has been launched for more than six months in Uttar Pradesh.

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

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

## **4.2.2 Content**

4.2.2.1 Unless otherwise specified or permitted by the Employer's Representative, each submission shall comprise:

- (1) for drawings - one A1 master on vellum (signed by the contractor), one A1 copy on vellum, one paper A1 copy, six paper A3 copies and an electronic data copy of all drawings; and
- (2) for documents - the unbound original, six bound copies and an electronic copy when applicable.

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

## **4.3 Records and Reports**

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

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

- (1) a document approval system which shall specify the level of authority for approval of all documents and material before submission to the Employer's Representative;
- (2) a system of issuing documents to ensure that pertinent documents are issued to all appropriate locations;
- (3) a document change or re-issue system to ensure that only the latest revision of a document can be used; and
- (4) a submission identification system which identifies each submission uniquely by the following:



- (a) contract number;
- (b) discipline;
- (c) submission number; and
- (d) revision indicator.

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

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

#### **4.3.5 Submission and review procedure**

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

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

4.3.5.3 For each stage of submittal, the Contractor shall prepare a Submission Review Request (SRR) carrying the date of submission, the submission reference number as defined in clause 4.3.2.(4) above, the submission title, the stage of submission, and the authorised signature of the Contractor's responsible engineer in the format shown in 20 of this Specification, to confirm that, in the opinion of the Contractor, the submission:

- (1) complies with all relevant requirements of the Specification;
- (2) conforms to all interface requirements;
- (3) contains, or is based on auditable and proven or verified calculations;
- (4) has been properly reviewed by the Contractor, according to the Contractor's QA system, to confirm its completeness, accuracy, adequacy and validity; and
- (5) has taken account of all requirements for approval by statutory bodies or similar organisations, and that where required, such approvals have been granted.

4.3.5.4 The Employer's Representative's response to the submission will normally be made within 30 calendar days of receipt of the submission, provided that the submission is made no later than the date shown on the Submissions Programme described in clause 2.5 above. The Employer's Representative may extend the review period depending on the amount of documentation accompanying the submission.

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



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

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

#### **4.3.6 Employer's Representative's Response**

4.3.6.1 The Employer's Representative will respond in one of the following three ways:

- (1) "Reviewed without Objection"
- (2) "Reviewed without Objection, Subject to"
- (3) "Rejected"

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

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

4.3.6.4 If the Employer's Representative issues a "Notice of No Objection Subject to", the Contractor shall resubmit the affected parts of the submission, clearly demonstrating how the Employer's Representative's comments have been taken into account and resubmit amended or corrected material within 10 working days of issue of the Employer's Representative's comments, using the process described in clause 4.3.5 above.

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

4.3.6.6 If the Employer's Representative issues a "Notice of Rejection", the Contractor shall resubmit the complete submission, clearly demonstrating how the

Employer's Representative's comments have been taken into account and resubmit amended or corrected material within 10 working days of issue of the Employer's Representative's comments, using the process described in clause 4.3.5 above.

#### **4.4 Records**

4.4.1 The Contractor shall establish and maintain a place for the storage and archiving of all the documents relating to the Works and not required to be submitted to the Employer's Representative under clause 4.1 above which shall be:

- (1) the same place or office where the Contractor is performing the work and storing documents reviewed by the Employer's Representative, or;
- (2) at the Site or elsewhere in Lucknow, a records office, which contains all other, documents that the Contractor is required to maintain in accordance with the Contract.

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

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

## CHAPTER 5

### 5. QUALITY MANAGEMENT

#### 5.1 Introduction

5.1.1 The Contractor shall maintain and implement a Quality Management System that shall remain in effect during the execution of the Works. The Contractor's Quality Management System shall be based on the International Standard ISO 9001/9002:2000 "Model for quality assurance in design, development, production, installation and servicing." The Contractor shall submit its Quality Management System documentation for the Employer's Representative's review as specified in this Chapter.

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

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

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

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

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

#### 5.2 General Requirements

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

##### 5.2.2 Quality Plans

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

- (1) a Management Quality Plan, for the control of all management related activities;
- (2) Deleted;
- (3) Manufacturing Quality Plan and Site Quality Plan, for the control of activities within each category of work or discrete element of procurement, manufacturing, delivery, construction and installation of the Works, including Temporary Works.

5.2.3 Within 30 days of the Commencement Date of the Works, the Contractor shall submit for review by the Employer's Representative:

- (1) a quality manual;
- (2) the quality system procedures and any associated system instructions and/or forms which he proposes to use for the Works; and
- (3) Deleted

5.2.4 The Contractor shall submit separate Manufacturing Quality Plan and Site Quality Plan covering all elements of the Works. These shall be in accordance with the specific requirements of this Chapter and shall be submitted to the Employer's Representative for review 60 days prior to the commencement of the manufacturing and construction works covered by the quality plans. In addition, the Contractor shall prepare inspection and test plans for the management and control of the inspection and/or testing by the Contractor of the Works identified in each quality plan.

5.2.5 The Contractor shall promptly supply the Employer's Representative with two (2) controlled copies of his quality manual, quality plans, inspection and test plans and related procedures/instructions/forms upon such documents being reviewed without objection by the Employer's Representative. The Contractor shall maintain such controlled documents throughout the duration of the Contract. For any amendment to quality system documentation, the Contractor shall as soon as reasonably practicable prepare and submit the proposed amendment for review by the Employer's Representative. In addition, the Employer's Representative may request further copies of the quality system documents and these documents shall reach the Employer's Representative's office within fourteen (14) days of notification.

5.2.6 The Contractor shall appoint (a) suitably qualified and experienced person(s) as Quality Manager(s), who shall be directly responsible to senior management level and is able to discharge his duties without hindrance or constraint, and provide such other resources as may be required to ensure effective implementation of the Quality Management System and all quality plans. Details of the qualifications, experience, authority and responsibility of the proposed Quality Manager(s) shall be submitted for review by the Employer's Representative within 30 days of the Commencement Date of the Works.

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

### **5.3 Management Quality Plan**

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

- (1) 5.3.1.1 the appointment of a Quality Manager in accordance with clause 5.2.6 above;
- (2) 5.3.1.2 the organisation of the Contractor's managerial staff with particular reference to any joint venture partners and main sub-

contractors. An organisation chart shall be produced to illustrate the sub-division of the Works into elements for effective technical and managerial control, the reporting structure and the interface relationship between all parties involved;

- (3) 5.3.1.3 the hierarchy of the overall quality management system documentation to be applied to the Works;
- (4) 5.3.1.4 the quality management system of the Contractor in monitoring and controlling sub-contractors and suppliers; and
- (5) 5.3.1.5 the list of quality system procedures and work instructions to be applied to manage the quality of the Works.

#### **5.4 Not used**

#### **5.5 Site Quality Plan**

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

- (1) the organisation of the Contractor's staff directly responsible for the day-to-day management of the construction and installation activities on or off the Site;
- (2) the specific allocations of responsibilities and authorities given to identified personnel or sub-contractors for particular construction and installation work;
- (3) the hierarchy of quality management system documentation for managing and controlling construction and installation works, including construction and installation works of sub-contractors of any tier; and
- (4) the list of procedures and instructions to be applied to manage and control the construction and installation works together with the procedures and instructions that have not been previously submitted for review.

5.5.2 The Contractor shall also prepare inspection and test plans to manage and control any test and inspection activities in accordance with clause 5.6.1 below.

#### **5.6 Inspection and Test Plans, Records and Reports**

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

- (1) the personnel responsible for undertaking and certifying the inspection and/or test;
- (2) the procedure or instructions for the inspection and/or test;
- (3) the test method or a reference to the relevant standard of testing;
- (4) the inspection and/or test required prior to commencement of an activity;

- (5) the inspection and/or test during an activity and its frequency;
- (6) the inspection and/or test required to complete an activity;
- (7) all Quality Control Points, Quality Hold Points and any notices or other documents to be given to the Employer's Representative in relation to Quality Control Points and Quality Hold Points;
- (8) the compliance criteria;
- (9) the method of analysis of test data;
- (10) the procedure for correction or disposal of any work which fails the compliance criteria;
- (11) examples of the documentation to be used for reporting the results of inspections, tests and analysis of test data;
- (12) examples of the documentation to be used for recording the status of inspections and tests in accordance with clause 5.8.1 below; and
- (13) the procedure for the distribution, filing and storage of inspection reports, test reports and reports on analysis of test data.

5.6.2 Each report of the inspection and/or test shall be prepared in accordance with clause 9.6.6.1 below.

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

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

## **5.7 Review, Verification & Audit**

5.7.1 The Contractor shall continuously monitor the performance of each quality plan related to the execution of the Works and shall include in each Monthly Progress Report the status of all quality system documentation, an up-to-date audit schedule and status and an up-to-date non-conformity register providing the status of all non-conformities identified by the Employer's Representative and the Contractor. The Contractor shall make an appraisal of such performance and identify in particular any non-conformities or other shortcomings in the quality management system, the actions being taken to dispose of these non-conformities, any necessary corrective action taken or proposed to be taken to prevent the re-occurrence of these non-conformities or shortcomings and, any other items as instructed by the Employer's Representative.

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

- 5.7.3 The Contractor shall ensure that the requirements for supervision and verification of work by the Contractor and/or his sub-contractors of any tiers are identified in the quality plans and adequate resources and trained personnel are provided for these activities.
- 5.7.4 The Contractor shall submit for review by the Employer's Representative details of the authority, qualifications and experience of personnel assigned to review, verification and to audit activities.
- 5.7.5 The Employer's Representative may, by notice to the Contractor, require external audits of the Contractor's quality management system to be carried out either by the Employer's staff or by his representative. In such case, the Contractor shall afford to such auditors all necessary facilities and access to the records to permit this function to be performed.

## **5.8 Quality Control Register**

- 5.8.1 The Contractor shall provide and maintain at all stages of the Works a quality control register or registers to identify the status of inspections, sampling and testing of the work and all certificates. Such registers shall be updated by the Contractor to show all activities in previous months and shall reach the Employer's Representative's office before the 7<sup>th</sup> working day of each month. Each register shall:
- (1) list the certificates received for each batch of goods and materials incorporated in the Works and compare this against the certification required by the Contract and the Contractor's quality plans;
  - (2) list the inspection and testing activities undertaken by the Contractor on each element of the Works and compare these activities against the amount of inspection and testing required by the Contract and the Contractor's quality plans;
  - (3) show the results of each report of inspection and/or test and any required analysis of these results and compare these results against the pass/fail criteria; and
  - (4) summarize any actions proposed by the Contractor to overcome any non-conformity identified in clauses 5.8.1.(1),(2) & (3) above.

## **5.9 Summaries of Inspection and/or Test**

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

## **5.10 Notification of Non-conformities**

- 5.10.1 If, prior to the issue of the Taking Over Certificate for the Works or the relevant Section, the Contractor has used or proposes to use or repair any item of the Works which does not conform to the requirements of the Contract, he shall immediately submit to the Employer's Representative such proposal, supplying full particulars of the non-conformity and, if appropriate, of the proposed means of repair which shall include any calculation analysis or other documentation to support the repair or acceptability of the non-conformity.

IF THE EMPLOYER'S REPRESENTATIVE ISSUES NON-CONFORMITY REPORTS OR SIMILAR DOCUMENTS TO NOTIFY THE CONTRACTOR OF ANY ITEM OF THE WORKS WHICH HE CONSIDERS TO CONSTITUTE A NON-CONFORMITY AND WHICH HAS NOT BEEN REPORTED IN ACCORDANCE WITH CLAUSE 5.10.1 ABOVE, THE



LKE(02)-02: Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 02 (two) Years Defect Liability Period (DLP) and 01 (one) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.

CONTRACTOR SHALL PROMPTLY INVESTIGATE THE MATTER AND, WITHIN 14 DAYS OF NOTIFICATION BY THE EMPLOYER'S REPRESENTATIVE, SUBMIT TO THE EMPLOYER'S REPRESENTATIVE FOR REVIEW THE REMEDIAL MEASURES TO BE TAKEN AND STATING THE REASONS FOR SUCH MEASURES.



## CHAPTER 6

### 6. SOFTWARE MANAGEMENT AND CONTROL

#### 6.1 Prescriptive Framework

All software to be developed or modified (re-engineered software) shall follow the normative requirements of EN50128 (Railway Applications: Software for Railway Control and Protection Systems). The Software shall be designed, developed and tested according to the Software Quality assurance Plan, Software Integrity Level (SIL) and the Software Lifecycle. The Contractor shall define within the Software Quality Assurance Plan what techniques and measures are to be applied for software development. In addition to the requirements of the Software Quality Assurance Plan, justification, which shall be reviewed without objection by the Employer's Representative, shall be required in respect of any highly recommended EN50128 Annex A normative clauses which are not to be applied to software development and supply.

#### 6.2 Software Framework

As defined in EN50128, all software produced or supplied for the project shall be subject to a defined quality framework. The Contractor shall use a Quality Assurance System which is compliant with CENELEC specifications, with EN29000 series and others and meet the requirements as stipulated in the PS. ISO 9000-3 is considered appropriate for Safety Integrity Level 0 or 1 software.

6.3 All Control & Monitoring Software has to be provided to the Employer in the following formats

- i) Source Code
- II) Detailed Programme With explanation of key functions, protection schemes and safety requirement.
- III) System description and layout module wise.
- IV) Troubleshooting of hardware & software including that in communication with SCADA.

6.4 System should generate non- conformity statements with classification of severity of the non-conformity. The daily reports should be updated.

6.5 This will form part of the submittals.

## CHAPTER 7

### 7. MATERIALS AND EQUIPMENT

#### 7.1 Materials and Equipment Provided by the Employer

- 7.1.1 Materials and equipment which are to be provided by the Employer will be as stated in the Contract.
- 7.1.2 Materials and equipment provided by the Employer shall be collected by the Contractor from the locations stated in the Contract and delivered by the Contractor to the Site. The Contractor shall inspect the materials and equipment before taking receipt and shall immediately inform the Employer's Representative of any shortage or damage.
- 7.1.3 Materials or equipment provided by the Employer which are damaged after collection shall be repaired by the Contractor and submitted to the Employer's Representative for review. Materials or equipment which are lost or which in the opinion of the Employer's Representative are not capable of being or have not been repaired satisfactorily shall be replaced by the Contractor.
- 7.1.4 The Contractor shall dispose of crates and containers for materials or equipment provided by the Employer.
- 7.1.5 Equipment / materials provided by the Employer, surplus to the requirements of the Works shall be returned to the locations stated in the Contract.
- 7.1.6 The Contractor shall protect and maintain equipment provided by the Employer while it is on the Site and shall provide operatives, fuel and other consumables required to operate the equipment.

#### 7.2 Materials

##### 7.2.1 General

- 7.2.1.1 Materials for inclusion in the Permanent Works shall be new unless otherwise stated in the Contract or having been reviewed without objection by the Employer's Representative.
- 7.2.1.2 Certificates of tests by manufacturers, which are submitted to the Employer's Representative, shall relate to the material delivered to the Site. Certified true copies of certificates may be submitted if the original certificates cannot be obtained from the manufacturer. A letter from the supplier stating that the certificates relate to the material delivered to the Site shall be submitted with the certificates.
- 7.2.1.3 Materials, which are specified by means of trade or proprietary names, may be substituted by materials from a different manufacturer, provided that the materials are of the same or better quality and comply with the specified requirements and have been reviewed without objection by the Employer's Representative.
- 7.2.1.4 In addition to any special provisions in the Contract for the sampling and testing of materials, the Contractor shall submit samples of all materials and goods which it propose to use or employ in or for the Works. Such samples, if having been reviewed without objection, shall be retained by the Employer's Representative and shall not be returned to the Contractor or used in the Permanent Works unless reviewed by the Employer's Representative. No materials or goods of which samples have been submitted shall be used in the Works unless and until the Employer's Representative shall have reviewed such samples without objection.
- 7.2.1.5 The Employer's Representative may reject any materials and goods which in his opinion are inferior to the samples previously reviewed and the Contractor shall promptly remove such materials and goods from the Site.

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

- (1) no statutory specification shall be altered except in accordance with relevant legal provision, if any;
- (2) the Employer's Representative is satisfied that the Contractor has made every reasonable effort to obtain the material in metric specifications;
- (3) in the opinion of the Employer's Representative, the substitute material is suitable for the Works in all respects;
- (4) in the opinion of the Employer's Representative, the substitute material complies with all the specifications for the material substituted, allowing minor discrepancies between the specified metric measurements and the corresponding imperial measurements of the substitute, provided that such discrepancies can be effectively and satisfactorily compensated for by the provision of extra quantity of the material; and
- (5) the Contractor shall be responsible for all extra quantities of the material required for meeting specification requirements of the Works due to the use of the substitute.

7.2.1.7 Hardwood shall not be used for Site Hoardings, shoring of trenches and pits, false work or form work.

## **7.2.2 Notice of place of manufacture and/or source of supply**

The Contractor shall notify the Employer's Representative of the places of manufacture and/or the source of supply of all goods and materials previously reviewed without objection by the Employer's Representative to be incorporated into the Permanent Works. The Contractor shall give reasonable notice (which shall not in any event be less than 56 days) to the Employer's Representative before the start of any manufacturing and/or the supply of goods and materials.

## **7.2.3 Certificates for Manufactured Goods or Materials**

The Contractor shall obtain certificates for each batch of goods and materials incorporated into the Permanent Works. Each certificate shall certify that the materials comply with the requirements of the Contract and shall include all reports of inspections and/or tests carried out at the place of manufacture.

## **7.3 Equipment**

### **7.3.1 Identification labels**

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

7.3.1.2 The proposed labelling system shall be submitted for review by the Employer's Representative at least 3 months before the scheduled date for the shipment of the first item of equipment to site.

7.3.1.3 The identification label shall be permanently attached in such a way that it shall not become detached or illegible during the lifetime of the system from any cause including wear and tear, environmental effects (such as rain, direct sunlight, etc.) or any other influence. Preference shall be given to embossed

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

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

7.3.1.5 All labels shall incorporate the inscription "Property of Employer".

## **7.4 Electronic Control Racks & Cabinets**

### **7.4.1 Racks & Cabinets**

7.4.1.1 Electronic control equipment shall be housed in racks suitably enclosed in metal cabinets.

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

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

7.4.1.4 Deleted

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

7.4.1.6 Unless otherwise specified in PS, indoor equipments shall have a minimum IP rating of IP54 and out door equipment shall have IP rating of IP 65 under IEC 529.

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

### **7.4.2 Cables**

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

7.4.2.2 Not used

7.4.2.3 All cable cores shall be terminated including all spare conductors.

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

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

## CHAPTER 8

### 8. PACKAGING, STORAGE, SHIPPING AND DELIVERY

#### 8.1 Storage of Equipment

- 8.1.1 The Contractor shall provide and maintain acceptable storage facilities for the Permanent Works, equipment and materials of all kinds intended for use in carrying out the Works or for incorporation into the Works.
- 8.1.2 The Contractor shall prepare, protect and store in an agreed manner all Permanent Works, Contractor's Equipment, equipment and materials so as to safeguard them against loss or damage from repeated handling, from climatic influences and from all other hazards arising during shipment or storage on or off the Site.
- 8.1.3 Secure and covered storage shall be provided by the Contractor for all Permanent Works, Contractor's Equipment, equipment and materials which are other than those having been reviewed without objection by the Employer's Representative as suitable for open storage.

#### 8.2 Crating

- 8.2.1 Deleted

#### 8.3 General Precautions

- 8.3.1 Spare parts shall be tropicalised in their packing for prolonged storage in accordance with BS 1133 or other equivalent International /Indian standard and shall be suitably and individually labelled to indicate:
- (1) shelf life and date of manufacture;
  - (2) type or condition(s) of storage and special handling information;
  - (3) description of item and relevant part number;
  - (4) serial number, if applicable;
  - (5) inspection/test certificate number and batch number; and
  - (6) Contract number, variation order number and item number.
- 8.3.2 Deleted
- 8.3.3 Deleted
- 8.3.4 Deleted
- 8.3.5 Deleted
- 8.3.6 Appropriate precautions in accordance with the Contractor's safety regulations, the regulations of the Employer, and statutory regulations shall be taken in respect of all hazardous, toxic, inflammable, etc. materials.

## **8.4 Packaging Procedures**

- 8.4.1 All required inspection/test certificates shall be supplied and packed together with individual material. All packaging materials and procedures shall be subject to review by the Employer's Representative.
- 8.4.2 All empty cases, crates or packages, whether or not returnable, shall be removed from the Site by the Contractor or stored by the Contractor in such a way that they do not interfere with the progress of the works of Project Contractors.

## **8.5 Shipping**

- 8.5.1 The Contractor shall notify the Employer's Representative 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.
- 8.5.2 Two copies of packing lists and quality certificates shall be attached to each case or package to be shipped. One copy shall be placed inside the package and the second copy shall be enclosed in a watertight enclosure on the outside of each case or package. A copy of packing lists and quality certificates shall be sent to the Employer's Representative after each package of the Works, the equipment, spare parts and other items to be shipped have been shipped.
- 8.5.3 Without prejudice to any other provisions of the Contract, the Contractor shall be responsible for all legal requirements, duties, dues, taxes and other such requirements and expenditures required for the importation of the Works, the equipment, spare parts and other items to be supplied under the Contract into Lucknow.
- 8.5.4 The Contractor shall clear the Works, the equipment, spare parts and other items to be supplied under the Contract through customs/Indian sea port in accordance with all Government of India Enactments.

## **8.6 Delivery**

- 8.6.1 The Contractor shall deliver the Works and all items to be supplied under the Contract to the Site.
- 8.6.2 The Contractor shall unload the Works and all items to be supplied under the Contract at the designated delivery point and positioning or storing them.
- 8.6.3 Any part of the Works or any item to be supplied under the Contract that is damaged in transit shall not be considered as delivered until repairs or replacements have been made and all necessary spare parts or items have been delivered to the Site.
- 8.6.4 All documents, manuals, drawings and other deliverables shall be delivered to an address in Lucknow/Kanpur to be designated by the Employer's Representative in writing.
- 8.6.5 The Contractor shall store and secure the Works, equipment, spare parts and other items until the same have been inspected and are considered delivered at the designated point by the Employer's Representative.

- 8.6.6            The Contractor shall remove temporary fittings required for shipment and re-assembly of equipment and shall complete this prior to the equipment or parts thereof being inspected and before they are considered delivered.
- 8.6.7            An item shall be considered delivered when all damage have been repaired and all documentation and post delivery preparation have been completed to the satisfaction of the Employer's Representative.

## CHAPTER 9

### 9. TESTING AND COMMISSIONING

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

#### 9.1 General

9.1.1 Deleted.

9.1.2 Deleted

9.1.3 Deleted.

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

#### 9.2 Manufacturing Test Plan

9.2.1 The Manufacturing Test Plan is the Contractor's plan for carrying out the necessary procedures to ensure that the items presented for acceptance by the Employer and the Employer's Representative are in compliance with the requirements of the Specification.

9.2.2 During the process of procurement and manufacture of the system components the Contractor shall undertake such testing and inspection as is required by the Quality Plan referred to in clause ~~5.4~~ above **5.6**.

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

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

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

#### 9.2.5 Inspection

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

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

#### 9.2.6 Type Tests

9.2.6.1 Deleted.

9.2.6.2 Deleted



- 9.2.6.3 Deleted
- 9.2.6.4 Type tests are not required if previously independently witnessed tests have been successfully carried out. Where only some of the required tests have been carried out, the Employer's Representative may agree to selected type tests being carried out individually rather than as part of a sequence.
- 9.2.6.5 Deleted
- 9.2.6.6 Deleted
- 9.2.6.7 For each test, the Employer's Representative will determine whether the item under test has passed or failed. In general, the test will be considered to have failed if either:
- The result of the test is not in accordance with the expected result described in the test procedure, or
  - The result of the test is in accordance with the expected result described in the test procedure, but some other unexpected or unexplained event occurred which the Employer's Representative considers to be a fault.
- 9.2.6.8 If during Type Tests, any failure occurs or the equipment is changed, it shall be reported to the Employer's Representative who may, at his discretion, require repetition of the previous tests at the Contractor's cost.
- 9.2.7 First Article Inspection**
- 9.2.7.1 FAI shall be performed jointly by the Employer and the Employer's Representative and the Contractor on all major equipment items or sub-systems identified by the Employer's Representative.
- 9.2.7.2 Equipment shall be shipped from the point of manufacture only after a FAI has been completed or the requirement waived in writing by the Employer's Representative.
- 9.2.7.3 The Contractor shall provide a minimum of 15 working days notice to the Employer's Representative before any FAI.
- 9.2.7.4 At least 15 days prior to each FAI, the latest drawings, inspection and test procedures, specifications and quality documentation required for adequate inspection of the equipment under inspection shall be submitted to the Employer's Representative. The drawings shall be complete to the lowest level replaceable unit.
- 9.2.7.5 The Contractor shall ensure that he and his subcontractors are prepared for all FAIs. The Contractor shall not schedule more than one FAI on the same day without prior notice of No Objection by the Employer's Representative.
- 9.2.7.6 Deleted
- 9.2.7.7 Deleted
- 9.2.7.8 The Contractor shall be responsible for the cost and scheduling, to the Employer and the Employer's Representative's convenience, of any repeat testing of items which fail FAI.
- 9.2.8 Factory Acceptance Test**
- 9.2.8.1 Before shipment all manufactured items or systems shall undergo FAT in accordance with the requirements of the PS / TS.

### **9.3 Commissioning Plan**

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

- (1) Factory Testing Plan ( see clause 3.5.1 above and PS / TS)
- (2) On-Site Testing and Commissioning Plan

9.3.2 Testing and Commissioning Phases

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

- (1) Factory Acceptance Test (which requirements are specified in clause 3.5.1 above);
- (2) Installation Tests;
- (3) Partial Acceptance Tests;
- (4) System Acceptance Tests;
- (5) Integrated Testing & Commissioning; and
- (6) Service Trial.

9.3.2.2 Items (3), (4), (5) and (6) as required by the PS / TS constitute the Tests on Completion referred to in the GCC.

### **9.4 On-Site Testing and Commissioning Plan**

9.4.1 The Contractor shall prepare and submit for review by the Employer's Representative the Contractor's On-Site Testing and Commissioning Plan detailing and explaining how the Contractor will plan, perform and document all tests and inspections that will be conducted to verify and validate the Works on Site. The On-Site Testing and Commissioning Plan shall consist of a narrative description supported by graphics, diagrams and tabulations as required.

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

- (1) the Contractor's strategy for testing and commissioning all constituent parts of the Works and how this relates to the sequence of construction and installation;
- (2) Deleted
- (3) the interdependency and interaction with other Contractors and their commissioning programmes; the type and extent of testing and commissioning to be undertaken and the parts of the Works to be proven by that testing; the objective of each test, what particular operating criteria the test or inspection will prove and how the success of the test will be demonstrated or measured;
- (4) Deleted

- (5) the plan for the production and submission of the testing and commissioning procedures to the Employer's Representative for review including the submission of the testing and commissioning reports and records; and
- (6) the On-Site Testing and Commissioning Plan shall be organised and submitted in the stages described in clauses 9.3.2 above, 9.4.3 below & 9.4.7 below.

#### 9.4.3 **Installation Tests**

- 9.4.3.1 The Installation Tests phase is defined as being the final stage of assembly/installation before the start of commissioning itself. The Installation Tests are to be performed by the Contractor under the Contract and may be witnessed by the Employer or the Employer's Representative. During this phase, the Contractor shall perform static testing of components and/or systems in preparation for Partial Acceptance Testing.
- 9.4.3.2 The particular requirements for Installation Tests are prescribed in the PS. Where performance across interfaces to other Contractors or to other parties is required to be verified, the Contractor shall liaise with the interfacing party to co-ordinate the test procedures and programme in the manner prescribed in clause 3.3.2 above.
- 9.4.3.3 The Contractor shall prepare three copies of a test report immediately after the completion of each test whether or not witnessed by the Employer or the Employer's Representative. If the Employer or the Employer's Representative has witnessed the test, he will countersign the report to indicate his agreement to the information and conclusions (i.e. whether or not the equipment being tested has passed satisfactorily) contained therein. If the Employer or the Employer's Representative has not witnessed the test (i.e. if a written waiver has been granted), the Contractor shall forward three copies of the test report without delay to the Employer's Representative.
- 9.4.3.4 The Employer's Representative will countersign the report to indicate his agreement to the information and conclusions (i.e. whether or not the equipment being tested has passed satisfactorily) and return one copy to the Contractor. Where the results of the test do not meet the requirements of the Specification, the Employer or the Employer's Representative may call for a re-test.
- 9.4.3.5 Test equipment and instrumentation shall be subject to calibration test within a properly controlled calibration scheme, and signed calibration certificates shall be supplied to the Employer's Representative in duplicate. Such calibration checks shall be undertaken prior to testing and, if required by the Employer or the Employer's Representative, shall be repeated afterwards.
- 9.4.3.6 The Contractor shall submit to the Employer's Representative a comprehensive schedule of tests as required by the PS giving full details and procedures for each test to be carried out under the Contract and including the pass / fail criteria (i.e. the standards or limits to be achieved).

#### 9.4.4 **Partial Acceptance Tests**

- 9.4.4.1 Partial Acceptance Tests are defined as the performance of functional tests of sections, areas, or stages of a system. The Partial Acceptance Tests are part of the Tests on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. During this phase, an energy source shall be introduced to enable functional testing to be performed. On satisfactory completion of the Partial Acceptance Tests, the tested items will be considered available for Systems Acceptance Testing.

- 9.4.4.2 The particular requirements for Partial Acceptance Tests prescribed in the PS / TS are indicative only.
- 9.4.4.3 The Contractor shall submit to the Employer's Representative a comprehensive Partial Acceptance Tests Plan including all requirements detailed in the PS / TS. The plan shall be submitted on a logical section-by-section basis, using a "top-down" approach describing the testing and commissioning strategies and processes clearly showing how these serve to provide the full verification of the systems and equipment.
- 9.4.4.4 The Partial Acceptance Tests Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass/fail criteria, sample records, resources to be made available, drawings and records to be submitted to the Employer's Representative, and a programme showing the dates for testing and for submission of each test procedure.
- 9.4.4.5 Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.
- 9.4.4.6 If any working equipment is relocated or altered by the Contractor during the execution of the Works, thorough re-testing shall be performed to verify that the equipment remains fully functional and operates safely according to its specification. The testing to be performed shall be no less rigorous than the procedures used for the original testing and commissioning of the equipment.
- 9.4.4.7 The Contractor shall submit to the Employer's Representative by the date laid down in the PS / TS (or if none is given, no later than two months before the commencement of the commissioning work whichever is earlier), 3 copies of its proposed Partial Acceptance Tests records. The records shall be appropriately sub-divided to make provision for the various parts of the systems and equipment covered by the Contract and shall cover all tests (mechanical, electrical or otherwise), positive identification of equipment, assemblies and sub-assemblies by serial number, drawing and specification reference numbers (and issue reference) and any other data to be certified by the Employer or the Employer's Representative during the course of commissioning.
- 9.4.4.8 The Contractor shall during the execution of the Works prepare such reports and records of, manufacture, installation, erection and testing as may be required in order that any relevant licences or approvals (including any statutory approvals) may be issued or granted. Such records shall be adequate to enable the system or its respective part to be commissioned and to meet the requirements of the licensing authority or statutory body.
- 9.4.4.9 Immediately following the successful Partial Acceptance Testing of the system or any constituent part, the Contractor shall complete the appropriate Partial Acceptance Tests records in the agreed format and submit 3 signed copies to the Employer's Representative.
- 9.4.4.10 The Contractor shall include a complete schedule of all Partial Acceptance Tests records and their current status within the Monthly Progress Report.
- 9.4.5 **System Acceptance Tests**
- 9.4.5.1 System Acceptance Tests are defined as the tests undertaken to demonstrate that the Works in its entirety is capable of functioning in accordance with the specified requirements in the Contract in all respects. The System Acceptance Tests are part of the Tests on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of

the Works. The System Acceptance Tests may commence before remote operations capability (if any) is fully functional, however, the system must be satisfactorily tested remotely (if specified to have such capability) before the System Acceptance Tests can be considered to be completed. On satisfactory completion of the System Acceptance Tests, the tested items will be considered available for Integrated Testing & Commissioning.

9.4.5.2 The particular requirements for System Acceptance Tests ~~are~~ prescribed in the PS / TS are indicative only.

9.4.5.3 The Contractor shall submit to the Employer's Representative a comprehensive System Acceptance Tests Plan including all requirements detailed in the PS / TS. The plan shall be submitted on a section by section basis to demonstrate how the System Acceptance Tests are to be carried out. The plan shall adopt a top down approach and describe the system completion strategy and process.

9.4.5.4 System Acceptance Tests shall comprise comprehensive testing of the assembled installation to ensure that it operates in accordance with the requirements of the PS / TS.

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

- (1) tests of all functional and performance requirements for the system;
- (2) tests of behaviour under failure conditions, e.g. changeover to redundant hardware; initiation of re-configuration functions or reverse modes of operation; and recovery of the equipment and system from failure.

9.4.5.6 The System Acceptance Test Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass / fail criteria, sample records, resources to be made available, drawings and records to be submitted to the Employer's Representative, and programme showing the dates for testing and for submission of each test procedure.

9.4.5.7 Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.

9.4.5.8 Immediately following the successful acceptance testing of the system, the Contractor shall complete the appropriate commissioning records in the agreed format and submit 3 signed copies to the Employer's Representative.

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

#### **9.4.6 Integrated Testing & Commissioning**

9.4.6.1 Integrated Testing & Commissioning are defined as the final tests to be undertaken before the commencement of Service Trial. The Integrated Testing & Commissioning are part of the Tests on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. The Integrated Testing & Commissioning shall demonstrate the full compatibility between all interfacing systems. On satisfactory completion of the Integrated Testing & Commissioning, the tested items will be considered available for Service Trial.

9.4.6.2 The particular requirements for Integrated Testing & Commissioning ~~are~~ prescribed in the PS are indicative only.

- 9.4.6.3 The Contractor shall submit to the Employer's Representative a comprehensive Integrated Testing & Commissioning Plan as required by the PS. The plan shall be submitted on a logical section-by-section basis, using a "top-down" approach describing the testing and commissioning strategies and processes clearly showing how these serve to provide the full verification of the systems and equipment in context of the complete railway system.
- 9.4.6.4 The Contractor shall co-ordinate with the Employer and the Employer's Representative and with all interfacing parties to ensure that the proposed test programme and schedule truly demonstrate that the full specified performance requirements are achieved.
- 9.4.6.5 The tests shall include, but shall not be limited to the following:-
- (1) test of all functional and performance requirements for the system;
  - (2) test to demonstrate compliance with all interface specifications; and
  - (3) test of behaviour under failure conditions (e.g. changeover to redundant hardware, initiation of re-configuration functions or reversionary modes of operation, recovery of systems and equipment from failure, demonstrations of planned emergency procedures, etc.).
- 9.4.6.6 The Integrated Testing & Commissioning Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass/fail criteria, sample records, resources to be made available, drawings and records to be submitted to the Employer's Representative, and a programme showing the dates for testing and for submission of each test procedure.
- 9.4.6.7 Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.
- 9.4.6.8 Immediately following the successful Integrated Testing & Commissioning of the system or any constituent part, the Contractor shall complete the appropriate commissioning records in the agreed format and submit 3 signed copies to the Employer's Representative.
- 9.4.6.9 The Contractor shall include a complete schedule of all Integrated Testing & Commissioning records and their current status within the Monthly Progress Report.
- 9.4.7 **Service Trial**
- 9.4.7.1 Service Trial is defined as the final test of the fixed equipment, the rolling stock, and the operational procedures including the final elements of the Tests on Completion to demonstrate that the system in its entirety can operate satisfactorily. The Service Trial is performed by the Employer with attendance by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. During this phase, the system will be run to the published timetable but without fare-paying passengers. This phase also allows for Validation of the training procedures in a real time environment.
- 9.4.7.2 The Commissioning Team in conjunction with the Employer will develop the Service Trial Plan. Operations Department and will serve to organise and co-ordinate all on-Site activities.



- 9.4.7.3 The particular requirements for tests to be undertaken during the Service Trial are prescribed in the PS / TS.
- 9.4.7.4 The Contractor shall provide special and general attendance to the Employer and the Employer's Representative during the Service Trial period as required by the PS / TS.
- 9.4.7.5 The Contractor shall co-operate with the Employer and the Employer's Representative and with all interfacing parties to ensure that the proposed Service Trial programme and schedule truly demonstrates that the full, specified performance requirements and operating parameters are achieved.
- 9.4.7.6 The Contractor shall review and comment on the Employer's Representative's Service Trial Plan and shall identify specifications, standards, method statements, procedures, pass / fail criteria, to the Employer's Representative for inclusion in the Plan.
- 9.4.7.7 The Contractor shall not interfere with the Service Trial tests and Validations in any manner. Any need for remedial works required to be performed by the Contractor shall be co-ordinated with the Employer and the Employer's Representative in advance.
- 9.4.7.8 Immediately following the successful tests of the system or any constituent part during Service Trial the Contractor shall complete the appropriate commissioning records in the agreed format, submit 3 signed copies to the Employer's Representative and may then apply for the Taking Over Certificate in accordance with the requirements of the GCC.
- 9.4.7.9 The Contractor shall include a complete schedule of all Service Trial records and their current status within the Monthly Progress Report.

## **9.5 Activity of the Employer and the Employer's Representative**

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

## **9.6 Records and Reports**

- 9.6.1 The Contractor shall submit to the Employer's Representative for review not less than six (6) months before commissioning activities commence his proposed format for the commissioning records. The records shall be appropriately sub-divided to make provision for the various parts of the Permanent Works covered by the Contract.
- 9.6.2 The format of the records shall cover all mechanical and electrical tests, provide positive identification by serial number for assemblies and sub-assemblies of the Permanent Works and show modifications to Employer's Drawings and diagrams or "as built" data to be certified by the Employer or the Employer's Representative in the course of installation, testing and setting to work of the Works.

- 9.6.3 The Contractor shall, during the execution of the Works, prepare such reports and records of manufacture, installation and testing as may be required in order that a licence may be issued or statutory requirements may be met or approval given. Such reports or records shall be adequate to enable each part of the Permanent Works to be commissioned and to meet the requirements of the licensing authority or any standing statutory regulations, and shall be reviewed by the Employer and the Employer's Representative.
- 9.6.4 The Contractor shall obtain reports of each inspection and/or test. Such reports shall show the results of all the inspections and/or tests carried out and shall certify that the work has been inspected and/or tested in accordance with the requirements of the Contract and that the work complies with the requirements of the Contract.
- 9.6.5 Any analysis of the results required to confirm that the work complies with the requirements of the Contract shall be compiled and reported to the Employer's Representative in accordance with Chapter 4.
- 9.6.6 A representative of the Contractor who has been allocated the required authority under the relevant quality plans shall sign each report of inspection and/or test.
- 9.6.6.1 Each report of inspection and/or test shall include the appropriate details of:-
- (1) the description of the item or goods subjected to the test or inspection;
  - (2) if applicable, the batch from which the samples were taken for test, the size and description of samples and the method of sampling;
  - (3) the place of testing;
  - (4) the date and time of tests;
  - (5) the environmental conditions;
  - (6) the technical personnel supervising or carrying out the test or inspection;
  - (7) the properties tested or inspected;
  - (8) the method of testing or inspection;
  - (9) all relevant checklists and work sheets used during the inspection and/or test, including the readings and measurements taken during the tests; and
  - (10) the test results, including any calculations and graphs.
- 9.6.7 After Commissioning of a part of the Works, the Contractor shall complete each commissioning record in the agreed format and shall forward copies of the record to the Employer's Representative for review.
- 9.6.8 The Contractor shall submit within its Monthly Progress Report a complete schedule of his commissioning records showing completion dates, target completion dates and status.



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

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

**9.6.10 Quality Control Register**

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

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

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

**9.7 Test Equipment and Facilities**

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

- i. Laboratory test instruments.
- ii. Special test equipment, emulators, simulators and test software, to permit full testing of System functions and performance.
- iii. Other items of the System, specified elsewhere as being part of the Contractor's supply, even if not part of the Subsystem under test.
- iv. Consumables.

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

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

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

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

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

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

## **9.8 Witnessing by the Employer and the Employer's Representative**

### **9.8.1 Notice for Trial, Inspection and/or Test to the Employer's Representative**

- 9.8.1.1 In relation to all Quality Control Points and Quality Hold Points involving inspection and/or testing by the Contractor, the Contractor shall give the Employer's Representative notice of when the relevant work will be inspected and/or tested using the form of this Specification. The period of notice shall be as stated in the PS or such period as in the opinion of the Employer's Representative is reasonable and notified to the Contractor. In the absence of any such statement or notice, a reasonable period of notice shall be given by the Contractor provided that:

- (1) in the case of on-Site work, such notice shall be given not less than 72 hours of normal working time before the work is to be inspected and/or tested;
- (2) in the case of work carried out off-site in Lucknow, such notice shall be given not less than 5 days before the work is to be inspected and/or tested; and
- (3) in the case of work carried out outside Lucknow, such notice shall be given not less than 14 working days before the work is to be inspected and/or tested.

- 9.8.1.2 In relation to all inspection and/or testing notified by the Contractor, the Employer and the Employer's Representative may elect to witness such inspections and/or tests but the Contractor may proceed with the inspections and/or tests notwithstanding the absence of the Employer or the Employer's Representative or of any response to the said notice.

- 9.8.1.3 If the Contractor is in any doubt whether inspection and/or testing by the Employer's Representative is required as a Quality Hold Point, the Contractor shall request that the Employer's Representative clarifies his requirements prior to submitting the relevant inspection and testing plan for review, and in any event not later than 30 days.

### **9.8.2 Timing for Inspection and/or Test by the Employer and the Employer's Representative**

- 9.8.2.1 The Contractor shall allow the Employer and the Employer's Representative a reasonable time to carry out any inspection and/or testing and to assess the result of any inspection and/or test before proceeding with the Works.

- 9.8.2.2 Unless the Employer's Representative's prior review without objection has been obtained, all inspections and/or tests to be carried out or witnessed by the Employer and the Employer's Representative shall be carried out between 0800 and 1800 hours.

### **9.8.3 Failure to Notify the Employer's Representative**

The Employer or the Employer's Representative may reject the test and test results in question, and require the test to be repeated in the event of any failure by the Contractor to notify the Employer's Representative in accordance with clause 9.8.1.1 above.

## **9.9 Failures**

- 9.9.1 The Contractor shall correct all faults found during testing, and shall arrange for the relevant tests to be repeated. The relevant tests shall only be repeated when the fault has been remedied and the equipment demonstrated to function correctly.
- 9.9.2 Where remedial measures involve significant modifications that might, in the Employer's Representative's opinion, affect the validity of earlier tests, the Contractor shall repeat the earlier tests and obtain results satisfactory to the Employer and the Employer's Representative before repeating the test in which the fault was first identified.
- 9.9.3 The Employer or the Employer's Representative shall have the right to order the repeat or abandonment of any test in the event that results demonstrate that the equipment is significantly non-compliant with the Contract.
- 9.9.4 The Employer or the Employer's Representative shall have the right to suspend any test in the event that errors or failures have become unacceptable. The Employer or the Employer's Representative shall also have the right to suspend any test if a fault was detected by the Contractor but not reported to the Employer's Representative within 24 hours of the detection. In this event, the suspension shall remain in effect until reporting has been brought up to date to the satisfaction of the Employer and the Employer's Representative.

## **9.10 Repeat Tests**

- 9.10.1 The Contractor shall correct and re-test every fault detected during the tests.
- 9.10.2 If the test results in a failure of the item under test the provisions of GCC Clause 7 shall apply.

## **9.11 Fault Categories**

- 9.11.1 Deleted

## **9.12 Fault Log**

- 9.12.1 The Contractor shall maintain a fault log throughout each series of tests. Every fault detected during the tests will be entered in the log, together with the actions taken to clear and re-test the fault.
- 9.12.2 The fault log will be retained as part of the permanent quality assurance record for the system and be subject to regular inspection by the Employer's Representative.

## **9.13 Hardware Failure Reports**

- 9.13.1 For each hardware failure that occurs at any stage of testing, the Contractor shall investigate the failure and prepare a report on its cause(s) and implications, if any, resulting from such failure. The report shall clearly show:
- (1) the observed symptoms;
  - (2) the most likely cause of the failure;
  - (3) the fault category

- (4) an analysis of any stress that may have been caused to other components of the equipment being tested as a result of the failure;
- (5) whether the failure is a result of any component operating outside its range; and
- (6) whether any design changes should be made to avoid further failures.

9.13.2 All such reports will be retained as part of the permanent quality assurance record for the system, which shall be subject to inspection by the Employer's Representative.

#### **9.14 Software Failure Reports**

9.14.1 For each software failure that occurs, once the software has been reviewed without objection for inclusion into the system and is subject to configuration control, the Contractor shall generate a software failure report.

9.14.2 All such reports will be retained as part of the permanent quality assurance record for the system, which shall be subject to inspection by the Employer's Representative.

9.14.3 The report shall clearly show:

- (1) the observed symptoms;
- (2) the likely cause;
- (3) the fault category (from Table 9.1); and
- (4) the operator input.

9.14.4 The report shall also clearly show the following information which shall be entered when the failure has been investigated:

- (1) the actual cause of the failure;
- (2) the corrective action taken; and
- (3) all software modules affected at the location
- (4) all similar software modules used in the project.

## CHAPTER 10

### 10. TRAINING

#### 10.1 Training Requirements

- 10.1.1 The Contractor shall provide comprehensive training to the Employer's staff to enable all of the systems and equipment supplied, installed or modified as part of the Works to be operated and maintained in the designed manner safely and efficiently so as to achieve the maximum reliability and economy, and to meet the requirements of the Employer's programme.
- 10.1.2 To achieve the objective, it will be necessary to train the Employer's staff, including Employer's Training Instructors (ETI). The Contractor shall submit to the Employer's Representative for review and critique the range of staff for which training is recommended and a Training Plan to be proposed for the Employer in accordance with clause 3.7.4 above.
- 10.1.3 The recommendation shall include details of training equipment necessary and appropriate to achieve the training objectives.
- 10.1.4 The Training Plan shall provide a structured training programme to educate and train the personnel of the Employer in all aspects of the system operation and maintenance and shall include, but not be limited to, the following:
- (1) schedule of training courses;
  - (2) objective, syllabus, format, class size and duration of each training course;
  - (3) training facilities to be provided by the Employer;
  - (4) list of training materials and documentation to be included with the training course;
  - (5) method of pre- and post- testing to be utilised;
  - (6) qualifications and experience level necessary for the trainees;
  - (7) instructor's qualifications; and
  - (8) course evaluation methods.
- 10.1.5 Courses offered shall be suitable for operations and maintenance staff classified below as distinct from engineering staff:
- (1) first line and second line maintenance staff undertaking recovery/corrective and routine/preventive maintenance;
  - (2) third line (high skill level) maintenance staff specialised in workshop repair and overhaul of equipment; and
  - (3) technical support staff specialising in fault analysis and investigation techniques associated with the particular type of equipment.

10.1.6 Training shall, as a minimum, impart the following techniques to the Employer's staff of the appropriate grades:

- (1) all planned maintenance and overhaul of the systems and equipment supplied, installed or modified under the Contract;
- (2) fault finding and rectification techniques for the systems and equipment supplied, installed or modified under the Contract. These shall be developed from the Contractor's previous experience with similar equipment and also from the fault tree analysis and other analyses carried out as part of the reliability engineering studies undertaken by the Contractor;
- (3) normal and degraded modes of operation of the systems and equipment supplied, installed or modified under the Contract;
- (4) all rules, regulations, practices and procedures necessary for the safe and efficient operation of the systems and equipment supplied, installed or modified under the Contract; and
- (5) all contingency plans necessary to recover speedily and safely from any mishaps or emergencies that may arise with the systems and equipment supplied, installed or modified under the Contract.
- (6) Shall include system assembly, installation, maintenance and software modification / customisation and training of Employer's personnel to cover the systems/subsystems as specified in Particular Specifications.
- (7) training shall essentially include the following aspects as a minimum:
  - Engineering or extensions and up gradations of the system.
  - Re-engineering to suit changed traffic conditions.
  - Incorporation of optional facilities.
  - Any other configuration/programmes required for maintenance/upgradation of hardware/software.

10.1.7 Training shall be carried out in the medium of the English language and supplemented, if necessary, in the Hindi language.

## **10.2 Training Method**

10.2.1 Training shall consist of classroom (theory) training, computer based interactive multi-media training (CBT) and practical (hands on) training.

10.2.2 The training shall take place in Lucknow, unless there are prohibitive reason(s), and shall be related to Permanent Works that are to be or are being installed on the Project.

10.2.3 The training in Lucknow shall be supplemented, where appropriate, by training at the Contractor's own premises and the premises of the major sub-contractors during the manufacturing and factory testing phases of the Works. Maximum use shall be made of the opportunities presented during equipment

testing phases of the Contract to demonstrate and practise fault finding and diagnostic techniques.

10.2.4 To meet this need, the Contractor shall supply competent trainers/instructors to carry out training to a high degree of proficiency in areas where the Contractor has the specialised knowledge.

10.2.5 In order to ensure that satisfactory standards are met, the Employer's relevant Operations/Maintenance Department in liaison with the Training Department will monitor all training.

10.2.6 During the Defects Liability Period, when the Contractor is responsible for fault-finding and repair, he shall provide practical hands on training to the Employer's maintenance staff to facilitate the successful hand over of this function.

10.2.7 Where applicable, the Employer will pay all of his staff's salaries, travelling, subsistence and other related allowances.

### **10.3 Employer's Instructor Training**

10.3.1 The Contractor shall provide training courses and training materials to train the Employer's Training Instructors (ETI) to a level of competence to allow the ETIs to subsequently train the Employer's staff in all aspects of operation and maintenance of the systems and equipment supplied, installed or modified as part of the Works.

10.3.2 For Maintenance Instructors, this shall include specific training in the use of maintenance documentation, all faultfinding guides and any special gauges, instrumentation or test equipment required in any maintenance or fault finding and analysis.

10.3.3 For Operations Instructors, this shall include training in the operation of the equipment and the various systems/sub systems under both normal and fault conditions.

### **10.4 Training Plant & Equipment**

10.4.1 With the prior review of the Employer's Representative, the Contractor may use the Permanent Works being erected, tested or commissioned for the training of the Employer's staff. In general, the Contractor shall not use Contract Spare parts for this purpose.

10.4.2 Training course notes shall be entirely compatible, and, where appropriate, cross-referenced to the manuals supplied by the Contractor as part of the Operation and Maintenance documentation.

10.4.3 The Contractor shall provide such written or printed matter, functional equipment, samples, models, cutaway equipment, slides, films and other instructional materials as may be necessary for training. Such equipment and material shall remain the property of the Employer and shall be sufficient both for the persons trained by the Contractor and for those to be subsequently trained by the ETI.

10.4.4 The Contractor shall provide an instructor's guide for each training course. The guide shall include the course agenda, objectives, list of resources and facilities required, detailed lesson plans, presentation notes, discussion guides, training aids and job aids, test papers, criteria and methodology for testing



and assessment, and all other things that will enable the ETI to carry out repeat or refresher courses in the future.

10.4.5 Not used

10.4.6 All training course notes and instructor's guides shall be in a form that allows for easy reproduction.

10.4.7 All training course notes and instructor's guides shall be in a standard format as set out by the Employer.

## **10.5 Testing and Assessment**

10.5.1 The Contractor shall, at the conclusion of each training course, issue questionnaires to, and/or set practical tests for all trainees directed at determining the level of satisfaction with the course content and to assess the level of knowledge and understanding of the course content by each trainee.

10.5.2 The Contractor shall review the responses to questionnaires and the trainees' test results and forward a summary to the Employer's Representative.

10.5.3 If the Employer's Representative considers that the course has not achieved the required objectives, he will advise the Contractor who shall then organise and implement appropriate re-training.

## **10.6 Training Records**

10.6.1 The Contractor shall, at the completion of each training course:

- (1) provide the Employer's Representative with a consolidated training record listing the training course title, date of training, name of all trainees, training result and other relevant information; and
- (3) issue an appropriate certificate to each trainee who has successfully completed the course.

## **10.7 Transfer of Technology**

10.7.1 Tenderer shall submit the detailed plan of transfer of technology along with MOU with suitable Indian companies or company having proven track record and working in related areas for major systems / subsystems in accordance with clause 10.7 of GS.

10.7.2 TOT shall be essential and shall include system assembly, installation, maintenance and software modification / customisation and training of Employer's personnel to cover the systems/subsystems as specified in Particular Specifications

10.7.3 TOT shall be essential and shall include the following aspects as a minimum:

- Engineering or extensions and upgradation of the system.
- Re- Engineering to suit changed traffic conditionins
- Incorporation of optioanal facilities.
- Any other configurations / programmes required for maintenance/upgradation of hardware/software.



- 10.7.4        The Transfer of Technology shall require involvement of Employer's personnel in each of sub-systems during the contract period. The sponsored engineers shall be under the technical administrative control of the contractor. It is tentatively proposed to deploy 2 No. Employer's personnel for this purpose.
- 10.7.5        The contractor shall undertake to supply or make arrangement with the original manufacturer to supply additional equipment required for replacement or expansion of the network in future.
- 10.7.6        The contractor shall undertake to provide, if required during the life of the equipment ordered, technical assistance in the form of additional drawings, maintenance practices and technical advice.

## CHAPTER 11

### 11. OPERATION AND MAINTENANCE DOCUMENTATION

#### 11.1 General

- 11.1.1 The Contractor shall supply Operation and Maintenance documentation in respect of the systems and equipment supplied or installed or modified under the Contract in accordance with the requirements of the following clauses, except where expressly specified otherwise in the Contract.
- 11.1.2 All Operation and Maintenance Manuals produced by the Contractor shall conform to the requirements of the Employer. The Contractor shall interface with the Employer for the requisite format.
- 11.1.3 The Contractor shall supply all documentation, including Operation and Maintenance Manuals and "as-built" drawings, necessary for operating, maintaining, repairing and modifying the systems and equipment supplied, installed or modified under the Contract.
- 11.1.4 Except where otherwise stated, the Contractor shall provide one electronic copy, eight bound copies and one unbound copy of all documentation. The unbound copy will be used by the Employer for reproduction purposes. All documentation shall be in the English language.
- 11.1.5 The Operation and Maintenance Manuals shall be provided in the English language.
- 11.1.6 The Contractor shall fully co-ordinate and cross-reference interfaces and areas associated with interconnecting equipment and systems within the Contract. The Operation and Maintenance Manuals shall fully describe the overall operation of all systems incorporating all equipment.
- 11.1.7 The Operation and Maintenance Manuals shall contain no irrelevant or ambiguous information and shall relate specifically to this Contract.
- 11.1.8 The Contractor may use manufacturer's data and handbooks for individual items of E&M equipment that are a sub-component of the overall system, including printed circuit boards, providing they meet the intent of the Specification, and are integrated by the Contractor into the description of his equipment, and are indexed accordingly in his own general index. All such documentation shall be contained in similar binders.
- 11.1.9 Where a sub-assembly item is of such a nature that local repairs in Lucknow/India cannot be made and it is necessary to be returned to the manufacturer as a unit for overhaul, the specific information concerning its repair and breakdown into component parts shall be provided.
- 11.1.10 The document shall be collated and numbered in proper order and correspond to the contents and index tables. Nomenclature or references to any items of equipment, diagrams, figure numbers or units shall be consistent throughout the text. In order to comprehend the text, diagrams, drawings, sketches and actual photographs shall be added where necessary. All manufacturers' literature identification codes or stamp markings shall be omitted. Precautions and warnings regarding the safety of life and equipment shall be included where applicable.

## **11.2 Arrangement and Format of Manuals**

11.2.1 The Contractor shall arrange all documentation in accordance with the Employer requirements.

11.2.2 The Contractor shall provide documentation for all hardware and software for computer systems and other associated electronic equipment to meet the following requirements. Such documents shall include but not be limited to:

- (1) manufacturers' documentation supplied as standard with the equipment;
- (2) hardware configuration with details of expansion capabilities and options;
- (3) programme loading instructions, including runtime environment configuration;
- (4) 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;
- (5) flow charts, data flow diagrams and state diagrams as appropriate;
- (6) description of software modules including purpose, linkage with other modules, error routines and any special considerations;
- (7) memory maps for both internal and peripheral memory showing description of all programmes, data files, overlay areas, memory available for expansion and the like;
- (8) loading and operating instructions for diagnostic programmes and specifically developed debugging tools; and
- (9) programming manuals relevant to operating systems, languages, development tools, etc.

11.2.3 The documentation shall in all respects be entirely sufficient to allow any competent software programming organisation to undertake programme and/or system modifications without recourse to the Contractor. These requirements shall apply in respect of microprocessor based equipment and 'firmware'.

## **11.3 Drawings**

11.3.1 The Contractor shall submit such drawings as may be required for the operation and maintenance and repair of the Permanent Works by the Employer.

11.3.2 Information contained on the drawings shall include but not be limited to:

- (1) arrangement drawings for all sub-systems and individual items of equipment;
- (2) installation and fixing drawings for all sub-systems and individual items of equipment;

- (3) interface drawings for all sub-systems and individual items of equipment;
- (4) schematic drawings for all electrical, pneumatic, hydraulic, water and drainage systems;
- (5) sizes, material and finish of all fixtures and threads;
- (6) manufacturer's code, drawing and reference numbers;
- (7) wiring diagrams to BS EN 60617, BS 3939 and BS 376 including internal wiring of sealed unit items;
- (8) setting dimensions and tolerances; and
- (9) bill of materials.

11.3.3 Where instructed by the Employer's Representative, drawings shall be supplied with Hindi language notation in addition to English. The Employer's Representative will supply such Hindi notation to the Contractor.

#### **11.4 Submissions**

11.4.1 The Contractor shall deliver all documentation to the Employer's Representative by the date stated in the PS, or, if none is given, not later than six (6) months prior to the issue of the Taking Over Certificate for the Works (for the final draft version), and one (1) month prior to the issue of the Taking Over Certificate for the Works (for the final version). The delivery shall include a copy of the software and licence to operate the software to modify the manuals together with one set of CADD drawing files. The final manuals shall incorporate comments made by the Employer's Representative on the draft manual.

11.4.2 Drawings shall be submitted to the Employer's Representative as stated in the PS. The submission shall be in accordance with stage commissioning requirements specified in the Works Programme and shall include two 35mm microfilms and/or Compact Discs (CD) for each drawing.

11.4.3 Following the Employer's Representative's review, the Contractor shall make a final submission of the complete Operation and Maintenance Manuals and as-built drawings in a form and in a quantity specified in the PS. The final submission shall be made not later than the date set by the Employer's Representative. The type of binder used to bind the Operation and Maintenance documentation shall be of a design, which will permit all changes and additions to the said documentation to be readily collated therein. The Contractor shall make such amendments to his submissions as may prove necessary during commissioning of the Permanent Works and the Defects Liability Period. Amendments found necessary during commissioning shall be completed within two months after the issue of the Taking Over Certificate for the Works. Subsequent amendments shall be completed two months prior to the issue of the Defects Liability Certificate.

#### **11.5 Operation and Maintenance Manuals**

The Employer shall have the right to reproduce any part or the whole of any Operation and Maintenance Manual as he wishes for his O and M requirements.

LKE(02)-02: Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 02 (two) Years Defect Liability Period (DLP) and 01 (one) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.

## CHAPTER 12

### 12. SUPERVISION AND PLANNING OF MAINTENANCE

#### 12.1 Scope

- 12.1.1 The Contractor shall be responsible for the supervision of maintenance of the equipment supplied under the Contract after the Employer's Taking Over of the Works or Part of the Works. The maintenance personnel shall be provided by the Employer.
- 12.1.2 The responsibility for the provision of supervision of maintenance shall be based on the number of man-months identified during the Tender period and incorporated into the Contract. The actual utilisation of these man-months shall be at the Employer's discretion and may be at any time up to six months after the Employer's Taking Over of the whole of the Works or the last part of the Works or the date of issuing of the Performance Certificate whichever shall be the later.
- 12.1.3 The scope of maintenance activities shall include all scheduled and unscheduled maintenance required including all routine inspections and service overhauls at trackside, on trains and in workshops. Maintenance work shall include faultfinding following report of incidents and repair of items of equipment changed out in the course of fault rectification but excluding any Contractor's liability for work to be carried out under the requirements of the Defects Liability Period.

#### 12.2 Maintenance Planning & Management Staff

- 12.2.1 The Contractor shall undertake the necessary tasks in planning the maintenance activities to ensure that the reliability of the operating railway is upheld including but not limited to:
- (i) Provide recommendations in respect of philosophy and procedures for repairs of electronic systems, including PCBs, and the scale of facilities required to be set up in the Depot and Workshops for this purpose.
  - (ii) Preparation of detailed operational plan for the routine servicing of any equipment which requires such service. The plan shall ensure that all items in use receive maintenance within the required time cycle by suitably trained and qualified staff and under the personal safety regime appropriate to the location of the equipment being maintained.
  - (iii) Preparation of a detailed staffing for each and every different inspection, overhaul and repair activity. The plan shall also identify and quantify resources required by staff and groups of staff in terms of tools, tackle, protective clothing, etc..
  - (iv) Preparation of a detailed quality plan, covering all maintenance activities. Based on the plan it shall be possible for the maintenance organisation to obtain ISO-9002-2002 certification.
  - (v) Preparation of a computer based Stores management Plan, which shall assist the management, ensuring a timely availability of spares, tools and consumable materials with a low level of inventory.

- (vi) Setting in position a computerised defects and failure analysis and documentation system, based on FMEA principles for all systems, sub-systems and components including individual PCBs.
- (vii) Efficient supervision of the maintenance, overhaul and repair activities of maintenance staff to ensure high quality work and productivity. This shall also include planning and supervision of ongoing training and re-training as required in the correct procedures using the training materials and courses supplied under the Contract. Where the supplied training courses are insufficient the Contractor shall develop additional training courses, manuals and materials to make good the deficiency as part of his Defects Liability responsibilities.

### **12.3 Supervisory Staff**

- 12.3.1 The Contractor shall provide supervisory maintenance staffs who are experts in the first and third line faultfinding, maintenance and repair of the various systems supplied under the Contract:
- 12.3.2 The experts provided for supervision of maintenance shall have adequate qualifications and experience in the relevant discipline in the maintenance depots / workshops of existing metro type undertakings.
- 12.3.3 The deployment of the experts may not be continuous and they may be required to supervise the maintenance in short periods at the discretion of the Employer.
- 12.3.4 The experts shall be available in Lucknow at short notice to supervise the Employer's staff at any time during the Normal Operating hours and by arrangement to undertake extended investigations during Non-Revenue hours.

## CHAPTER 13

### 13. SUPPLY OF SPARE PARTS, SPECIAL TOOLS AND TEST EQUIPMENT

#### 13.1 Details of supply

13.1.1 Deleted

13.1.2 Deleted

13.1.3 The Contractor shall submit to the Employer's Representative for review, in the format of a contract spares schedule, in accordance with Chapter 4 above, a list of:

- (a) the Spare Parts to be supplied by the Contractor as part of the Works to suit stage, categorised into individual parts or sealed units; and
- (b) the Special Tools and Test Equipment to be supplied by the Contractor as part of the Works to suit stage.

Such list shall be an amplification and confirmation of the list supplied with the Tender, as may have been subsequently modified during the Tender period, and shall be amended as necessary to reflect changes that may have occurred since the date of the Letter of Acceptance.

13.1.4 The Contractor shall use separate sets of contract spares schedules for different sub-assemblies of the main assembly / equipment.

13.1.5 The information supplied in respect of each spare part or special tool shall include, but not be limited to, the following:

13.1.5.1 core data - main assembly/equipment

- (i) manufacturer / brand name
- (ii) manufacturer's type/model number
- (iii) rating
- (iv) serial number if applicable
- (v) total number of the main assembly/ equipment supplied under the Contract

13.1.5.2 core data - sub-assembly of main assembly/equipment

- (i) manufacturer / brand name
- (ii) manufacturer's type/model number
- (iii) rating
- (iv) serial number, if applicable

(if items (i) to (iv) above are different from those of the main assembly/equipment)



- (v) total number of sub-assembly in the main assembly/equipment supplied under the Contract

#### 13.1.5.3 Individual item of main/sub assembly/equipment

- (i) manufacturer order number
- (ii) parts description - a full description of the Spare Part, including a note as to whether it is a sealed unit or whether it is an assembly or sub-assembly which can be broken-down into component parts
- (iii) manufacturer / brand name
- (iv) the manufacturer's part number (if different from the ordering number)
- (v) the sub-contractor's ordering part number/reference, if applicable
- (vi) recommended quantity
- (vii) unit of measurement
- (viii) unit price CIF to Lucknow including delivery to designated location amount (quantity multiplied by unit price)
- (ix) total number of the Spare Part in the sub-assembly of the main assembly/equipment supplied under the Contract
- (x) total number of the Spare Part in all the sub-assemblies of all the main assemblies/ different equipment supplied under the Contract

The Contractor shall ensure that the ordering part numbers specified shall enable the Employer to procure the exact item in future without reference to the Contractor.

#### 13.1.5.4 **primary data**

- (i) parts catalogue number/cross reference (illustrated parts catalogues to be submitted together with the contract spares schedules to the Employer's Representative)
- (ii) drawing number

#### 13.1.5.5 **secondary data**

- (i) lead times stating whether for ex-stock or for product manufactured upon receipt of order.
- (ii) delivery schedule(s).
- (iii) supplementary information:
  - a) special handling instruction, e.g. for fragile materials, hazardous substances, radioactive materials, etc.
  - b) storage requirement, e.g. overall dimensions including special packing (if any) for bulky materials, materials with limited shelf life, etc.
  - c) statutory requirements, e.g. licences, test certificates, etc.

- d) interchangeability information
- e) tailor-made product for the Contract or a standard bought-in product
- f) the source of the Spare Part or Special Tool and Test Equipment, including the manufacturer's name and address together with that of his Lucknow agent
- g) Supplementary sheets to be used for detailed information that is important to the Employer's future procurement.

## **13.2 Manufacture and delivery of Spare Parts**

- 13.2.1 All Spare Parts shall be manufactured, works tested and inspected in accordance with the relevant quality system, suitably packed and labelled in accordance with Chapter 8 above, and delivered to the Employer by the Contractor. Before the Spare Parts are delivered to the Employer, the Contractor shall submit to the Employer's Representative a shipment advice notifying details such as date of despatch, date of arrival, vessel name, etc. as well as a packing list to indicate the contract number, variation order number, the lot size, quantity and weight. The Spare Parts shall be consigned to the Employer and delivered in accordance with The Employer's Representative's instructions to a programme which shall ensure that sufficient Spare Parts are delivered to facilitate normal routine maintenance of the Permanent Works by the Employer at all stages of completion.
- 13.2.2 Spare Parts shall be fully interchangeable with their corresponding part. All Spare Parts shall be configured to the latest revision during the Defects Liability Period. For Spare Parts such as electronic components, lamps, fuses and other consumable and high-use items, the Contractor shall ensure that a minimum of two alternative sources of supply are available.
- 13.2.3 An adequate supply of Spare Parts shall be available throughout the design life of the Works, from the date of the Employer's Taking Over of the Works. The Contractor/OEM undertakes to notify the Employer at least 6 months prior to deleting any item used in the Works from general availability.
- 13.2.4 For any Spare Parts that the Contractor/OEM is unable to supply throughout the design life of the Works, or where the Contractor ceases availability support of that item before the end of such design life or if the Contractor ceases trading, the Contractor undertakes to transfer the relevant intellectual property rights, design rights and technology to the Employer and the Employer shall have the full right to manufacturing drawings, schedules, software and any other information needed to manufacture the relevant item. Such rights shall give the Employer complete freedom to manufacture the item in Lucknow or anywhere else world-wide. The Contractor shall also undertake to notify the Employer two years in advance of the intended cessation of spares availability of any item.
- 13.2.5 If any Spare Part is rendered obsolete by a design change or material change during the design life of the Works supplied under the Contract, the Contractor shall design a replacement item to match the identical mechanical and electrical interfaces as the former item.
- 13.2.6 If, as a result of changes in technology, any Spare Part is not completely interchangeable with the original item, or the performance of any Spare Part

is different from the original item, then the Contractor/OEM shall purchase the same from the Employer, at a price agreed between the parties, such quantities of the obsolete Spare Part as the Employer may possess.

13.2.7 The contractor shall furnish an undertaking that he has no objection whatsoever and shall not in any way deter or obstruct the Employer, its licensee or its representative from dealing directly with the OEMs for purchase of the Spares during the service life of the equipment. Such an undertaking has to be submitted at the time of Vendor approval.

13.2.8 Contractor shall obtain an undertaking from all OEMs approved by the Engineer under the contract at the time of Vendor Approval that they will deal directly with Employer for Supply of Spares, Equipment and/or sub-system or any required technical support if the Employer so desires. The Employer shall have the option to procure as many Spares Parts as desired at a reasonable cost.

### **13.3 Contract Spares**

13.3.1 **Deleted**

13.3.2 **Deleted**

13.3.3 **Deleted**

13.3.4 Deleted

13.3.5 Deleted

13.3.6 Deleted

13.3.7 Deleted

### **13.4 Commissioning Spares**

13.4.1 In addition to the Contract Spares, the Contractor shall keep on the Site under his own custody throughout the installation, erection and commissioning periods, sufficient stocks of Spare Parts to enable immediate replacement of any item in the Permanent Works found to be defective or in any way in non-conformance with the Specification during the installation, erection and commissioning period ("Commissioning Spares").

13.4.2 The Contractor shall supply and deliver the Commissioning Spares on or before the commencement of any Partial Acceptance Tests (PAT) or as defined in the PS.

13.4.3 Deleted

13.4.4 The Contractor shall not be entitled to use any of the Contract Spares to replace any item in the Permanent Works during the installation, erection and commissioning periods.

### **13.5 Defects Liability Spares**

13.5.1 In addition to the Contract Spares, the Contractor shall keep sufficient stocks of Spare Parts, in his own custody in an off-site location in Lucknow throughout the Defects Liability Periods to enable rapid replacement of any item in the Permanent Works found to require replacement as part of the Contractor's obligations during the Defects Liability Periods ("Defects Liability Spares").

13.5.2 **Deleted**

13.5.3 The Contractor shall submit to the Employer's Representative for review a list of all Defects Liability Spares that shall be maintained by the Contractor during the Defects Liability Periods.

13.5.4 The Contractor shall not be entitled to use any of the Contract Spares to replace any item in the Permanent Works during the Defects Liability Periods.

**13.6 Special Tools and Test Equipment**

13.6.1 The Special Tools and Test Equipment (together with the relevant calibration certificates) required to carry out all the functions described in the Operation and Maintenance Manual or as required by the PS shall be suitably packed and identified in accordance with Chapter 8 above, consigned to the Employer by the Contractor and delivered to the Employer in accordance with the Employer's Representative's instructions not later than the date scheduled for stage commissioning. The extent of supply shall include protective carrying cases as may be appropriate for the storage and use of each item.

13.6.2 All Special Tools and Test Equipment shall be supplied with Operation and Maintenance Manuals, complete diagrams, schematics, assembly and connection drawings, calibration instructions and circuit diagrams/descriptions for future maintenance.

13.6.3 Where the Contractor has used the Special Tools and Test Equipment for installation and commissioning of the Permanent Works, he shall refurbish and re-calibrate each item to the satisfaction of the Employer's Representative prior to handover to the Employer, accompanied by the Certificate of Calibration traceable to a recognised International or National standard.

13.6.4 Where any item of Special Tools and Test Equipment is provided by the Contractor, it shall be accompanied by drawings, manuals and full operating instructions to enable them to be used by suitably skilled (but not necessarily specially trained) personnel in a non-hazardous manner and to achieve the desired result in terms of accuracy and quality.

13.6.5 The Contractor shall provide the means and instructions which describe the parameters of each item of Special Tools and Test Equipment that are critical to their proper methods of use and which enable the Employer's staff using the Special Tools and Test Equipment to achieve the proper performance and operation. Such means and instructions shall include, but not be limited to, any routine checking or re-calibration needs for the Special Tool and Test Equipment itself.

**13.7 Coding and Tagging of Spare Parts and Special Tools and Test Equipment**

13.7.1 All Spare Parts and Special Tools and Test Equipment to be delivered to the Employer shall each carry a tag suitably marked, bar-coded (as directed by the Employer's Representative) and numbered.

13.7.2 The numbers on the tags shall correspond with those on the coding system developed by the Contractor for all E&M components, parts and equipment's. See also clause 7.3.1 above.

## CHAPTER 14

### 14. THE WORKS AND CARE OF THE WORKS

#### 14.1 Methods of Construction

- 14.1.1 The Contractor shall, as stated in the PS and in any case not less than 12 weeks before starting the construction of the Works on Site, submit to the Employer's Representative the Construction and Installation Plan as specified in Chapter 3 above.

#### 14.2 Temporary Works

Upon receiving a written application from the Contractor, the Employer's Representative may at his absolute discretion consent to certain Temporary Works of a minor nature being exempted from the requirements of this Chapter. Such exemption shall not relieve the Contractor of any of his obligations under the Contract.

#### 14.3 Normal Working Hours

- 14.3.1 Normal working hours shall be defined as the period between 0700 hours and 1900 hours on all days excluding General Holidays. Work outside normal working hours shall not be carried out unless reviewed without objection by the Employer's Representative and unless the Contractor has obtained any necessary permission or approval from Relevant Authorities.
- 14.3.2 The Contractor shall inform the Employer's Representative 24 hours, or such shorter period reviewed without objection by the Employer's Representative, in advance of any occasion when work outside normal working hours is proposed.

#### 14.4 Drawings and Schedules

Detailed manufacturing drawings for the Permanent Works will not normally be required to be submitted to the Employer's Representative for review but shall be available on the Contractor's or his sub-contractor's premises if required. The Contractor shall also maintain at the Site a comprehensive and up-to-date set of drawings properly indexed and catalogued, which shall include complete sets of detailed working and, where applicable, manufacturing drawings and shall permit free access to such drawings by the Employer's Representative at any reasonable time.

#### 14.5 Notification and Inspection of Works

- 14.5.1 The Works will be the subject of a formalised system of written applications for inspection.
- 14.5.2 Work that is carried out without being appropriately sanctioned by the Employer's Representative could be classified as defective work.

#### 14.6 Construction Restraints

- 14.6.1 The Contractor shall design and implement Temporary Traffic Management (TTM) in accordance with the provisions of the Enactment.
- 14.6.2 The Contractor shall ensure that the , construction and performance of all Temporary Works and the and construction of all Permanent Works shall be

such that any ground movements in and around the Site will not result in settlement and/or subsidence of the ground that will cause damage to any buildings, structures, rail, roads, footpaths, slopes or utilities.

- 14.6.3 The Contractor shall ensure that the method of installation of any part of the Permanent Works (prior to dewatering and excavation) minimises settlements in the adjacent ground or buildings. Dewatering of an excavation will not be permitted unless a closed perimeter of impermeable wall is complete.

#### **14.7 Protection from Water**

14.7.1 Deleted

14.7.2 Deleted

14.7.3 Deleted

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

#### **14.8 Protection from Weather**

14.8.1 Work shall not be carried out in weather conditions that may adversely affect the work unless protection by methods reviewed without objection by the Employer's Representative is provided.

14.8.2 The Permanent Works, including materials for the Permanent Works, shall be protected by methods reviewed without objection by the Employer's Representative from exposure to weather conditions which may adversely affect the Permanent Works.

#### **14.9 Protection of Work**

Finished work shall be protected damage that could arise from the execution of adjacent work. Work shall be carried out in such a manner that work carried out by others, including Government departments, utility undertakings, Relevant Authorities and Project Contractors, is not damaged.

## CHAPTER 15

### 15. SITE ESTABLISHMENT AND ATTENDANCE

#### 15.1 Use of the Site

- 15.1.1 The Site shall not be used by the Contractor for any purpose other than for executing the Works or carrying out other work which is associated with the Works and having been reviewed without objection by the Employer's Representative.
- 15.1.2 Deleted
- 15.1.3 All materials and equipment stored on Site shall be adequately protected against loss or damage due to any cause such as climatic effects, vandalism, shock and vibration, etc. according to the nature of the articles stored and the local Site condition.
- 15.1.4 The particular use to which the Site is put shall be submitted to the Employer's Representative for review with the following particulars:
- (1) drawings showing the layout within the Site of the Employer's Representative's and Contractor's accommodation, access roads and major facilities required early in the Contract;
  - (2) drawings showing the layout and the construction details of the Employer's Representative's accommodation; and
  - (3) proposals for the Employer's Representative's Site accommodation (if applicable) as defined by clause 15.4 below.

#### 15.2 Survey of the Site

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

#### 15.3 Fences and Signs on the Site

- 15.3.1 Hoardings, fences, gates and signs on and at the Site shall be maintained in a clean, stable and secure condition.
- 15.3.2 Project signboards stated in the Contract shall be erected not more than 28 days, or such other period reviewed without objection by the Employer's Representative, after the Commencement Date of the Works. Other advertising signs shall not be erected on the Site unless reviewed by the Employer's Representative.
- 15.3.3 The permission of the Employer's Representative shall be obtained before hoardings, fences, gates or signs are removed. Hoardings, fences, gates and signs which are to be left in position after Employer's Taking Over of the Works shall be repaired and repainted as instructed by the Employer's Representative.



#### **15.4 The Contractor's Site Accommodation**

- 15.4.1 The Contractor's offices, sheds, stores, mess rooms, latrines and other accommodation on the Site shall be maintained in a clean, stable and secure condition. Living accommodation shall not be provided on the Site unless stated in the Contract or having been reviewed without objection by the Employer's Representative. The Contractor's personnel shall not be allowed to live on the Site.
- 15.4.2 The Contractor shall provide and maintain all necessary offices, sheds, stores, mess rooms, latrines and other accommodation and remove the same from the Site on the Employer's Taking Over of the Works. These shall be to the satisfaction of the Employer's Representative and shall be kept in a clean and sanitary condition. No structure shall be erected by the Contractor within the Site without the written consent of the Employer's Representative and such consent will not relieve the Contractor of the responsibility of siting temporary structures clear of the Works.
- 15.4.3 A copy of the plan showing the extent and position of all offices, stores, sheds, etc. shall be prepared by the Contractor and retained for inspection in the Site office.
- 15.4.4 The Contractor shall also provide at its own cost and maintain at its own cost two (02) nos. four wheeler (not less than 2000cc and manufacture year should not be more than three years old along with drivers availability for 24 hrs a day) for delivery of DAK, Test samples, inspection etc. along-with 1 Steno/Draftsman, 1 office boy with computer for use/utilization by employer. The Computer, etc. provided by the contractor shall be taken back by the contractor after completion of project.
- 15.4.5 The Contractor shall not erect or operate canteen and kitchen facilities on the Site except with the consent of the Employer's Representative and, where appropriate, the Relevant Authorities. Any such facilities shall, in particular but without limitation, conform to all regulations and standards to the extent required by the concerned city authorities of UP Government.

#### **15.5 Site Utilities and Access**

- 15.5.1 Temporary clean drinking water, wash room with water, electricity, telephone, emergency transportation (Passenger vehicle) sewerage and drainage facilities shall be provided for the Employer's Representative's accommodation and for the Contractor's use in carrying out the Works. The Contractor shall make all arrangements with and obtain the necessary approvals from the Relevant Authorities for the facilities.
- 15.5.2 If, under the Contract, the Contractor is provided with Site utilities and access by any Other Contractor under the attendance of the same or another Other Contractor, the Contractor shall ensure that all requirements in terms of use of such facilities, their upkeep and maintenance, etc. are properly observed. If the facilities provided under such attendance are insufficient for the Contractor's bona fide needs, the Contractor shall be solely responsible for providing such additional facilities he may require for the execution of the Works.
- 15.5.3 Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, passable and stable condition.



## **15.6 Site Facilities for the Employer's Representative**

- 15.6.1 The Contractor will be required to provide suitable accommodation for Employer's representative in Contractor's site office/work site.
- 15.6.2 The accommodation for Employer's Representative shall include furniture, fan, air conditioner, drinking water facilities and suitable communication facilities.
- 15.6.3 In case of emergency the Contractor will be required to provide emergency transport facilities.
- 15.6.4 Office facilities and equipment provided for the use of Employer's Representative shall be maintained in a clean and suitable condition and all containers shall be replenished if required.
- 15.6.5 If any facility is to be removed/curtailed, the permission of the Employer's Representative shall be obtained.
- 15.6.6 The accommodation to be provided for the Employer's Representative can be used for the Contractor's staff associated with the Project, if necessary.
- 15.6.7 All accommodation and equipment for the Employer's Representative shall be provided throughout the course of the Works and for so long a period of time during the Defects Liability Period as the Employer's Representative may require.
- 15.6.8 The Contractor's proposals for the construction of the offices shall be submitted for review by the Employer's Representative within 14 days of the Commencement Date of the Works and erected within 42 days of the Commencement Date of the Works.
- 15.6.9 The Contractor shall, when advised in writing by the Employer's Representative, remove the accommodation and equipment, leaving the Site in a clean and tidy condition.

## **15.7 Clearance of the Site**

Temporary Works, which are not to remain on the Site after the Employer's Taking Over of the Works, shall be removed on the Employer's Taking Over of the Works or at such other time(s) as instructed by the Employer's Representative. The Site shall be cleared and reinstated to the lines and levels and to the same condition as existed before the Works started except as otherwise stated in the Contract.

## **15.8 Attendance**

### **15.8.1 Offices for the Employer or the Employer's Representative**

Unless otherwise stated in the Contract, the Employer or the Employer's Representative may supply his own temporary accommodation on the Site at locations indicated in the Contract or in writing. The Contractor shall afford, provide and maintain free and unhindered access to such Employer or the Employer's Representative's Site offices and parking areas and for the Employer or the Employer's Representative's Site officers, contractors and workmen as may be necessary for installation, inspection, maintenance, repair and removal of the aforesaid Employer or the Employer's Representative's Site offices and the services thereto.

### **15.8.2 Attendance on the Employer or the Employer's Representative**

The Contractor shall provide all necessary assistance to the Employer or the Employer's Representative, including adequate and safe means of access to

all parts of the Site to assist him in carrying out his duties and responsibilities under the Contract. Such assistance shall not include the provision of full-time attendance upon the Employer or the Employer's Representative.

**15.8.3 Attendance on the Commissioner of Metro Rail Safety or other inspecting authorities.**

15.8.3.1 The Contractor shall afford all necessary attendance upon the Commissioner of metro Rail Safety or other inspecting authorities Inspectorate during their inspections including adequate and safe means of access to appropriate parts of the Site.

15.8.3.2 The Contractor shall provide all documents necessary for inspection as are requested by the above authorities.

**15.8.4 Not used**

**15.8.5 Attendance on Other Contractors**

15.8.5.1 The Contractor shall provide general and special attendance on Other Contractors who will be carrying out the execution of electrical and mechanical and other works on the Site. Reference shall be made to the PS to determine the full extent of such attendance.

15.8.5.2 General attendance shall include but not be limited to providing for accepting deliveries, unloading and storing materials for the Other Contractors on the Site and allowing the Other Contractors space for their site offices, and all reasonable access and facilities for the proper execution of their work including the free use of access roads, craneage, scaffolding, ladders, stores, mess rooms, sanitary and welfare facilities provided that these facilities are normally available on the Site at the time.

15.8.5.3 Intentionally left blank

15.8.5.4 Special attendance shall include but not be limited to cutting of holes and other openings, forming chases, providing built-in sleeves, grouting in bolts, anchors, brackets, base plates, frames and the like, including making good to the disturbed work and cleaning after completion of the disturbed work.

**15.8.6 Attendance by Other Contractors**

15.8.6.1 Where provided for under the Contract, the Contractor shall receive attendance from Other Contractors. The Contractor shall ensure that by receiving such attendance, it does not hinder, obstruct or otherwise frustrate the Other Contractor that is providing the attendance in any way.

**15.9 Contractor's Equipment**

The Employer's Representative reserves the right to order the immediate removal and replacement of any Contractor's Equipment that, in his opinion, is unsatisfactory for its purpose.

**15.10 Security**

15.10.1 The Contractor shall be responsible for the security of the works area for Contractor's accommodation and shall provide and maintain fencing.

15.10.2 The Contractor shall provide adequate training to its security staff to ensure that they are able to discharge their security duties properly.

15.10.3 The Contractor shall establish and maintain contingency plans to cope with emergency situations such as fire, flooding, serious damage to the Works, etc.

- 15.10.4        The Employer's security staff will conduct inspections and security audits on the Site and the works area for Contractor's accommodation from time to time. The Employer's Representative will give recommendations for improvement arising from the inspections and security audits to the Contractor. However, managing the security of the Site and the works area for Contractor's accommodation remain the Contractor's responsibility.

## **CHAPTER 16**

### **16. LIAISON WITH OTHERS**

#### **16.1 Liaison with Others**

- 16.1.1 The Contractor shall make all necessary arrangements with and obtain the necessary approvals from Government departments, utility undertakings and other duly constituted authorities for the execution of the Works.
- 16.1.2 The Contractor shall maintain close liaison with Other Contractors and other contractors employed by the Employer, utility undertakings or other authorities who are carrying out work on or adjacent to the Site. The Contractor shall ensure as far as possible that the progress of the Works is not adversely affected by the activities of such other entities.

#### **16.2 Work by Other Contractors**

- 16.2.1 The contractor shall keep note of the works which may be proceeding on various adjacent areas by others include, but is not limited to, those listed in the PS. The Employer's Representative will keep the Contractor informed of forthcoming work by Other Contractors in the proximity of the Site.
- 16.2.2 The Contractor shall provide reasonable access to such contractors and any other adjacent contractors and shall where necessary liaise with the appropriate contractors, utility undertakings and other duly constituted authorities on details of interdependent phasing. The Contractor shall notify the Employer's Representative and other concerned entities at least 14 days in advance should he wish to alter these access arrangements during the course of the Works.

#### **16.3 Interface Management**

- 16.3.1 The Contractor shall co-ordinate with Relevant Authorities and Other Contractors in the execution of the Works.
- 16.3.2 The Contractor shall interface and liaise with Other Contractors to ensure the effective and compatible co-ordination of all aspects of the installation and testing of the Works. The Employer's Representative shall be kept fully informed at all stages of the Works.
- 16.3.3 The Contractor shall assign a person as the interface contact for each Other Contractor to actively manage the progress of each interface to ensure adherence to the jointly developed Interface Management Plan.
- 16.3.4 Throughout the process, the Contractor shall liaise with Other Contractors to develop interface designs in conjunction and co-operation with the designers of interfacing systems. Interfacing systems include, but are not limited to, those listed in the PS / TS. These interface designs will be monitored and reviewed by the Employer's Representative but the Contractor shall work directly with the Other interfacing Contractors to develop designs which are mutually acceptable to all parties. The Employer's Representative will provide details of the Other Contractors as contracts are awarded.
- 16.3.5 The Employer's Representative may, at his discretion, attend the Contractor's meetings with Other interfacing Contractors. The Contractor shall give the Employer's Representative a minimum of 7 days notice of all meetings to be

- held with any Other interfacing Contractors, or 14 days notice if the meeting is to be outside Lucknow/Kanpur. If insufficient notice is given to the Employer's Representative, he may require the meeting to be postponed to a later date to enable him to attend.
- 16.3.6 The Contractor shall provide the Employer's Representative with two copies of the minutes of all meetings within 14 days of each meeting and also two copies of all correspondence with any Other Contractor.
- 16.3.7 The Contractor shall attend co-ordination meetings chaired by the Employer's Representative at no greater than monthly intervals to discuss and ensure that designs are correct and that conflicts in E&M services requirements between the Contractor and Other Contractors are identified and resolved.
- 16.3.8 The Contractor shall co-ordinate his installation activities with the Other Contractors. The Contractor shall ensure that there is no interference to the work of the Other Contractors and shall maintain close co-ordination with Other Contractors working on or adjacent to the Works to ensure that their work can progress in a smooth and orderly manner.
- 16.3.9 The Contractor shall be given access to the various parts of the Site by the dates relative to the Works Programme defined in the ITT and the PS as Access Dates. The ITT and the PS specify certain Key Dates by which the Contractor shall complete certain parts of his Works to enable work to be undertaken by the Other Contractors. These dates may be subject to adjustment by the Employer's Representative in consultation with the Contractor and the Other Contractors to ensure the progress of the Project.
- 16.3.10 The Contractor's responsibility shall include provision of and receipt from Other Contractors or the Employer's Representative of information required for construction of the Works and the installation of the Works and Contractor's Equipment, insofar as that requirement is specified in or can reasonably be inferred from the Contract. Where the execution of work by a Other Contractor depends upon the Contractor's Site management or upon information to be given by the Contractor, the Contractor shall provide the Other Contractor with either the required services or the correct and accurate information required to enable the Other Contractor to meet his programme for the construction or installation of his works.
- 16.3.11 In the event of any disagreement as to the extent of services or information required to be exchanged between the Contractor and another Contractor, the Employer's Representative shall determine the requirements and this determination shall be final and binding on the Contractor and the Other Contractor.
- 16.3.12 The Contractor shall co-ordinate his testing and commissioning activities with the Other Contractors. The Contractor shall ensure that there is no interference to the work of the Other Contractors and shall maintain close co-ordination with Other Contractors working on or adjacent to the Works to ensure that their testing and commissioning work can progress in a smooth and orderly manner.

## CHAPTER 17

### 17. THE SITE

#### 17.1 Access to Site

The Contractor will be given access to the Site in accordance with following conditions.

#### 17.2 Site Restrictions

17.2.1 The particular use to which the Site is put shall be submitted to the Employer's Representative for review within 14 days of the Commencement Date of the Works and the Contractor shall:

- (1) confine his use of the areas of the Site to purposes having been reviewed without objection by the Employer's Representative who reserves the right to extend, amend or restrict the uses to which areas of the Site will be put;
- (2) 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;
- (3) refrain from depositing rubbish or causing nuisance or permitting nuisance to be caused and, except where reviewed without objection by the Employer's Representative, depositing earth on or removing earth from areas of the Site;
- (4) Deleted
- (5) refrain from obstructing manholes, utility access points and the like; and
- (6) Deleted

17.2.2 Work other than that necessary for completion of the Works shall not be carried out on the Site.

17.2.3 While the Contractor is being given access to the Site, he shall provide means of distributing loads imposed by Contractor's Equipment and prevent damage to utility services.

17.2.4 Except where otherwise provided, the Contractor shall not permit any person to reside on the Site.

17.2.5 Unless otherwise stated, the Contractor shall pay all rates and charges of any nature whatsoever arising out of his use of the Site and all work areas provided therein under the Contract. The location and size of stockpile material, including excavated material within the Site, shall be submitted to the Employer's Representative for review. All stockpiles shall be maintained at all times in a stable condition.

17.2.6 The Contractor shall not allow animals to be brought onto or kept on the Site.

17.2.7 The Contractor's attention is drawn to the Waste Disposal Regulation currently prevalent in Lucknow, regarding storage, transportation and disposal of chemical waste. The Contractor's proposed methods and chemicals to be

used in cleaning shall be submitted for review by the Employer's Representative.

- 17.2.8 No rock crushing or screening facilities shall be set up on Site unless reviewed by the Relevant Authorities and reviewed without objection by the Employer's Representative.

### **17.3 Site Services**

- 17.3.1 Deleted

- 17.3.2 The Contractor shall provide such services for use solely in connection with the proper execution of the Works. The Contractor shall comply with all regulations of the utility companies and Government departments concerned. The Contractor shall provide and maintain installations associated with such services and in relation thereto and shall take all reasonable precautions to safeguard the safety and health of all persons and the security of the Site. The Employer's Representative may demand the immediate disconnection or alteration of such installations or portions thereof he considers as being prejudicial to safety, health or security. As soon as any or all of the Contractor's installations are no longer required for the execution of the Works, they shall be entirely removed to the satisfaction of the Employer's Representative.

- 17.3.3 Deleted

- 17.3.4 The Employer's Representative will instruct the Contractor as to the requirements for Site services to be connected to the Employer's Representative's portable Site accommodation at any given location and the Contractor shall provide and maintain these services during his use of the Site.

### **17.4 Site Cleanliness**

- 17.4.1 Deleted

- 17.4.2 Deleted

- 17.4.3 Deleted

- 17.4.4 Deleted

- 17.4.5 Deleted

### **17.5 Prevention of Mosquito Breeding**

- 17.5.1 Measures shall be taken to prevent mosquito breeding on the Site. The measures to be taken shall include the following:

- (1) empty cans, oil drums, packing and other receptacles which may retain water shall be deposited at a central collection point and those not required for future use shall be removed from the Site regularly;
- (2) standing water shall be treated at least once every week with an environmental acceptable oil which will prevent mosquito breeding; and



- (3) Contractor's Equipment and other items on the Site that may retain water shall be stored, covered or treated in such a manner that water will not be retained.
- (4) Anti mosquito breeding sprays should be done in the area during the rainy season at frequent intervals.

17.5.2 Posters in both English and Hindi drawing attention to the dangers of permitting mosquito breeding shall be obtained from the UP Government and displayed prominently on the Site, to the requirement of the Enactments. These posters shall be removed on Employer's Taking Over of the Works.

**17.6 Deleted**

**17.7 Deleted**

**17.8 Deleted**

**17.9 Access to the Site by Other Contractors**

17.9.1 Due to the multi-discipline nature of the Project, several different parties may require access to the same portion of the Site during the construction phase for the installation, erection and testing of the Works. To facilitate the organisation and co-ordination of access and occupation requirements, including the use of Works Trains, if any, the Employer's Representative will issue and maintain a TRIP as referred to in clause 2.13 above.

17.9.2 The TRIP will be developed from the declared requirements of all Project Contractors and others having need of access and occupancy, at the weekly Works Train Meeting. The TRIP will be subject to revision and updating to reflect changing circumstances during the progress of the Project.

17.9.3 The Contractor shall work in accordance with the arrangements prescribed by the TRIP.

17.9.4 The Contractor shall ensure that his working arrangements on the Site conform to the agreements made with the Employer's Representative during establishment of the TRIP requirements. In particular, the Contractor shall ensure that his occupancy does not extend either physically or chronologically beyond the agreed boundaries.

**17.10 Transportation to Site**

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

17.10.2 In this context, the definition of the terms "very large" and "very heavy" refer to articles that cannot be transported by normal road vehicles or be handled by readily available methods. Where doubt exists, it shall be the responsibility of the Contractor to notify and discuss the nature of the load in question with the Employer's Representative in accordance with clause 17.10.1 above.

17.10.3 The Contractor shall comply with the requirements of the Commissioner of Transport and /or the Commissioner of Police and / or any other Relevant Authority regarding any special traffic arrangements that may be necessary.



The Contractor's attention is drawn to the Road Traffic (Regulation and Licensing of Vehicles) Regulations and the Road Traffic (Construction and Use) Regulations currently in use at Lucknow.

- 17.10.4 Extraordinary traffic may be moved from docks and between areas of the Site over public highways only by police escort and on a route and at a time determined by the Relevant Authority. The Contractor shall be responsible for obtaining permission from the Relevant Authorities to move extraordinary loads and traffic and for arranging police escorts as necessary.
- 17.10.5 The Contractor shall make all arrangements and assume full responsibility for transportation to the Site of all Contractor's Equipment, materials and supplies needed for the proper execution of the Works.
- 17.10.6 While travelling to and from the Site, the Contractor shall observe all posted speed limits, traffic regulations, stop signs, etc., and adherence to the access route indicated on the Employer's Drawings or as instructed by the Employer's Representative. No employee of the Contractor shall trespass into any part of the Employer's premises other than the Site or the designated route of access.
- 17.10.7 The Contractor shall ensure that all roads and pavements, etc. leading to and around the Site are kept free from obstructions and shall not cause inconvenience or hindrance to traffic or persons either by its vehicles or by its workmen, scaffolding, plant, materials, equipment, etc.
- 17.10.8 The Contractor shall repair damage to existing roads, footpaths, steps, cables, sewers, live drains, etc. and shall reinstate any damage caused by the Contractor's actions.

#### **17.11 Contractor's Own Rolling Stock**

- 17.11.1 Where the Contractor is to provide rolling stock (either self-propelled or trailing) for use during the installation and testing of the Works, the requirements of clause 17.12 below shall apply. All the Contractor's own rolling stock shall not exceed the Construction Vehicle Load Gauge as shown in the Specification Drawings except with the Employer's Representative's written consent.
- 17.11.2 The Contractor shall submit full details of any rolling stock that is to be used during the installation and testing of the Works to the Employer's Representative for review within 90 days of the Commencement Date of the Works. Such details shall include a full description and drawings of the rolling stock, details of axle load, stopping distance, fail-safe braking system, kinematic envelope, and operating and maintenance instructions.
- 17.11.3 Deleted
- 17.11.4 Prior to use, and following each maintenance examination, the Contractor's qualified engineer shall certify the Contractor's own rolling stock as fit-to-run. Thereafter, the Contractor's qualified engineer shall issue a registration tag. The expiry date, i.e. the date of the next inspection, shall be shown on the registration tag. The Contractor's own rolling stock shall not be used without a valid registration tag.
- 17.11.5 Deleted
- 17.11.6 If the Contractor's own rolling stock is found to be operating in an unsatisfactory or unsafe condition, it shall be immediately removed until it has

been restored to an acceptable condition to the satisfaction of the Employer's Representative.

#### **17.12 Defined Area Working and Works Train Operations**

- 17.12.1 When the Project under construction has been made available for track related electrical and mechanical installation works, the area will be classified as a Defined Area within which Works Trains will be operated.
- 17.12.2 All persons whose duties require them to work within a Defined Area must observe safety rules and procedures to be provided by the contractor and reviewed without objection by the Employer's Representative. It shall provide procedures and guidance for the safety of all persons in the Defined Area.
- 17.12.3 Deleted
- 17.12.4 Persons working on or near tracks in a Defined Area, either by themselves or supervising a working party, must be suitably trained and qualified by the Employer or his delegates in the safety provisions of the Works Train Manual. Persons who are not qualified shall not attempt to gain access to the railway tracks unless accompanied by a qualified person.
- 17.12.5 When overhead lines are energised, EMUs may be running at high speed for testing. No work may be undertaken on either the Up or Down tracks when test trains are running. Procedures for gaining access to the energised track will be detailed in the Works Train Manual. The Contractor shall make requests for gaining access to the energised track at the weekly Works Train Meetings.

#### **17.13 Not used**

## CHAPTER 18

### 18. HEALTH AND SAFETY

#### 18.1 Health and Safety Philosophy

- 18.1.1 The health, safety and welfare of all personnel working on the Project, the general public and the avoidance of damage to property are of paramount importance to the Employer. Prime consideration shall be paid to construction activities to ensure that all operations shall be conducted in such a manner as to eliminate the risks to persons and property. The Contractor shall treat safety measures as the first priority in all his activities with respect to executing the Works.
- 18.1.2 The Contractor will be issued with the following Employer documents: Corporate Safety Standards, Safety Policy, Safety Plan, Safety Procedure Rule Book and Joint Operating Procedure as they become available. These documents set out the minimum standards to be achieved by the Contractor but do not relieve the Contractor of his liabilities and obligations under the Enactment. Where there is a discrepancy in the documents, the higher or stricter standards shall be applied.

#### 18.2 Health and Safety Management

- 18.2.1 The Contractor shall be fully responsible for safety on the Site, for the Works, his personnel, sub-contractors' personnel, the public domain and all persons directly or indirectly associated with the Works, on or in the vicinity of the Site.
- 18.2.2 The Contractor shall submit reports, notices and information to Government bodies where there is a statutory requirement to do so.
- 18.2.3 The Contractor shall and will ensure that, his sub-contractors of any level, all persons employed by him on the Site and any person authorised by him to be on the Site shall comply in every respect with the provisions of relevant statutory requirements and the Employer's safety documents as listed in clause 18.1.2 above.
- 18.2.4 The provisions of the GS regarding health and safety shall apply to the Contractor and his sub-contractors of any level for any part of the Works.
- 18.2.5 The Contractor shall ensure that proper and adequate provisions to ensure compliance are included in all sub-contracts placed by him and into all sub-contract documentation.
- 18.2.6 The safety standards of the sub-contractors are to be properly assessed prior to the placing of contracts and the Contractor shall employ only sub-contractors with a track record of maintaining the highest safety standards.
- 18.2.7 The Employer's representative reserves the right to order the immediate removal and replacement of any item of Contractors equipment or temporary works, which in his opinion, is unsatisfactory for its purpose or is in an unsafe condition.

### **18.3 Legislation, Codes of Practice, Standards, etc.**

- 18.3.1 The Contractor shall comply with all current and future Enactments, Codes of Practice and Safety Guides approved by the Commissioner for Labour relating to the Works.
- 18.3.2 Where identified specifically in the GS, Indian Standards are also to be complied with.

### **18.4 Breach of Health and Safety Obligations**

- 18.4.1 Serious or repeated breaches of the Employer's safety documents as listed in clause 18.1.2 above, statutory regulations, or other disregard for the health and safety of any person, may be reasons for the Employer's Representative to exercise his authority to require the removal from the Site of any employee of the Contractor or a sub-contractor of any level.
- 18.4.2 Once removed from the Site at the request of the Employer's Representative, that person shall not be re-employed on the Contract, allowed on the Site or on any other Employer related project.
- 18.4.3 The Employer's Representative shall have the right to order the suspension of any or all of the Contractor's activities where the Employer's Representative considers that to continue such activity or activities may pose a hazard to the safety of persons or property.
- 18.4.4 Where the Employer's Representative orders such suspension as described in clause 18.4.3 above, such suspension shall continue until the Contractor has satisfied the Employer's Representative that satisfactory corrective action has been taken to eliminate the hazard, the subject of the suspension

### **18.5 Contractor's Health and Safety Documentation**

#### **18.5.1 Sub-contractors documentation**

- 18.5.1.1 Deleted
- 18.5.1.2 Deleted
- 18.5.1.3 Deleted
- 18.5.2 Not used

#### **18.5.3 Site Safety Plan**

- 18.5.3.1 Deleted
- 18.5.3.2 The Site Safety Plan shall fully comply with the Health and Safety requirements of the Project conditions and proposed work activities, the GS, the Employer's safety documents as listed in clause 18.1.2 above and all relevant Enactment, Regulations, Codes of Practice, Safety Guides and relevant Indian Standards. The plan shall be prepared and submitted to the Employer's Representative for review within 112 days of the date of Notice to Proceed.
- 18.5.3.3 The Site Safety Plan shall include a policy statement signed by the chief executive officer of the Contractor (or other senior officer) declaring that occupational health and safety shall be given the highest practicable priority in all aspects of the Contract and in the discharge of his contractual obligations. In the event that the Contractor is a consortium, partnership or joint venture, a policy statement signed by the chief executive officer (or other senior officer endorsed by the chief executive officer and agreed by the

Employer's Representative), from each of the companies comprising the consortium, partnership or joint venture shall be submitted.

#### 18.5.4 **Not used**

#### 18.5.5 **Method Statements**

18.5.5.1 Deleted

18.5.5.2 Deleted

18.5.5.3 Deleted

18.5.5.4 Deleted

18.5.5.5 Deleted

18.5.5.6 Deleted

#### 18.6 **Contractor's Safety Arrangements**

##### 18.6.1 **Co-ordination of work activities**

18.6.1.1 Deleted

18.6.1.2 Deleted

##### 18.6.2 **Safety inspections**

18.6.2.1 The Contractor shall conduct formal, documented Site safety inspections (at least once a month) which are to be attended by the Contractor's most senior Site staff and safety staff.

18.6.2.2 A report of each safety inspection shall be made and shall include the actions taken to resolve any problems or shortcoming discovered during the inspection. The report shall be made available for audit purposes and be discussed at the relevant meetings.

18.6.2.3 Deleted

18.6.2.4 Deleted

18.6.2.5 Deleted

18.6.2.6 Deleted

18.6.2.7 Deleted

18.6.2.8 Deleted

##### 18.6.3 **Safety audits**

18.6.3.1 Deleted

18.6.3.2 Deleted

18.6.3.3 Deleted

18.6.3.4 Deleted

18.6.3.5 Deleted

18.6.3.6 The Contractor shall conduct regular (at least every 3 months) internal safety audits on both the safety management system and the physical Site conditions. The internal safety audits shall be performed to the same criteria and using the same grading and benchmarking as the Employer's audits.

18.6.3.7 The internal safety audits shall be conducted by person(s) reviewed without objection by the Employer's Representative, who are qualified and competent to carry out safety audits. The documentation generated by the

audit process, shall be made available to the Employer's Representative for audit purposes.

18.6.3.8 The internal safety audits shall include the work of sub-contractors of all levels.

18.6.3.9 The Contractor shall advise the Employer's Representative of the date of the internal safety audit. The Employer's Representative may send a representative to assess the thoroughness of the internal safety audit.

#### 18.6.4 **Reporting of accidents, incidents and dangerous occurrence**

18.6.4.1 The Contractor shall notify the Employer's Representative immediately of any dangerous occurrences or accidents, which result in death, serious bodily injury or incapacity for more than 3 days. Such initial notification may be verbal but shall in any event be followed by a preliminary written report, in a format reviewed without objection by the Employer's Representative, within 24 hours of the occurrence/accident and a detailed written report shall be submitted within 7 days. Copies of all accident, incident and dangerous occurrence reports shall be kept on file and made available for audit purposes.

18.6.4.2 The Contractor's attention is drawn to the reporting requirements set out in the Factories and Industrial Undertakings Regulations, Occupational Safety and Health Ordinance and other local Regulations.

18.6.4.3 The Contractor shall deliver to the Employer's Representative, within 48 hours of the incident, a copy of any Form 2 or 2a or other statutory reports he submits to Government departments under these Regulations.

18.6.4.4 Deleted

#### 18.6.5 **Monthly reports**

18.6.5.1 The Contractor shall, as part one of each Monthly Progress Report, submit a Site Safety Report duly signed by the Contractor's director responsible for the Contract.

18.6.5.2 The Site Safety Report shall comprehensively address all relevant aspects of occupational safety and health and shall contain certain standard forms and information, as directed by the Employer's Representative, for statistical analysis.

18.6.5.3 The Contractor shall submit reports or accident analysis, in a format reviewed without objection by the Employer's Representative, as and when required by the Employer's Representative.

#### 18.6.6 **Safety staff**

18.6.6.1 The Contractor shall ensure that their safety staff have the necessary authority given to them to suspend any work where there is imminent danger of accident or injury. He shall also in consultation with the Employer's Representative deploy adequate number of Safety Supervisors.

#### 18.6.7 **Deleted**

#### 18.6.8 **Safety information**

18.6.8.1 The Contractor shall display in each of his Site offices, workshops and canteens a copy of the document on "A Guide to the Construction Sites (Safety) Regulations" published by the Government or a similar approved document. This document shall be translated into languages, which are understood by labour engaged by the Contractor or sub-contractors.

- 18.6.8.2 The Contractor shall ensure that safety, rescue and occupational health matters are given a high degree of publicity to all persons, regularly or occasionally on Site. Posters in English, Hindi and other languages understood by the workers, drawing attention to Site safety, rescue and occupational health, shall be made or obtained from appropriate sources and shall be displayed prominently in relevant areas of the Site.
- 18.6.8.3 Posters in both English and Hindi drawing attention to safety shall be obtained from the Labour Department and displayed prominently throughout the Site.
- 18.6.8.4 The Contractor shall keep on Site a complete and up-to-date set of all relevant occupational health and safety legislation, relevant Codes of Practice and any relevant guides and safety pamphlets published by the Labour Department and the Occupational Safety and Health Council or similar authorities or reference.
- 18.6.8.5 The Contractor shall keep a working stock of all relevant statutory forms to be used in compliance with the occupational health and safety legislation.
- 18.6.9 **Safety meetings**
- 18.6.9.1 The Employer's Representative shall establish a monthly Site Safety Management Committee to formally review the safety management of the Contractor and monitor the implementation of the Health and Safety Plan. The Employer's Representative shall act as chairman of this committee with members of the Employer's Representative's staff attending as appropriate.
- 18.6.9.2 Attendance from the Contractor shall include, but not be limited to, the Senior Manager on Site and the Safety Manager/Officer/Supervisor.
- 18.6.9.3 The Contractor shall act without delay upon such decisions or recommendations as may be made by the committee on matters of health and safety.
- 18.6.9.4 The Employer's Representative as appropriate may invite representatives from third parties including statutory bodies.
- 18.6.9.5 The Contractor shall establish a tier of monthly safety meetings and shall ensure that all level of staff, all disciplines and all work areas are covered so that the dissemination of information is carried through to all levels of staff and workers.
- 18.6.9.6 The Contractor shall hold monthly meetings at which representatives from all sub-contractors shall attend.
- 18.6.9.7 Minutes of all tiers of Contractor safety meetings shall be issued to the Employer's Representative for information.
- 18.6.10 **Safety training**
- 18.6.10.1 The Contractor shall ensure that induction training courses shall be provided for construction site workers or equivalent.
- 18.6.10.2 The induction course shall be conducted by suitably qualified persons and repeated at six-month intervals.
- 18.6.10.3 All workers must receive induction training before they are allowed to commence work on the Site.
- 18.6.10.4 The Contractor is to issue all Site workers with a Site pass once they have attended the induction course. The pass is to include the worker's name, ID card no., photograph, types of courses attended and expiry date of the card (maximum 6 months). The pass is to be carried at all times when on the Site.



18.6.10.5 The Contractor shall keep records of such training for health and safety audit purposes. Upon completion of their training, the Contractor's Site staff shall sign a copy of their assigned safety responsibility statement, which shall be kept by the Contractor for audit purposes.

18.6.10.6 The Contractor is to report the number of training sessions and employees trained each month, at the Site Safety Management Committee meeting and in the Monthly Progress Report.

#### 18.6.11 **Alcohol and drugs**

18.6.11.1 Deleted

18.6.11.2 Deleted

18.6.11.3 Deleted

### 18.7 **Site Conditions**

#### 18.7.1 **Emergency procedures and facilities**

18.7.1.1 The Contractor shall establish and implement emergency procedures which detail the organisation of rescue and/or damage limitation teams to deal with emergency situations on the Site such as, but not limited to, fire, loss of power, typhoon, flooding, stranding or the evacuation of a seriously injured person(s) from a remote or difficult Site location, etc. The emergency procedures shall specify what equipment is needed, where it will be located and who is responsible for its maintenance.

18.7.1.2 The Contractor shall carry out regular (at least every 3 months) emergency evacuation exercises from their offices and Site area. This requirement includes evacuation of viaducts as a joint Fire Services Department exercise where applicable.

#### 18.7.2 **First aid facilities**

18.7.2.1 The Contractor shall provide, or have access to, sufficient first aid provisions, including trained personnel and facilities appropriate to the Site conditions. Arrangements for transporting the injured (ambulance, stretcher, etc.) shall be provided.

18.7.2.2 A Nurse or trained First-Aider is required at all times at the Site of working.

18.7.2.3 The Contractor shall maintain a register of all persons attending the clinic or receiving first aid treatment. Records are to be in a comprehensive format as required by the appropriate authority and shall be kept for audit purposes.

18.7.2.4 First aid kits, up to the standards required by the appropriate authority shall be carried in supervisor's vehicles and made available where work is in remote areas

18.7.2.5 Minimum one telephone should be provided at every site/ site office for communication in emergency as per clause 15.5.1. The site should also display important telephone numbers of fire police, hospital, Project Management, Employer etc for immediate use.

#### 18.7.3 **Lifting appliances and lifting gear**

18.7.3.1 The Contractor shall prepare and maintain an up-to-date Site register of lifting equipment containing test certificates of all lifting and hoisting equipment used on the Works. The register shall be available on Site, from the commencement of construction, for inspection by the Employer's Representative and Relevant Authorities.



- 18.7.3.2 A system is to be devised and implemented, such as colour coding, to identify the expiry of the certification of lifting appliances and lifting gear. This system is to be displayed in the cabs of all lifting appliances.
- 18.7.3.3 A trained banksman shall be in attendance at each lifting appliance or hoisting operation.
- 18.7.3.4 The banksman shall be equipped with a radio link to the crane or hoist operator and shall be easily identifiable from other workers.
- 18.7.3.5 Competent operators with certificates issued by a recognised training body shall be provided to operate all mechanical plant particularly all lifting and hoisting equipment.
- 18.7.3.6 The operators of shaft hoisting gear shall be in communication with the top and bottom of the shaft and each intermediate landing.
- 18.7.3.7 All crane hooks and other lifting devices used on or around the Site shall be fitted with a safety catch or other device to stop the lifting gear being detached.
- 18.7.3.8 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.
- 18.7.3.9 Slings, shackles and such-like equipment used in lifting shall be colour coded for identifying lifting gear which require re-inspection or disposal.
- 18.7.4 **Fire precautions**
- 18.7.4.1 The Lucknow/U.P. Fire Service Ordinance and any relevant regulations made there under and other requirements laid down in the Specification or as laid down from time to time by the Employer's Representative shall be observed at all times.
- 18.7.5 **Dangerous goods, hazardous substances**
- 18.7.5.1 Not used
- 18.7.5.2 The Contractor shall ensure that all explosives, compressed gases, petrol and other dangerous substances, shall be stored and handled in accordance with the relevant Ordinance.
- 18.7.5.3 Before being brought on to Site, any materials proposed by the Contractor shall be assessed by the Contractor for their occupational health and environmental compatibility. Any material that is toxic, explosive or inflammable or may otherwise create a hazard shall, whenever possible, be replaced by a less hazardous product.
- 18.7.5.4 All hazardous substances and dangerous goods brought onto the Site shall be entered into a Site register.
- 18.7.5.5 The Contractor shall ensure that material safety data sheets are available and issued to workers, for all hazardous substances brought onto the Site.
- 18.7.5.6 The Contractor shall make adequate provision for the storage and disposal of waste oils, de-greasing agents, etc.
- 18.7.5.7 Flash back arrestors shall be fitted to all oxygen and acetylene cylinders.
- 18.7.5.8 Oxygen and acetylene cylinders shall be stored and used in a vertical position and be transported upon a trolley or in cage.

18.7.6 **Not used**

18.7.7 **Excavations and floor openings**

18.7.7.1 Before the commencement of any excavation work, sufficient information shall be obtained from the utility companies to identify the locations of buried services. Buried services are to be located using a cable detector, digging hand dug trial pits and by reference to the relevant drawings, before mechanical digging takes place.

18.7.7.2 Excavations shall be carried out by trained and experienced workers who shall be fully instructed on the possible dangers and safety precaution to be taken, before work is commenced.

18.7.7.3 The Employer's Representative shall be notified immediately of any damage or interruption to a utility.

18.7.7.4 A Permit to Dig system shall be established and implemented prior to excavation starting.

18.7.7.5 The Contractor shall ensure that all temporary covers/decking to the trenches and barriers at the edges of excavations are safe and securely installed at all times, especially during adverse weather conditions.

18.7.7.6 Where there is a danger to the public, extra care must be taken to properly cover all temporary openings and adequately barrier and sign the excavation. Flashing warning lights, signs and adequate lighting is to be installed where required.

18.7.8 **Site transport**

18.7.8.1 The Contractor shall ensure that all Site vehicles are regularly maintained and kept in a safe condition with fully working brakes, lights, exhaust, windscreen, windows and doors, etc.

18.7.8.2 Each vehicle, piece of plant or machinery shall be uniquely and clearly identified and registered for maintenance purposes.

18.7.8.3 When instructed by the Employer or the Employer's Representative, the Contractor will remove any vehicle from the Site that is not up to the standards required.

18.7.8.4 The Contractor will remove from the Site immediately any vehicle that is beyond repair.

18.7.8.5 The Contractor is to ensure that only vehicles fitted with seats with backrests and seat belts are used as Site transport. If required by law the carrying of passengers in vehicles that have not been fitted with seat belts is strictly prohibited. No person shall ride in the back of vehicles not legally authorised to carry passengers. Drivers of vehicles permitting this practice are to be warned for a first offence then removed from the Site for the second offence.

18.7.8.6 The speed limit on the Site is to be restricted and signs displayed advising drivers of the limits imposed.

18.7.8.7 Speed bumps are to be located at strategic points throughout the Site to enforce the speed limits.

18.7.9 **Driving/operator's licenses**

Drivers of vehicles and operators of the Contractor's Equipment shall hold the necessary license group for the vehicle or plant they are driving/operating. Where no such license group exists, drivers/operators shall have an equivalent group and undertake training in the vehicle/plant given by the Contractor's plant department. Records of the training given are to be retained.

**18.7.10 Personal protective equipment (PPE)**

18.7.10.1 The Contractor shall make available on Site at all times adequate provision of safety equipment including, but not limited to, safety helmets, goggles, ear protectors, safety belts, respiratory protection, safety equipment for working in sewers, drains and enclosed spaces, equipment for rescue from drowning, fire extinguishers, first aid equipment and other necessary safety equipment.

18.7.10.2 The Contractor shall ensure that safety footwear is worn at all times inside the tunnels and actively encourage the wearing of safety footwear on other areas of the Site. Where safety footwear is not worn, the Contractor is to ensure that strong shoes are worn.

18.7.10.3 High visibility vests shall be worn at all times when in the tunnels.

18.7.10.4 Deleted

18.7.10.5 Deleted

**18.7.11 NOT USED**

**18.7.12 Ladders, temporary access**

18.7.12.1 The Contractor shall provide, register, maintain and use only ladders, which are purchased as proprietary products, on the Site. Site made ladders are not to be used under any circumstances.

18.7.12.2 All ladders shall be free from patent defects, secured against movement and installed in accordance with the relevant construction regulations and Codes of Practice.

18.7.12.3 Wooden access steps with handrails are to be installed and maintained as access where the use of mobile access staircases are impractical.

**18.7.13 Temporary Works**

18.7.13.1 The Contractor shall appoint an engineer as a Temporary Works Co-ordinator. His duties shall include, but not limited to, checking and certifying all Temporary Works prior to erection and loading, ensuring that the erection work is carried out in accordance with the design, compiling a Temporary Works register, completing a suitably designed form or certificate which is to be displayed on the Temporary Works to say it has been inspected and is safe to load.

18.7.13.2 The Temporary Works Co-ordinator shall not be the same person who designed the Temporary Works.

18.7.13.3 Suspended, cantilever, bracket type scaffolding or working platforms are to be designed, certified and inspected by an independent engineer, who may be the Temporary Works Co-ordinator, prior to loading.

**18.7.14 Temporary buildings, sheds, workshops, etc.**

18.7.14.1 No temporary structure is to be erected without the consent of the Employer's Representative.

18.7.14.2 Except where consent is obtained from the Employer's Representative, no person shall reside on the Site.

LKE(02)-02: Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 02 (two) Years Defect Liability Period (DLP) and 01 (one) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.

**18.7.15 Deleted**

18.7.16 Deleted

**18.7.17 Deleted**

## CHAPTER 19

### 19. DAMAGE AND INTERFERENCE

#### 19.1 Damage and Interference

19.1.1 Work shall be carried out in such a manner that, as far as is practicable, there is no damage to or interference with the following, other than such damage as is necessitated to enable the execution of the Works:

- (1) watercourses or drainage systems;
- (2) utilities;
- (3) structures, roads including street furniture, or other property;
- (4) public or private vehicular or pedestrian accesses;
- (5) trees, graves or burial urns; and
- (6) existing railways and railway systems.

The Contractor shall obtain prior approval of the concerned authority or party, if so required, for any work near properties under their ownership or management.

The Contractor shall inform the Employer's Representative as soon as practicable of any item, utility or thing which is not stated in the Contract as requiring diversion, removal or relocation but which the Contractor considers as requiring diversion, removal or relocation to enable the Works to be executed. The Contractor shall not divert, remove or relocate any such item, utility or thing without such diversion, removal or relocation having been reviewed without objection by the Employer's Representative.

19.1.2 Items which are damaged or interfered with as a result of the Works being carried out and items which are diverted, removed or relocated to enable the Works to be carried out, shall be reinstated to the same condition as existed before the Works started or to such condition as may be reviewed without objection or instructed by the Employer's Representative.

19.1.3 The Contractor shall excavate by hand where damage may be caused by the operation of mechanical plant adjacent to any utilities.

19.1.4 Except with the prior approval of the UP Fire Services, no damage or interference with existing fire hydrants and valves shall be caused.

19.1.5 Prior to trench excavation, the Contractor shall carry out investigations to locate utilities by means of hand-dug inspection pits. The locations and number of inspection pits required in meeting the Contractor's obligations to establish the location of existing utilities and underground features shall be determined by the Contractor. The Contractor shall note that many existing

pipes/ducts/cables may not be shown in the records kept by the utility undertakings, and may only be exposed as the excavation proceeds. The trench excavation shall be carried out by hand where there are utilities adjacent to or within the excavation works and the Contractor shall have allowed in his programme the time required for the exposing, temporary support and diversion of these recorded or unrecorded utilities. Should any

pipes/ducts/cables or cover tiles be exposed, the respective utility undertaking shall be contacted to determine if all the utilities have been located. Cover tiles and utilities shall only be removed by the utility undertakings concerned.

- 19.1.6 Where the Employer's Representative has conducted utility and ground investigation on behalf of the Employer, the Contractor may obtain the data obtained from the investigations from the Employer's Representative in accordance with clause 1.7.2 above and subject to the condition of clause 19.3 below.

## **19.2 Watercourses and Drainage Systems**

- 19.2.1 Existing watercourses and drainage systems shall be temporarily diverted as required to enable the Works to be carried out. Particulars of the proposed diversions shall be submitted to the Employer's Representative for review at least 14 days before the relevant work starts. Diversions shall be constructed to the satisfaction of the Employer's Representative with such alignment and in such manner that the flow is discharged adequately and effectively without causing flooding or erosion to the adjacent area. The diversions shall be maintained while the work is being carried out and shall be reinstated, including the removal of any obstructions to flow, as soon as practicable after the work is complete.
- 19.2.2 Measures shall be taken to prevent excavated material, silt or debris from being deposited in existing drainage systems, watercourses or the river.
- 19.2.3 Under no circumstances shall foul sewage flow be diverted into existing storm-water drains and vice versa.
- 19.2.4 The Contractor shall adequately maintain the existing drainage and sewerage systems at all times including removal of solids in sand traps, manholes, gullies and streambeds.
- 19.2.5 The Contractor shall discharge water surface run-off from the Site into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sediment basins. Channels or sandbag barriers shall be provided on Site to properly direct the storm water to such silt removal facilities. The Contractor shall remove all silt, which may have accumulated in the drainage or sewerage systems whether within the Site, or not. If at any time such provisions prove to be ineffective, the Contractor shall take such additional measures as the Employer's Representative deems necessary.
- 19.2.6 Water pumped out of the trenches under construction shall be discharged into storm drains after the removal of silt in silt removal facilities.
- 19.2.7 The Contractor shall maintain the silt removal facilities, channels and manholes and remove the deposited silt and grit regularly, at the onset and after each rainstorm to ensure that these facilities are functioning properly at all times.
- 19.2.8 No obstruction to flow is to be left in position longer than is necessary for carrying out the Works. The Contractor shall ensure that adequate provisions are made for dealing with increased flow of water during the wet season.
- 19.2.9 The Contractor shall keep interruption or disturbance to the public due to the diversion works to a minimum.

- 19.2.10 If any mechanical equipment is required for the foul sewage diversion work, the Contractor shall suggest and provide precautionary measures to mitigate against consequences of break down of the equipment.
- 19.2.11 The Contractor shall at all times ensure that all existing stream courses and drains within and adjacent to the Site are kept safe and free from any debris and any excavated materials arising from the Works. The Contractor shall ensure that chemicals and concrete agitator washings are not deposited in watercourses.
- 19.2.12 The Contractor shall be responsible for the Temporary Works involved in training, diverting, or conducting of open streams or drains intercepted by the Works and the Site, for the maintenance of the Temporary Works and waterways as required by the Employer's Representative, and for reinstating these to their original courses on Employer's Taking Over of the Works, when and where in the opinion of the Employer's Representative such action is desirable.
- 19.2.13 The Contractor shall take all necessary precautions to prevent water entering upon or being discharged from the Site, from entering upon the works of adjacent contractors or adjacent properties.
- 19.2.14 The Contractor shall provide where necessary temporary water courses, floodwalls, flood gates, ditches, drains, pumping or other means of maintaining the Works and the Site free of water.

### **19.3 Utilities**

- 19.3.1 The details of existing utilities are given by the employer for information only and the accuracy of the details is not guaranteed. The Contractor shall make his own enquiries and shall carefully excavate trial holes to locate accurately the utilities indicated to him by the utility undertakings.
- 19.3.2 Temporary supports and protection to utilities shall be provided by methods reviewed without objection by the Employer's Representative. Permanent supports and protection shall be provided if instructed by the Employer's Representative.
- 19.3.3 The Contractor shall inform the Employer's Representative and the utility undertakings without delay of the following:
- (1) damage to utilities;
  - (2) leakage of utilities;
  - (3) discovery of utilities not shown on any drawings; and
  - (4) diversion, removal, repositioning or re-erection of utilities which is required to enable the execution of the Works.
- 19.3.4 The Contractor shall take all steps necessary to enable the utility undertakings to proceed in accordance with the programme agreed between the Contractor and the utility undertakings under clause 2.2.2 above. The Contractor shall maintain close liaison with the utility undertakings and shall inform the Employer's Representative of any delays in works by the utility undertakings.



- 19.3.5 The Contractor shall keep records of existing utilities encountered on the Site and a copy provided for the Employer's Representative. The records shall be submitted for review by the Employer's Representative and shall contain the following details:
- (1) location of utility;
  - (2) date on which utility was encountered;
  - (3) nature and size of utility;
  - (4) condition of utility; and
  - (5) temporary or permanent supports provided.
- 19.3.6 The Contractor shall co-ordinate the activities of the utility undertakings in connection with the diversion of utility services necessary for the execution of the Works.
- 19.3.7 The Contractor shall set up and manage a Utilities Liaison Group for the duration of the Contract. The Group shall meet at a frequency to be as instructed by the Employer's Representative but at least once a month, and shall discuss and resolve matters associated with utility undertakings on programming, co-ordination and action. The Contractor shall ensure that all relevant utility undertakings and the Employer's Representative are represented at the meetings.
- 19.3.8 The Contractor shall inform the Employer's Representative of the date, time and place of every meeting with utility undertakings and he shall copy all correspondence and minutes of meetings to the Employer's Representative.
- 19.3.9 The programme for any section of work to be carried out by a utility undertaking shall be confirmed in writing by the Contractor to the utility undertaking no more than four weeks and no less than one week before the agreed scheduled start date for that section of Works, such confirmation to be notified to the Employer's Representative.
- 19.3.10 The Contractor shall monitor the progress of utility undertakings against the agreed programmes and shall notify the Employer's Representative of any slippage to these programmes. The agreed programmes shall mean those programmes agreed in writing by the Contractor and the various utility undertakings described in 19.3.9 above.
- 19.3.11 In the event of any such slippage, the Contractor shall prepare and execute a plan of action with the relevant utility undertaking to redress the slippage. Such a plan may, if necessary, include provision of Contractor's labour resources, materials and/or plant to the utility undertaking.
- 19.3.12 The Contractor shall ensure that the peak particle velocity and amplitude of ground movement due to temporary sheet pile driving for trench excavation or any other construction activities, as measured by a vibrograph at all water mains within or adjacent to the Site shall not exceed the values specified in Table 19-1 of this GS.

Type of structure or installation	Peak particle velocity (mm/s)	Vibration amplitude (mm)
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Type of structure or installation	Peak particle velocity (mm/s)	Vibration amplitude (mm)
Water retaining structures Water tunnels	13	0.1
Water mains Other structures and pipes	25	0.2

**Table 19-1 – Peak Particle Velocity & Vibration Amplitude**

19.3.13 Hand digging method shall always be employed where there are utilities adjacent to or within the trench excavation works. Portable mechanical tools may be used but shall be restricted to the breaking of the pavement surface. Due care shall be exercised to prevent damage to the underground cables, water pipes, gas pipes or other utility installations.

19.3.14 Exposed utility installations shall be adequately supported and protected from accidental damage.

19.3.15 Smoking and use of naked flames shall be prohibited if gas pipes are present, or pipes the use of which are not identified are present.

#### **19.4 Structures, Roads and Other Property**

19.4.1 The Contractor shall immediately inform the Employer's Representative of any damage to structures, roads or other property that is not required for the execution of the Works.

19.4.2 The Contractor shall use every reasonable means to prevent any of the highways or bridges connecting with, or on the routes to, the Site from being damaged by any traffic of the Contractor or any of his sub-contractors of any tier and the Contractor shall, in particular, select routes, choose and use vehicles and restrict and distribute loads so that the moving of Temporary Works, Permanent Works and Contractor's Equipment from and to the Site shall be organised as far as reasonably possible so that no unnecessary damage or injury may be occasioned to such highways and bridges. The Contractor shall in selecting such routes take advice from and follow the instructions of the Commissioner for Transport and other Relevant Authorities of UP Government and GOI.

19.4.3 Should the Commissioner for Transport or any other Relevant Authority or the Contractor be of the opinion that it should be necessary to move one or more loads of Temporary Works, Permanent Works or Contractor's Equipment over a highway or bridge the moving of which is likely to damage any highway or bridge unless special protection or strengthening is carried out then the Contractor shall, before moving the load on to such highway or bridge, give notice to the Employer's Representative of the weight and other particulars of the load to be moved and request the protection or strengthening of the said highway or bridge. If within 14 (fourteen) days of receipt of such notice the Employer's Representative directs in writing that such protection or strengthening is unnecessary then the Contractor may move the said load or loads over the said highway or bridge but otherwise the Contractor shall not move the said load or loads until notified by the Employer's Representative of the route which he may use.

- 19.4.4 If during the execution of the Works or at any time thereafter the Contractor shall receive any claim arising out of the execution of the Works in respect of damage or injury to highways or bridges he shall immediately report the same to the Employer's Representative and thereafter the Employer shall negotiate the settlement of and pay all sums due in respect of each claim and shall indemnify the Contractor in respect thereof and in respect of all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in relation thereto. Provided always that if and so far any such claim or part thereof shall in the opinion of the Employer's Representative be due to any failure on the part of the Contractor to observe and perform his obligations under clauses 19.4.2 above and 19.4.3 above, the amount certified by the Employer's Representative to be due to such failure shall be paid by the Contractor to the Employer.
- 19.4.5 Where the nature of the Works is such as to require the use by the Contractor of water-borne transport, the foregoing provisions of this Clause shall be construed as though "highway" includes any river or other structure related to, on or beneath a waterway, and "vehicle" includes craft, vessels or platforms and shall be read and construed accordingly.
- 19.4.6 If in the course of or for the purposes of the execution of the Works or any part thereof any highway or road or way shall have been damaged, broken or broken into then notwithstanding anything herein contained:
- (a) If the permanent reinstatement of such highway or road or way is to be carried out by the appropriate Relevant Authority or by some person other than the Contractor or any sub-contractor of any tier to him, the Contractor shall:
    - (i) at his own cost and independently of any requirement of or notice from the Employer's Representative be responsible for the temporary reinstatement of such highway, road or way and the making good of any subsidence or shrinkage or other defect, imperfection, settlement or fault in the temporary reinstatement of such highway, road or way and for the execution of any necessary repair or amendment thereof from whatever cause the necessity arises until the end of the Defects Liability Period in respect of the part of the Permanent Works beneath or over such highway, road or way or until the Relevant Authority or such other person as aforesaid shall have taken possession of the highway, road or way for the purpose of carrying out permanent reinstatement, whichever is the earlier; and
    - (ii) indemnify and save harmless the Employer against and from any damage or injury to the Employer or claims by third parties arising out of or in consequence of any neglect or failure of the Contractor to comply with the foregoing obligations or any of them, and against and from all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto; and
  - b) as from the end of such Defects Liability Period or the taking of possession of such highway, road or way referred to in clause 19.4.6(a)(i) above whichever shall first happen, the Employer shall indemnify and save harmless the Contractor against and from any damage or injury to the Contractor arising out of or in consequence

of or in connection with the said permanent reinstatement or any defect, imperfection or failure of or in such permanent reinstatement and against and from all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

- 19.4.7 Where the Relevant Authority or other person referred to in clause 19.4.6 above shall take possession of the highway, road or way as aforesaid in sections or lengths, the responsibility of the Contractor under clause 19.4.6 above shall cease in regard to any such section or length at the time at which possession thereof is so taken. But shall during the continuance of the said Defects Liability Period continue to be responsible for any section or length of which possession has not been taken and the indemnities given by the Contractor and Employer respectively under clause 19.4.6 above shall be construed and have effect accordingly.

## **19.5 Access**

Alternative access shall be provided if interference with existing public or private vehicular or pedestrian access is necessary to enable the execution of the Works. The arrangements for the alternative access shall be as reviewed without objection by the Employer's Representative. The permanent access shall be reinstated as soon as practicable after the work is complete and the alternative access shall be removed as soon as practicable after it is no longer required.

## **19.6 Trees and Other Similar Obstructions**

- 19.6.1 Trees which are to be retained or which are not required to be removed in order to carry out the Works, shall be protected from damage at all times by methods reviewed without objection by the Employer's Representative. Materials, including excavated materials, shall not be banked around such trees and they shall not be trimmed or cut without having been reviewed without objection by the Employer's Representative.
- 19.6.2 If any trees or other obstructions are required to be removed during the execution of the Works which are not specifically required to be removed or otherwise catered for, the Contractor shall draw the attention of the Employer's Representative to them and shall not remove them without having received a notice of no objection from the Employer's Representative.

## **19.7 Noise Control on Works Site**

- 19.7.1 All Contractor's Equipment shall be effectively "sound-reduced" by means of silencers, mufflers, acoustics linings or shields or acoustic sheds or screens to levels prescribed in the relevant Noise Control Ordinance and measured outside the nearest occupied property or to the satisfaction of the Employer's Representative. The Contractor shall provide details of proposed noise control measures to the Employer's Representative for review prior to the use of any Contractor's Equipment on the Site.
- 19.7.2 Provided that the provisions of this Paragraph shall not be applicable in the case of emergency work necessary to save life or property or for the safety of the Works or in the case of blasting operations necessitated by urgency and reviewed by the Employer's Representative.

- 19.7.3 The Contractor shall provide a sound level meter (as specified in this Specification), reviewed without objection by the Employer's Representative, for the exclusive use of the Employer's Representative at all times during the continuance of the Contract.

## **19.8 Spoil Disposal**

- 19.8.1 The Contractor shall make his own enquiries and arrangements regarding the location and the availability of spoil disposal areas and reclamation and shall pay all costs of complying with all regulations and requirements of Relevant Authorities in connection with the use of such areas. These areas are not within the control of the Employer and no claims will be entertained in respect of non-availability of a particular areas or changes in the costs of arrangements for the use thereof.
- 19.8.2 The Contractor shall be responsible for all necessary liaison to ensure compliance with the requirements of unproductive disposal of any surplus excavated rock or soft material which is suitable for filling
- 19.8.3 The Contractor shall conform to all pertinent Environmental Protection Ordinances and be liable for any breach of such Ordinances committed by himself and/or his sub-contractors during the disposal of surplus excavated material and water from the Site.

## CHAPTER 20

### 20. ENVIRONMENTAL PROTECTION REQUIREMENTS

#### 20.1 GENERAL

- 20.1.1 The Contractor shall conform to the Indian Environmental Laws and codes as applicable. The current national standards established by the Ministry of Environment and Forest, Government of India and other government agencies for control of environmental pollutants such as air, water, noise and visual impacts/aesthetics shall be followed for compliance during project construction.
- 20.1.2 The Contractor shall comply with all enactment which shall include but are not limited to:
1. Environment Protection Act, 1986
  2. Air (Prevention and control of Pollution) Act, 1981
  3. Water (Prevention and Control of Pollution) Act, 1974
- 20.1.3 The provisions listed herein regarding Environmental Protection shall apply to and be binding upon the Contractor for any works on the site and the persons employed by sub-Contractors. The Contractor shall ensure that proper and adequate provisions to this end are included in all sub-contracts placed by him.
- 20.1.4 The provisions of this Chapter however, shall not be applicable in the case of emergency works necessary for saving of life and property or safety of the Works.
- 20.1.5 The Contractor has been issued with the Employer's Environmental Quality Management Manual. Within 20 weeks of notification of acceptance of the Tender, the Contractor shall submit for review by the Employer's Representative, a draft of his own contract specific Site Environmental Plan based on the Employer's Environmental Quality Management Manual and his construction methodology. He shall submit a final version prior to the commencement of the works.
- 20.1.6 This contract specific Site Environmental Plan of the Contractor, as referred to in Chapter 3 above, shall be consistent with the provisions of the Environmental Management Plan outline, as given in the Employer's Environmental Quality Management Manual. The Contractor is however not required to undertake air monitoring.
- 20.1.7 The Contractor shall ensure that audits of all the activities detailed in his Site Environmental Plan are carried out at weekly intervals or at such intervals as the Employer's Representative may require to ensure the continuing effectiveness and compliance with the Site Environmental Plan. The Contractor shall make available on request any document, which relates to his recent internal audits.
- 20.1.8 The Employer's Representative may conduct quarterly Audits of the Contractor's Site Environmental Plan and its effective implementation on the works site. Not less than 2 weeks notice will be given by the Employer's

Representative. During the audit by the Employer's Representative, the Contractor shall provide suitably qualified staff to accompany the auditor.

20.1.9 Payments will be achieved for successful quarterly audits for which the Employer's Representative has issued a "Notice of No Objection" or a "Notice of No Objection subject to...."

20.1.10 Requirements established in this Chapter shall apply to all sites and all activities of the Contractor, and shall supplement the Employer's Requirements – Construction.

## **20.2 AVOIDANCE OF NUISANCE**

20.2.1 The Contractor shall take all precautions to avoid any nuisance arising from his operations. This shall be accomplished, wherever possible by suppression of nuisance at source rather than abatement of the nuisance once generated.

20.2.2 Following site clearing and before construction, the Contractor shall remove all trash, debris and other weeds.

20.2.3 The Contractor shall ensure that the work place is free of trash, garbage, debris and weeds. He shall provide and ensure proper uses of refuse containers to ensure that rodents, fleas and other pests are not harboured and attracted.

20.2.4 The Contractor shall provide at site, metal or heavy-duty plastic 'Refuse Containers' with tight fitting lids for disposal of all garbage or trash associated with food. The containers shall not have openings that allow access by rodents.

20.2.5 To keep the area free of litter and garbage, specific locations shall be designated for consuming food and snacks to prevent random disposal of waste. All waste shall be deposited in the refuse containers described in (3) above. Suitable notice shall be deployed prominently for strict compliance of these requirements.

20.2.6 The refuse containers shall be kept upright with their lids shut tight. These containers shall be emptied at least once daily by the Contractor to maintain site sanitation.

## **20.3 AIR QUALITY**

20.3.1 The Contractor shall take all necessary precautions to minimise fugitive dust emissions from operations involving excavation, grading, clearing of land and disposal of waste. He shall not allow emissions of fugitive dust from any transport, handling, construction or storage activity to remain visible in atmosphere beyond the property line of emission source for any prolonged period of time without notification to the Employer's Representative.

20.3.2 The Contractor shall use equipment designed and equipped to minimise or control air pollution. He shall maintain evidence of such equipment and make these available for inspection by Employer's Representative.

20.3.3 If after commencement of activity, Employer's Representative believes that the Contractor's equipment or methods of working are causing unacceptable air pollution impacts then these shall be inspected and remedial proposals

shall be drawn up by the Contractor, submitted for review to the Employer's Representative and implemented.

- 20.3.4 In developing these remedial measures, the Contractor shall inspect and review all dust sources that may be contributing to air pollution. Remedial measures include use of additional/ alternative equipment by the Contractor or maintenance/modification of existing equipment of the Contractor.
- 20.3.5 Dust generating materials shall be:
- (i) Transported in closed containers or covered trucks.
  - (ii) Loaded and unloaded in closed systems or wind protected areas.
  - (iii) Watered as appropriate to minimise dust production.
- 20.3.6 Contractor's transport vehicles and other equipment shall conform to emission standards fixed by Statutory Agencies of Government of India from time to time at Lucknow. The Contractor shall carry out periodical checks and undertake remedial measures including replacement, if required, so as to operate within permissible norms.
- 20.3.7 In the event that approved remedial measures are not being implemented and serious impacts persist, the Employer's Representative may direct the Contractor to suspend work until the measures are implemented, as required under the Contract.
- 20.3.8 The Contractor shall cover loads of materials, debris and soil transported from construction sites. All trucks carrying loose material should be covered and loaded with sufficient free- board to avoid spills through the tail board or side boards.
- 20.3.9 The Contractor shall be responsible for ensuring that no earth, rock or debris is deposited on public or private right of way as a result of his operations, including any deposits arising from the movement of loaded/unloaded trucks and/or other construction vehicles.
- 20.3.10 The Contractor shall make his own arrangements for water for purposes stated in above clauses and wherever it may be required to control air pollution, dust and debris.
- 20.3.11 The Contractor shall establish and maintain records of routine maintenance program for internal combustion engine powered vehicles and equipment used on this project. He shall keep records available for inspection by Employer's Representative.
- 20.3.12 The Contractor shall promptly transport all excavation disposal materials of whatever kind so as not to delay work on the project. Stockpiling of materials will only be allowed at sites designated by the Employer's Representative.
- 20.3.13 The Contractor shall protect structures, utilities, pavements and other facilities from disfiguration and damage.
- 20.3.14 The Contractor shall place excavation materials in the dumping/disposal areas designated in the plans as given in the specifications.
- 20.3.15 The temporary dumping areas shall be maintained by the Contractor at all times until the excavate is re-utilised for backfilling or as directed by Employer's Representative.



- 20.3.16 The Contractor shall place material in a manner that will minimise dust production. Material shall be stabilised each day and wetted, to minimise dust production.
- 20.3.17 During dry weather, dust control methods must be used daily especially on windy, dry days to prevent any dust from blowing across the site perimeter.
- 20.3.18 The Contractor will make water sprinklers, water supply and water delivering equipment available at any time that it is required for dust control use.
- 20.3.19 Dust control activities shall continue even during any work stoppage.
- 20.3.20 The Contractor shall water down work sites as required to suppress dust, during handling of excavation soil or debris or during demolition.
- 20.3.21 At each work site, the Contractor shall provide storage facilities for dust generating materials and shall be:
- (i) Closed containers/bins or;
  - (ii) Wind protected shelters or;
  - (iii) Mat covering or;
  - (iv) Walled.
- Or any combination of the above to the satisfaction of the Employer's Representative.
- 20.3.22 The Contractor shall implement his blasting techniques so as to minimise dust generation.

## **20.4 WATER QUALITY**

- 20.4.1 The Contractor shall comply with the Indian Government legislation and other State regulations in existence in Lucknow insofar as they relate to water pollution control and monitoring.
- 20.4.2 The Contractor shall provide adequate precautions to ensure that no spoil or debris of any kind is pushed, washed, falls or deposited on land adjacent to the site perimeter.
- 20.4.3 In the event of any spoil or debris from construction works being deposited on adjacent land any silt washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land and areas restored to their natural state by the Contractor to the satisfaction of the Employer's Representative.
- 20.4.4 Due to lowering of potable water supplies in Lucknow and subsequent contamination of ground water, the Contractor is not allowed to discharge water from the site without the approval of the Employer's Representative. The Contractor must comply with the requirements of the Central Ground Water Board for discharge of water arising from dewatering. Any water obtained from dewatering systems installed in the works must be either re-used for construction purposes and this water may subsequently be discharged to the drainage system or, if not re-used, recharged to the ground water at suitable aquifer levels. The Contractor must submit his proposals for approval of Employer's Representative, on his proposed locations of dewatering of excavation and collection of water for either construction re-use or recharge directly to aquifers. The Contractor's recharge proposals must be sufficient for recharging of the quantity of water remaining after deduction of water re-



used for construction. The Contractor will not be permitted to directly discharge, to the drainage system, unused ground water obtaining from the excavation without obtaining approval of Employer's Representative or the Agency controlling the system.

- 20.4.5 The Contractor shall prevent soil particles and debris from entering the wells or water discharge points by use of filters and sedimentation basins as required.
- 20.4.6 The Contractor shall provide treatment facilities as necessary to prevent the discharge of contaminated ground water.
- 20.4.7 The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to the site are kept safe and free from any debris and any excavated materials arising from the Works. The Contractor shall ensure that earth, bentonite, chemicals and concrete agitator washings etc. are not deposited in the watercourses but are suitably treated and effluents and residue disposed off in a manner approved by local authorities.
- 20.4.8 All water and waste products (surface runoff and wastewater) arising on the site shall be collected and removed from the site via a suitable and properly designed temporary drainage system and disposed off at a location and in a manner that will cause neither pollution nor nuisance.
- 20.4.9 Any mud slurry from drilling, tunnelling, diaphragm wall construction or grouting etc. shall not be discharged into the drainage system unless treatment is carried out that will remove silt, mud particles, bentonite etc.
- 20.4.10 The Contractor shall discharge wastewater arising out of site office, canteen or toilet facilities constructed by him into sewers after obtaining prior approval of agency controlling the system. A wastewater drainage system shall be provided to drain wastewater into the sewerage system.
- 20.4.11 Oil removal / interceptors shall be provided to treat oil waste from workshop areas etc.
- 20.4.12 The Contractor shall take measures to prevent discharge of oil and grease during spillage from reaching drainage system or any water body through Spill Prevention and Control Plan.

## **20.5 NOISE**

### **20.5.1 General**

- (1) The Contractor shall consider noise as an environmental constraint in his planning and execution of the Works. The Contractor shall, at his own expense, take all appropriate measures to ensure that work carried out by the Contractor and by his sub-Contractors, whether on or off the Site, will not cause any unnecessary or excessive noise which may disturb the occupants of any nearby dwellings, schools, hospitals, or premises with similar sensitivity to noise.
- (2) Without prejudice to the generality of the foregoing, noise level reduction measures shall include the following:
  - (a) the Contractor shall ensure that all powered mechanical equipment used in the Works shall be effectively sound reduced using the most modern techniques available including but not limited to silencers and

mufflers.

- (b) the Contractor shall construct acoustic screens or enclosures around any parts of the Works from which excessive noise may be generated.

(3) The Contractor shall ensure that noise generated by work carried out by the Contractor and his sub-Contractors during day time and night time shall not exceed the maximum permissible noise limits, as given in the Employer's Environmental Quality Management Manual. The same may be varied from time to time by and at the sole discretion of the Employer's Representative, In the event of a breach of this requirement, the Contractor shall immediately re-deploy or adjust the relevant equipment or take other appropriate measures to reduce the noise levels and thereafter maintain them at levels which do not exceed the said limits. Such measures may include without limitation the temporary or permanent cessation of use of certain items of equipment.

(4) The noise monitoring requirements are given in the Employer's Environment Quality Management Manual. However, the monitoring locations shall be decided in consultation with the Employer's Representative.

20.5.2 Construction material should be handled and transported in such a manner as not to create unnecessary noise as outlined below.

20.5.3 Under the Contract, the Contractor shall:

- (1) Perform Work within the procedures outlined herein and comply with applicable codes, regulations, and standards established by the Central and State Government and their agencies.
- (2) Keep noise to the lowest reasonably practicable level. Appropriate measures will be taken to ensure that construction works will not cause any unnecessary or excessive noise, which may disturb the occupants of any nearby dwellings, schools, hospitals, or premises with similar sensitivity to noise. Use equipment with effective noise-suppression devices and employ other noise control measures as to protect the public.
- (3) Schedule and conduct operations in a manner that will minimize, to the greatest extent feasible, the disturbance to the public in areas adjacent to the construction activities and to occupants of buildings in the vicinity of the construction activities.
- (4) The Contractor shall submit to the Employer's Representative a Noise Monitoring and Control Plan (NMCP) under contract specific Site Environmental Plan. It shall include full and comprehensive details of all powered mechanical equipment, which he proposes to use during daytime and nighttime, and of his proposed working methods and noise level reduction measures. The NMCP shall include detailed noise calculations to demonstrate the anticipated noise generation by the Contractor.
- (5) The NMCP prepared by the Contractor shall guide the implementation of construction activity. The NMCP will be reviewed on a regular basis and updated as necessary to assure that current construction activities are addressed. It shall appear as a regular agenda item in project coordination meetings.

#### 20.5.4 Vibration Level Limits

The vibration level limits at historical sites adjacent to the alignment shall conform to revised version of the German Standard (DIN 4150). The scheme for monitoring vibration level at these historical sites shall be submitted to Employer's Representative for his approval. The scheme shall include:

- (1) monitoring requirements for vibrations at regular intervals throughout the construction period.
- (2) pre-construction structural integrity inspections of historic and sensitive structures in project activity.
- (3) Information dissemination about the construction method, probable effects, quality control measures and precautions to be used.

### 20.6 WASTE

20.6.1 The Contractor shall handle waste in a manner that ensures they are held securely without loss or leakage thus minimising potential for pollution.

20.6.2 The Contractor shall remove waste in a timely manner. Scrap and waste material shall be removed and disposed off at landfill sites after obtaining approval of Conservancy and Sanitation Engineering Department of Municipal Corporation of Lucknow/Nagar Nigam for its disposal.

20.6.3 Burning of wastes is prohibited. The Contractor shall not burn debris or vegetation or construction waste on the site but remove it in accordance with (2) above.

20.6.4 The Contractor shall maintain and clean waste storage areas regularly.

20.6.5 If encountered or generated as a result of Contractor's activity, then waste classified as hazardous under the "Hazardous Wastes (Management & Handling) Rules, 1989" and chemicals classified as hazardous chemicals under "Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 of Environment (Protection) Act, 1986 shall be disposed off in a manner in compliance with the procedure given in the rules under the aforesaid act.

### 20.7 PREVENTION OF MOSQUITO BREEDING

20.7.1 Measures shall be taken to prevent mosquito breeding at site. The measures to be taken shall include:

- (a) empty cans, oil drums, packing and other receptacles which may retain water shall be deposited at a central collection point and shall be removed from the Site regularly;
- (b) still waters shall be treated at least once every week with oil in order to prevent mosquito breeding;
- (c) Contractor's Equipment and other items on the Site which may retain water shall be stored, covered or treated in such a manner that water could not be retained.
- (d) Water storage tanks shall be suitably provided.

- 20.7.2 Posters in both Hindi and English which draw attention to the dangers of permitting mosquito breeding shall be displayed prominently on the Site.

## CHAPTER 21

### 21. PHOTOGRAPHS

#### 21.1 Photographs

- 21.1.1 Colour progress photographs showing the progress of the Works and the quality of the materials and workmanship shall be taken by the Contractor. The photographs shall be taken by a professional photographer, nominated by the Contractor and reviewed without objection by the Employer's Representative. Processing shall be carried out by a competent processing firm, nominated by the Contractor and reviewed without objection by the Employer's Representative. The photographs shall be taken under the direction of the Employer or the Employer's Representative at locations selected by the Employer or the Employer's Representative. Photographs shall be taken once every month and at other times instructed by the Employer or the Employer's Representative.
- 21.1.2 One proof 3R print of each progress photograph shall be provided to the Employer's Representative not more than 2 days after the photographs are taken. The Employer's Representative shall select the sets of progress photographs to be provided. The selected sets shall be provided not more than 2 days after the Employer's Representative has selected the sets. The following shall be provided for the Employer's Representative:
- (1) one set of each selected progress photograph comprising the negatives and three 3R prints;
  - (2) albums for the photographs and negatives; and
  - (3) printed labels for each photograph.
- 21.1.3 The Contractor shall provide to the Employer's Representative the photographs selected in clause 0 above on Photo Compact Disks with a minimum resolution of 64 Base (4096 x 6144).
- 21.1.4 The Contractor may propose to the Employer's Representative the use of a digital photography system to meet the requirements of this Chapter. The Employer's Representative shall at his discretion, review the proposed system for practical and technical compliance.
- 21.1.5 Colour progress photographs shall provide a fair representation of the Works. A minimum of 24 photographs per month shall be submitted to the Employer's Representative.

## CHAPTER 22

### 22 TEMPORARY ELECTRICITY SUPPLY

#### 22.1 Electricity Supply for the Contractor by the Project Civil Contractors

22.1.1 Please Refer Appendix-2D of GS

#### 22.2 Applicability

22.1.1 Where the Contractor is required to provide temporary electrical supplies, or to use, extend or expand on temporary supplies installed by others, all such activity shall be executed in accordance with clauses 22.2 to 22.17 inclusive.

22.1.2 When the Contractor makes use of temporary electrical supplies provided by other, viz. Project (Civil) Contractors, he will observe and comply with the requirements of this Chapter.

#### 22.2 Work on Site

22.2.1 The Contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Employer's Representative for review not later than 4 weeks before the appointment and who shall be solely responsible for ensuring the safety of all temporary electrical equipment on Site. The Contractor shall not install or operate any temporary Site electrical systems until this representative is appointed and has commenced duties.

22.2.2 The name and contact telephone number of the representative having been reviewed without objection by the Employer's Representative shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.

22.2.3 The Contractor shall submit schematic diagrams and the details of the equipment for all temporary electrical installations, and these diagrams together with the temporary electrical equipment shall be submitted to the Employer's Representative for review.

22.2.4 All electrical installation work on Site shall be carried out in accordance with the requirements laid down in BS 7375 and the Specification. All work shall be supervised or executed by qualified and suitably categorised electricians, who are registered as such under the Electricity Ordinance 1990/Electricity (Registration) Regulations 1990.

#### 22.3 Electrical General

Temporary electrical Site installations and distribution systems shall be in accordance with:-

- (1) Indian Electrical Regulations;
- (2) The Power Companies' Supply Rules;
- (3) Electricity and its subsidiary Regulations;
- (4) IEE Wiring Regulations (16th Edition);
- (5) BS 7375 Distribution of Electricity on Construction and Building Sites;
- (6) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites; and

- (7) Any other applicable national standards

## **22.4 Materials, Appliances and Components**

All materials, appliances and components used within the distribution system shall comply with BS 4363 and BS 7375 Appendix A.

## **22.5 Mains Voltage**

- 22.5.1 The Site mains voltage shall be as the Electricity Companies' Utility supplies, 415V 3-phase 4 wire system.
- 22.5.2 Single-phase voltage shall be as the Electricity Companies' Utility supplies, 240V supply.
- 22.5.3 Reduced voltages shall conform to BS 7375.

## **22.6 Types of Distribution Supply**

- 22.6.1 The following voltages shall be adhered to for typical applications throughout the distribution systems:
  - (1) fixed plant - 415V 3 phase;
  - (2) movable plant fed by trailing cable - 415V 3 phase;
  - (3) installations in Site buildings - 240V 1 phase;
  - (4) fixed flood lighting – 240V 1 phase;
  - (5) portable and hand held tools - 115V 1 phase;
  - (6) Site lighting (other than flood lighting) - 115V 1 phase; and
  - (7) portable hand-lamps (general use) - 115V 1 phase.
- 22.6.2 When the low voltage supply is energised via the Employer's transformer, any power utilised from that source shall be either 415V 3 phase or / 240V single phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.

## **22.7 Protection of Circuits**

- 22.7.1 Protection shall be provided for all main and sub-circuits against excess current, residual current and earth faults. The protective devices shall be capable of interrupting (without damage to any equipment or the mains or sub-circuits) any short circuit current that may occur.
- 22.7.2 Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with:-
  - (1) BS 88;
  - (2) BS EN 60898; and
  - (3) BS 7375;
  - (4) Any other appropriate Indian Standards.



### **22.7.3 Earthing**

22.7.4 Earthing and bonding shall be provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises and to ensure that faults are rapidly cleared by installed circuit protection.

22.7.5 Earthing systems shall conform to the following standards:-

- (1) IEE Wiring Regulations (16th Edition);
- (2) BS 7430;
- (3) BS 7375; and
- (4) IEEE Standard 80 Guide for Safety in AC Substation Grounding.

### **22.8 Plugs, Socket Outlets and Couplers**

Low voltage plugs, sockets and couplers shall be colour coded in accordance with BS 7375, and constructed to conform to BS EN 60309. High voltage couplers and 'T' connections shall be in accordance with BS 3905.

### **22.9 Cables**

22.9.1 Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required. Supply cables up to 3.3KV shall be in accordance with BS 6346. The cable armouring shall be used as the earth return in conditions where the cable is continuously extended and not subject to continuous movement after installation.

22.9.2 For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to one of the following standards appropriate to the duties imposed on it:

- (1) BS 6708 flexible cables for use at mines and quarries;
- (2) BS 6007 rubber insulated cables for electric power and lighting; and
- (3) BS 6500 insulated flexible cords and cables.

22.9.3 Where low voltage cables are to be used, reference shall be made to BS 7375. The following standards shall also be referred to particularly for underground cables:-

- (1) BS 6346 for armoured PVC insulated cables; and
- (2) BS 6708 Flexible cables for use at mines and quarries.

22.9.4 All cables which have a voltage to earth exceeding 65 V (except for supplies from

welding transformers to welding electrodes) shall be of a type having a metal sheath and/or armour which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.

22.9.5 Armoured cables having an over-sheath of polyvinyl chloride (PVC) or an oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring.

22.9.6 For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.

22.9.7 Cables which have applied to them a voltage to earth exceeding 12 V but not normally exceeding 65 V shall be either one of the type as described in clause 22.9.5 above or alternatively of a type insulated and sheathed with a general purpose or heat resisting elastomer.

22.9.7.1 All cables that are likely to be frequently moved in normal use shall be flexible cables.

22.9.7.2 Flexible cables shall be in accordance with BS 6500 and BS 7375.

## **22.10 Lighting Installation**

22.10.1.1.1 Lighting circuits shall be run separate from other sub-circuits and shall be in accordance with BS 7375 and BS 4363.

22.10.1.1.2 Voltage shall not exceed 55 V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.

22.10.1.1.3 Luminaries shall have a degree of protection not less than IP 54. In particularly bad environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.

22.10.1.1.4 Where the Employer's Representative requires Site inspection of the Works, the Contractor shall upgrade the lighting level to a minimum of 200 lux by localised lighting in all areas.

22.10.1.1.5 Use of wire guards or other such devices shall provide mechanical protection of luminaries against damage by impact whenever risk of damage occurs.

## **22.11 Electrical Motors**

22.11.1.1.1 Totally enclosed fan cooled motors to BS 4999:Part 105 shall be used.

22.11.1.1.2 Motor control and protection circuits shall be as stipulated in BS 6164. Emergency stops for machinery shall be provided.

## **22.12 Inspection and Testing**

Electrical installations on Site shall be inspected and tested in accordance with the requirements of the IEE Wiring Regulations (16th Edition).

#### **22.13 Identification**

Identification labels of a type reviewed without objection by the Employer's Representative shall be affixed to all electrical switches, circuit breakers and motors to specify their purpose.

#### **22.14 Maintenance**

Strict maintenance and regular checks of control apparatus and wiring distribution systems shall be carried out by an electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems. The Contractor shall submit for review by the Employer's Representative details of his maintenance schedule and maintenance works record.

#### **22.15 Maintenance Record**

All portable electrical appliances shall be permanently numbered (scarf tag labels or similar) and a record kept of the date of issue, date of the last inspection carried out and the recommended inspection period.

#### **22.16 Metering**

22.16.1 For the purposes of the clause 22.16 above, "construction works" shall mean the Works excluding both the Contractor's on and off Site, fabrication facilities, workshops, work-yards, offices and stores.

22.16.2 The Contractor shall install a separately metered and invoiced supply or supplies of electricity for:-

- (1) Site fabrication facilities;
- (2) Site workshops and work-yards; and
- (3) Site offices and stores.

#### **22.17 Inability to Supply**

Wherever, the Project Contractor is not in a position to supply construction power and water supply to the Systemwide Contractor, he (the Systemwide Contractor) shall arrange for his own separate construction power and water supply.

LKE(02)-02: Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 02 (two) Years Defect Liability Period (DLP) and 01 (one) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.

## **CHAPTER 23**

Not Used

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **APPENDIX 1**

### **DRAWING LIST**

Deleted

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 2A**

#### **WORKS AREAS**

#### **WORKS AREAS**

- (a) Temporary Occupation of land is governed by Chapter-XI of land acquisition act - 2013 which limits occupation to 3 years.
- (b) Prior to the Works Area Handover Dates for returning any Works Area, the Contractor shall carry out the following works:
  - (i) construct all Permanent Works within the area, to the extent defined in this Appendix, in accordance with the requirements of the Contract,
  - (ii) reinstate the area to the condition as close as possible to its condition when it was taken over,
  - (iii) form the area to the approved lines and levels and carry out such other works as may be required by the Employer's Representative,
  - (iv) remove all rubbish, debris and other materials.

## **EMPLOYER'S REQUIREMENTS**

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

## APPENDIX 2B

### Key dates

Key Dates	Weeks from date of issue of LOA					Liquidated Damage for not achieving the key dates
	Description of Project Activity	Elevated Corridor & Depot-1B	UG Corridor-1B	Agra & Kanpur Corridor-1 & 2	Agra Staff Quarters	
KD-1	Submission of Preliminary Design	6	24	2	4	0.01% of the contract value per week of delay for the key date.
KD-2	Submission of Definitive design	12	32	5	10	0.01% of the contract value per week of delay for the key date.
KD-3	Delivery at Site	95	160	15	30	0.01% of the contract value per week of delay for the key date.
KD-4	Installation, Testing & Commissioning	111	180	29	36	0.01% of the contract value per week of delay for the key date.
KD-5	Taking over & Integrated Testing	113	182	31	38	0.01% of the contract value per week of delay for the key date.

#### Notes:-

1. These dates are sacrosanct and are to be strictly adhered to.
2. For part week. Full week will be considered for this purpose.
3. The LD of 0.01% will be distributed equally for each Lift/Escalator and the same shall be levied only for the Lift/Escalators where Key-Date is not achieved.



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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 2C - Deleted**

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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**EMPLOYER'S REQUIREMENTS**

**APPENDIX 2D- Interface Management Document**

**(Refer Appendix-A of Particular Specification)**

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 3**

#### **PROJECT CALENDAR**

- (1) The Project Weeks shall be commenced on a Monday. A day shall be deemed to commence at 0001 hour on the morning of the day in question. Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week.
- (2) Requirements for the computation of Key Dates are given in Appendix 2B to the Employer's Requirements.
- (3) A 7day week calendar shall be adopted for various (Work) programme schedules for scheduling purposes.
- (4) For Project purposes, the presentation shall be in 'Week''' units.

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 4**

#### **PROGRAMME REQUIREMENTS**

##### **1. GENERAL**

###### **(1) Purpose of Programme**

There are two primary purposes for the requirement of Programme (Scheduling) information described in this document:

- a. Evaluation of Tender
- b. Status Reports during Construction

To provide the Engineer with status reports for managing, monitoring and coordinating the awarded contracts during their execution within the overall multi-contract project schedule.

The requirements are organized in two stages. The first stage is a requirement for all Tenderers and shall be submitted as part of Tender. The second stage is a requirement of the Employer and describes a series of reports to be submitted by the Contractor to the Engineer during the execution of the contract, following the award of Contract.

- (2) The Tenderer/ Contractor shall programme his work at all times to meet the Key Dates stated in Appendix 2B to the Employer's Requirements and the specified interface periods for the design and installation of the Works with those of the Designated Contractors and shall during the progress of the Works constantly monitor his progress against the programmes described below.
- (3) The Tenderer/ Contractor shall include in all programmes his work obligations towards shared access, shared Site areas and other coincident or adjacent Works Areas.
- (4) The Works Programme, and all more detailed or revised versions, shall be submitted to the Engineer in **hard copy as well as soft copy** for his consent in accordance with the provisions of the GCC.

##### **2. METHODOLOGY**

- (1) The **computerized Critical Path Method (CPM) network using the Precedence Diagramming Method (PDM)**, has been selected by the Employer as the technique for contract management system and in co-coordinating the multi-contract project. This technique shall also be employed by the Tenderer in preparing their Tender submissions and by the Contractor in their Construction Stage submissions.
- (2) Unless otherwise agreed by the Engineer, all programmes submitted by the Contractor shall be produced using computerized Critical Path Method (CPM) Networks developed implementing the Precedence Diagramming Method (PDM) with Cost Loaded Charts and Tables.

- (3) The Contractor shall implement and use throughout the duration of the Contract, a computerized system to plan, execute, maintain and manage the planning, design, pre-construction, construction, and sub-contracts in executing the CPM scheduling by PDM. 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 the planned works, and for making decisions; and shall enable timely preparation of the same for presentation to the Engineer.

### **3. PROGRAMME MANAGEMENT SOFTWARE**

- (1) CPM programming software used shall be **Primavera Project Planning (P6) Program - Ver latest**. Any other compatible system capable of direct file interchange capability with software program used by the Employer - Primavera (P3), Ver 2.0b can be used with Engineer's consent. Scheduling software and relevant instruction manuals, licensed for use in connection with the contract, shall be provided by the Contractor according to the Employer's specifications
- (2) The Tenderer may use a system other than Primavera but will be required to demonstrate that full electronic data transfer to Primavera is available and that the various levels of reporting and coding capabilities are at least equivalent to Primavera. Compatibility and comparable performance between Primavera and the Tenderer's proposed system shall be demonstrated in his Tender submission. Should compatibility not be demonstrated to the Employer's satisfaction the Contractor shall utilise Primavera for development, statusing, updating and revision of all the Programmes during the duration of the Contract. Upon the Engineer's consent of a system other than Primavera, the Contractor shall supply the Engineer with an original licensed copy, including manuals and approved training of the software and any subsequent versions thereof at no extra cost.

### **4. (Not Used)**

### **5. POST CONTRACT AWARD**

- 5.1 The Contractor shall develop his Tender Programme into the Initial Works Programme including an outline Narrative Statement and submit within 15 days of the date of the Notice to Proceed and its more detailed version within **sixty (60)** days of receiving the Engineer's consent to the proposed Initial Works Programme.
- 5.2 The first Three Month Rolling Programme shall be submitted within **thirty (30)** days of the date of Notice to Proceed and all subsequent editions shall accompany the Monthly Progress Report. The Monthly Progress Reports shall also include a Programme Update as described below. These programmes shall subsequently be updated as described below.
- 5.3 Following the Contractor's Initial Works Programme submission but in any case no later than six (6) months from the date of award of contract, the contractor shall make submissions of the detailed **Works Programme** suitably amended to take into account the programmes of Designated Contracts. It is the Contractor's responsibility to ensure timely co-ordination with the Designated Contractors to review, revise and finalise his

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Initial Work Programme so as not to affect the progress of Works/ and or the works of the Designated Contractors. The resubmitted programme when approved by the Engineer shall form the **Baseline Programme** against which actual progress of the Contract shall be reckoned. As the work progresses, it may be necessary to update/ revise the Baseline programme but such updating shall only be carried out with the prior consent of the Engineer or when directed by them.

5.4 For Initial & Detail Work Programme submission, one (1) original and six (6) copies each of the following Programmes and Reports shall be submitted to the Engineer:

- a) Programme: Baseline CPM Network
- b) Programme: Baseline Milestone based Cost Activity Schedule
- c) Baseline Schedule Report
- d) Narrative
- e) Baseline Physical Progress 'S' curve
- f) Baseline Resource Charts

5.4.1 The Engineer shall review and comment on the Contractor's programmes and information submitted under this Clause. The Engineer will confirm his consent or otherwise of the submissions within thirty (30) calendar days.

5.5 The Engineer shall require the Contractor to re-submit within thirty (30) calendar days if he is of the opinion that the programmes and information submitted by the Contractor is unlikely to meet the Contract key dates.

5.6 If in the opinion of the Engineer, any of the Contractor's revised programmes or Baseline Schedule Report is not acceptable, it shall be construed as a failure of the Contractor to meet a Milestone.

5.7 Notwithstanding the above, the Engineer may at any time during the course of the Contract require the Contractor to reproduce the computer-generated Baseline Schedule Report described above to reflect actual activity dates and generate schedules based upon "what if" statements. The initial computer-generated report after receiving the Engineer's consent will serve as the base against which the contract progress will be measured. Any changes to the Report reflected in subsequent Baseline Schedule Reports shall also require the Engineer's consent.

5.8 Failure to include any element of work required for performance of the Contract shall not relieve the Contractor from completing all works required under the Contract to achieve the original or any extended key completion date.

## **6. WORKS PROGRAMME**

- (1) The Works Programme shall show the Contractor's plan for organising and carrying out whole of the Works.
- (2) The Works Programme shall be a computerised Critical Path Method (CPM) network developed using the Precedence Diagramming Method (PDM) and shall be present in bar chart and time-scaled network diagram format to a weekly or monthly time scale.
- (3) Tasks in the Works Programme shall be sufficiently detailed to describe activities

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and events that include, but are not limited to, the following:

- (a) Key Dates,
  - (b) all physical work to be undertaken in the performance of the Contract obligations, including Temporary Works,
  - (c) the requested date for issue of any drawings or information by the Engineer,
  - (d) incorporation of principal aspects of the Design Submission Programme,
  - (e) procurement of major materials and the delivery and/or partial delivery date on-Site of principal items of Contractor's Equipment,
  - (f) any off-site work such as production or pre-fabrication of components,
  - (g) installation of temporary construction facilities,
  - (h) interface periods with Designated Contractors or utility undertakings,
  - (i) design, supply and/or construction activities of sub-contractors,
  - (j) any outside influence which will or may affect the Works.
- (4) The Works Programme shall show achievement of all Key Dates.
- (5) Activity descriptions shall be unique, describing discrete elements of work. Any activity creating an imposed time or other constraint shall be fully defined by the Contractor.
- (6) 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).

Each activity in the Works Programme shall be coded to indicate:

- (a) Activity ID and Activity Code.
- (b) The Engineer may request additional activity coding to the extent available without restraint to the Contractor's utilisation of the programme software. When requested the Contractor shall add the required additional coding to the Programme. The Contractor shall use additional code fields as requested to comply with the requirements and for the use of the Contractor.
- (7) Activity duration shall not exceed two (2) weeks, unless otherwise consented to by the Engineer, except non-construction activities such as submittals, submittal reviews, procurement and delivery of materials or equipment and concrete curing. The Contractor shall submit a Programme/Project Calendar cross reference clearly indicating the allowance for holidays.
- (8) The Works Programme, in each submission, shall be accompanied by an Activity Report and a Narrative Statement as described below in both electronic (CD-R or USB drive) and hard copy format (time scale logic diagrams in A1 size, reports in A4 size).
- (9) **Activity Report** shall list all activities, and events in the Works Programme, sorted by activity identification number.

The Activity Report shall include the following for each activity and event:

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- (a) activity identification number and description,
  - (b) duration expressed in Days,
  - (c) early and late start, & 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,
  - (g) calendar.

**(10) Narrative Statement**

The Narrative shall be a comprehensive statement of the Contractor's plan and approach for the execution of the Works and the achievement of key dates, handover dates, submission dates and any intermediate dates. It shall incorporate outline method statements in respect of major items of work including construction sequences and primary item of plant, Construction Equipment, Temporary Works and the like. It shall fully explain the reasons for the main logic links in the Programme and include particulars of how activity duration are established. This shall include estimated quantities, production rates, hours per shift, work days per week and a listing of the major items of Construction Equipment planned for use on the project. Activities, which may be expedited by use of overtime or additional shifts, shall be identified and explained. A listing of holidays, and other special non-work days being used for the computer reports shall be included.

**(11) Baseline Physical Progress 'S' Curve**

The Contractor shall also submit a forecast Cumulative Physical Progress 'S' curve based on the time-phased distribution of cost in the CPM Network Logic Diagram, expressed in percentage terms. This 'S' curve shall be generated from the computerised CPM Network Logic Diagram.

**(12) Baseline Resource Charts**

The Contractor shall also submit a Resource Charts, generated from the Contractor's CPM Network Diagram, showing the anticipated manpower and main Construction Equipment usage during the execution of the Project.

As an additional monitoring facility, indicator resources shall be assigned to relevant activities for the major items of work. Indicator resources shall be directly allocated for excavation (cum), piling (no.), diaphragm walling (m), concrete (cum), tunnel lining (m), etc. Resource indicators may be input as a daily rate, expected required rate, or as an activity total in the relevant units. These are purely indicative quantities and do not form part of contract.

**(13) All submissions of proposed Works Programmes subsequently, after approval of the Initial Works Programme, shall include the actual physical progress of work and forecast of the remaining work. Actual progress shall be stated in percent complete, remaining duration, and actual start and finish dates for each activity in the Works Programme.**



**7. INITIAL WORKS PROGRAMME**

- (1) The Initial Works Programme submitted as under Clause 5.1 need not include the full details given under Clause 6 above. It should be a condensed version with combined activities of longer. The outline Narrative Statement shall be in sufficient detail to clearly show the Contractor's intention.
- (2) Within thirty (30) days of the Engineer's consent to the Initial Works Programme, the Contractor shall submit to the Engineer an expanded and more detailed version of the Initial Works Programme containing all of the information and detail required under Clause 5 above.
- (3) Such submission shall make use of the Tender Programme submitted earlier but refined to include the best estimates of dates for the work of Designated Contracts which has impact on the Contractor's programme. Such programmes shall be amended subsequently to incorporate the actual dates/schedule of the affecting contracts. It is the Contractor's responsibility to ensure timely co-ordination with the Designated Contractors to finalise the Initial Programme, without affecting progress of the work.

**8. WORKS PROGRAMME REVISIONS**

- (1) The Contractor shall immediately notify the Engineer in writing of the need for any changes in the Works Programme, whether due to a change of intention or of circumstances or for any other reason. Where such proposed change affects timely completion of the Works or any other Key Date the Contractor shall within fourteen (14) days of the date of notifying the Engineer submit for the Engineer's consent its proposed revised Works Programme and accompanying Narrative Statement. The proposed revised Works Programme shall show the sequence of operations of any and all works related to the change and the impact of changed work or changed conditions.
- (2) If at any time the Engineer considers the actual or anticipated progress of the work reflects a significant deviation from the Works Programme, he may request the Contractor to submit a proposed revised Programme which together with an accompanying Activity Report and Narrative Statement, shall be submitted by the Contractor within fourteen (14) days after the Engineer's instruction. The proposed revised Works Programme shall show the sequence of operations of any and all work related to the change and the impact of changed work or changed conditions.
- (3) All activities that have negative float must be analysed by the Contractor to identify the impact on the timely completion of the Works or on the achievement of Key Dates.

**9. THREE MONTH ROLLING PROGRAMME**

- (1) The Three Month Rolling Programme shall be an expansion of the current Works Programme, covering sequential periods of three months. The Three Month Rolling Programme shall provide more detail of the Contractor's plan, organisation and execution of the work within these periods. In particular, the Contractor shall expand each activity planned to occur during the next three (3) month period, if necessary to a daily level of detail.
- (2) The Three Month Rolling Programme shall be developed as a Critical Path Method (CPM) network, and shall be presented in bar chart and time-scaled

network diagram format. Bar charts shall be presented on an A4 and time-scaled networks diagrams on an A1 size reproducible media. Tasks in the programme shall be derivatives of and directly related to tasks in the approved Works Programme.

- (3) The Contractor shall describe the discrete work elements and work element inter-relationships necessary to complete all works and any separable parts thereof including work assigned to sub-contractors.
- (4) Activity duration shall not exceed two (2) weeks unless otherwise consented to by the Engineer.
- (5) Each activity in the Three Month Rolling Programme shall be coded, or described so as clearly to indicate the corresponding activity in the Works Programme.

#### **10. THREE MONTH ROLLING PROGRAMME REVISIONS AND UPDATE**

- (1) The Three Month Rolling Programme shall be extended forward each month as described under Clause 5(1) above. 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 next three-month period.
- (2) 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.
- (3) 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.

#### **11. THREE WEEK ROLLING BAR CHART SCHEDULE**

Once a week, on a day mutually agreed to by the Engineer and the Contractor, a meeting will be held to assess progress by the Contractor during the previous work week. The Contractor shall submit a construction schedule listing activities completed and in-progress from the previous week and the activities scheduled for the succeeding two weeks based on the detailed Works Programme. Copies of the schedule shall be submitted on A3 sized paper.

#### **12. PROJECT CALENDAR**

For the Project, the Contractor shall adopt 7 days a week calendar, identical calendar for the purpose of programming and Execution of Works. Official documents shall be transacted during 5 days week - Monday through Friday, except for National (Govt. of India) Holidays. For Project purposes, a week begins at 0001 hours on a Monday and ends at 2359 hours on a Sunday. The completion of an activity or the achievement of an event when given a week number shall be taken to mean midnight on the Sunday at the end of the numbered week. An access date or activity start date when given as a week number shall be taken to mean 0001 hours on a Monday of the Numbered week.

**13. PROGRAMMING PERSONNEL**

The Contractor shall submit, as part of its Staff Organisation Plan, the names and required information for the staff to be employed on Works Programming. The principal Works Programmer shall hold reputable professional qualifications acceptable to the Engineer including at least five (5) years relevant experience in programming civil engineering works. Others in the group shall have at least three (3) years' experience in such work. The programmers shall be employed by the Contractor full time on the Contract until the completion or such earlier time the Engineer may give his consent.

**14. PROGRAMME AND REPORT SUBMISSION FORMAT**

The Contractor shall submit one (1) original and six (6) copies and one (1) reproducible (for Programmes) of all submissions to the Engineer. All submissions shall be in AO, A1, A3 or A4 size, as appropriate except as may otherwise be agreed by the Engineer. In addition, the computerised programme and report shall be submitted in CD-R/USB Drive (similarly for submissions required under Clause 5.4).

The format for all Programme and Report submissions shall be strictly in accordance with the format as stated herein or as requested by the Engineer.

**15. FAILURE TO SUBMIT PROGRAMME**

Failure of the Contractor to submit any programme, or any required revisions thereto within the time limits stated for acceptance by the Engineer, shall be sufficient reason for not making the relevant stage on account payment by the Engineer

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 5**

#### **MONTHLY PROGRESS REPORTS**

##### **1. Topics**

##### **1.1.1 The Monthly Progress Report required under clause 2.17 of the GS shall include as a minimum the following sections and topics:**

- (1) Executive Summary, highlighting any matters of concern and explaining corrective action to be taken
- (2) Programme and overall progress
- (3) Physical progress report (see Paragraph 2.19 of the General Specification)
- (4) Achievement of Key Dates and Milestone Dates planned vs actual dates
- (5) Interface; and Interface co-ordination progress
- (6) Approval of design and drawings, vendor finalisation
- (7) Issue of purchase orders for equipments, expected date of inspection, expected date of arrival at site.
- (8) Installation / erection on Site
- (9) Commissioning activity
- (10) System integration tests
- (11) Training
- (12) Maintenance issues
- (13) Payments / invoices
- (14) Employer's Representative's instructions and variation orders
- (15) Claims / potential claims
- (16) Contractor's resources (details of all staff and sub-contractors engaged on the Works)

##### **2. Progress Reports**

The Monthly Progress Reports shall be accompanied by:

- a) the Works Programme, marked to show the status of progress to date;
- b) control schedules for document submissions and issues of a repetitive or multiple nature;
- c) where appropriate, exception reports to highlight any problem areas including any submissions and information which are overdue;

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	<ul style="list-style-type: none"> <li>d) the programme analysis report, in accordance with Paragraph 2.18 of the General Specification;</li> <li>e) the physical progress (earned value) report, in accordance with Paragraph 2.20 of the General Specification;</li> <li>f) “S” curve showing current status of the Contract;</li> <li>g) a full list of all submissions and their current status in comparison to the Submissions Programme. Special commentary shall be provided for each item that is late to this programme giving the reasons for the delay and the proposed corrective action that will ensure that the delay does not affect any overall or stage completion dates, particularly those that interface with other parties;</li> <li>h) identification and discussion of significant accomplishments, problem areas encountered, actions taken or planned to resolve actual or potential problems and conflicts, and other comments or proposals on matters (including the interfacing works) affecting or likely to affect the Works; and</li> <li>i) a critical items action list which identifies outstanding problems associated with the timely completion of the Works including anticipated actions for their resolution.</li> </ul>
2.1	The programmes shall show current status to provide a comparison between the Works Programme and reported progress.
2.2.1.1	<p>Actual progress shall be reported for each activity in the Works Programme in the following terms:</p> <ul style="list-style-type: none"> <li>(1) the percentage of the work which is complete;</li> <li>(2) the remaining duration of the work;</li> <li>(3) the actual start date; and</li> <li>(4) the actual completion date.</li> </ul>
2.3	Actual progress shall reflect the physical scope of the work that has been completed and shall not be calculated based on elapsed time or hours worked. Any automatic statistical indications in the Contractor's software that is based on this principle shall be disabled.

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2.4 Each Monthly Progress Report shall include a programme activity listing and an analysis report. All activities that have negative float shall be analysed by the Contractor to identify the impact on the achievement of target dates.

**3.0 Copies**

3.1 The Contractor shall submit 1 unbound original and 4 bound hard copies of all Monthly

Progress Reports and of the accompanying documents plus one copy in electronic format on PC compatible 3-1/2" diskettes compatible with Microsoft Office and Primavera P3 applications.

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 6**

#### **QUALITY ASSURANCE**

##### **1. General**

The Contractor shall implement a Project Quality Management Plan in accordance with ISO-9001 "Quality System - Model for Quality Assurance in Design/Development, Production, Installation and Servicing" to ensure that all materials, workmanship, plant and equipment supplied and work done under the contract meets the requirements of the contract. This plan shall apply to all activities related to the quality of items, including designing, purchasing, inspecting, handling, assembling, testing, storing, and shipping of materials and equipment and different elements of construction work and installations of system components.

The Quality Plan to be prepared by the Contractor and submitted to the Engineer shall follow the requirements of ISO 9000 and address each element therein.

Registration of the Contractor's organisation, or subcontractors or subconsultants is not required for this Project but the Project Quality Management Plan as submitted shall meet the intent of the ISO 9000 requirement in that there is a comprehensive and documented approach to achieving the project quality requirements.

##### **2. Quality Assurance Management Plan**

The Project Quality Management Plan (PQMP) shall as a minimum address the quality system elements as required by ISO 9001, generally noting the applicability to the Contractor's Works Programme for the Project. Procedures or Quality Plans to be prepared by others (Suppliers, Subcontractors, Subconsultants) and their incorporation in the overall PQMP shall be identified.

The Contractor shall provide and maintain a Quality Assurance Plan (QA) to regulate methods, procedures, and processes to ensure compliance with the Contract requirements. The QA Plan, including QA written procedures, shall be submitted to the Engineer for his review.

Adequate records shall be maintained in a readily retrievable manner to provide documented evidence of quality monitoring and accountability. These records shall be available to Employer at all times during the term of the Contract and during the Defects Liability Period and for a five-year period thereafter.

The Plan shall identify:

- Design Process: that control, check and verify the accuracy, completeness and integration of the design shall be performed by certified personnel and in accordance with documented procedure that have the written consent of the Engineer.
- Special Processes: that control or verify quality shall be performed by certified personnel and in accordance with documented procedures that have the written consent of the Engineer;

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- Inspection and Test: Inspection and testing instructions shall provide for reporting non-conformances or questionable conditions to the Engineer; Inspection shall occur at appropriate points in the installation sequence to ensure compliance with drawings, test specifications, process specifications, and quality standards. The Engineer shall designate, if necessary, inspection hold points into installation or inspection planning procedures;
- Receiving Inspection: These procedures shall be used to preclude the use of nonconforming materials and to ensure that only correct and accepted items are used and installed;
- Identification and Inspection Status: a system for identifying the progressive inspection status of equipment, materials, components, subassemblies, and assemblies as to their acceptance, rejection, or non-inspection shall be maintained;
- Identification and Control of Items: an item identification and traceability control shall be provided;
- Handling, Storage, and Delivery: provide for adequate work, surveillance and inspection instructions.

The Plan shall ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, and defects in materials and equipment shall be promptly identified and corrected.

The Plan shall provide for establishing, and maintaining an effective and positive system for controlling non-conforming material including procedures for the identification, segregation, and disposal of all non-conforming material. Dispositions for the use or repair of non-conforming materials shall require the Engineers consent.

### **3. Plan Implementation and Verification**

The Plan shall clearly define the QA Organisation. Management responsibility for the QA shall be set forth on the Contractor's policy and organisation chart. The Plan shall define the requirements for QA personnel, their skills and training. Records of personnel certifications shall be maintained and monitored by the QA personnel. These records shall be made available to the Engineer for review, upon request.

The QA operations shall be subject to the Engineers, Employer or Employer's authorised representative's verification at any time, including: surveillance of the operations to determine that practices, methods and procedures of the plan are being properly applied; inspection to measure quality of items to be offered for acceptance; and audits to ensure compliance with the Contract documents.

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

The results of Quality Audits shall be summarised in the Contractor's monthly reports.

The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer to carry out on-site and off-site surveillance of Quality Assurance Audits to verify that the quality system which has the consent of the Engineer is being implemented fully and properly.



**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 7**

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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 8**

#### **WORKS AREAS & TEMPORARY POWER SUPPLY**

##### **1. INTRODUCTION**

- (1) The Contractor shall provide within the designated principal Works Areas, at locations agreed with the Engineer, the compounds and facilities for the Engineer and other contractors of the Employer defined under Clause 2 of this Appendix.
- (2) The standard conditions applying to the use of any Works Area by the Contractor for its site facilities are given under Clause 2 of this Appendix.
- (3) The Conditions for supply of electricity by the Contractor to Designated Contractors are given under Clause 3 of this Appendix.

##### **2. STANDARD ENGINEERING CONDITIONS**

The following standard engineering conditions apply to all Works Areas:

- (1) Formation
  - (a) The Works Areas shall be formed to the levels that the Engineer has given his consent. No such levels shall be amended without prior consent of the Engineer.
  - (b) The Works Areas shall be surfaced in a manner agreed with the Engineer, compatible with their intended use, and, in particular, footpaths and roadways connecting facilities shall be clearly defined. Measures shall be taken to the satisfaction of the Engineer to ensure all areas are properly drained and kept free of static water.
  - (c) The removal, diversion or reinstatement elsewhere as may be required of any existing works or installation whatsoever within the Works Areas shall be carried out to the satisfaction of the Engineer.
- (2) Roads & Parking
  - (a) Space shall be provided within the Works Areas for parking, loading/unloading and manoeuvring of motor vehicles.
  - (b) Any damage done to the adjoining public roads and fixtures and properties (public or private) shall be made good to the satisfaction of the Engineer.
- (3) Drainage & Sewerage
  - (a) All storm or rainwater from the Work Areas including any access roads thereto shall be conveyed to the nearest stream course, catch-pit, channel or storm water drain as required by the Engineer. All temporary and permanent works shall be carried out in such a manner that no damage or nuisance are caused by storm water or rain water to the adjacent property.

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- (b) No drain or watercourse shall be used without consent of the Engineer.
  - (c) Damages or obstructions caused to any watercourse , drain , water- main or other installations within or adjoining the Works Areas shall be made good to the satisfaction of the Engineer.
  - (d) Treatment and disposal of sewage and wastewater from the Works Area shall be provided to the satisfaction of the Engineer.
- (4) Buildings
- (a) No permanent structures other than those required for the Permanent Works shall be Temporary permitted on the Works Areas.
  - (b) Electricity, water, telephone and sewerage shall be provided by the Contractor, as required, for all temporary buildings.
  - (c) No potable water from the NDMC/MCD shall be used for heating, cooling and humidification purposes, or vehicle washing without the written consent of the Engineer.
- (5) Pedestrian Access
- Every existing pedestrian access throughout the Works Areas shall be maintained in a usable condition at all times to the satisfaction of the Engineer including lighting, signing and guarding.
- (5) Fencing
- The Works Areas shall be secured against unauthorised access at all times. In particular fencing or the like shall be maintained, removed and re-erected in the new location wherever and whenever a Works Area is relinquished in stages.
- 3. Temporary Water & Power Supply to Designated Contractors**
- As mentioned in Appendix 2D of these Appendices.
- 4 Applicability**
- (1) Where the Contractor is required to provide temporary electrical supplies, or to use, extend or expand on temporary installed by others, all such activity shall be executed in accordance with Paragraphs of this Appendix.
  - (2) When the Contractor supplies makes use of temporary electrical supplies provided by others he will observe and comply with the requirements of this Appendix.
- 5 Work on Site**
- (1) The Contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Engineer for review not later than 4 weeks before the appointment and who shall be solely responsible for ensuring the safety of all temporary electrical equipment on Site. The Contractor shall not install or operate any temporary Site electrical systems until this representative is appointed and has commenced duties.
  - (2) The name and contact telephone number of the representative having been reviewed without objection by the Engineer shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.
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**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

- (3) Schematic diagrams and the details of the equipment for all temporary electrical installations shall be submitted by the Contractor, and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for his consent.
- (4) All electrical installation work on Site shall be carried out in accordance with the requirements laid down in BS 7375 and the Specification. All work shall be supervised or executed by qualified and suitably categorised electricians, who are registered as such under the Electricity Ordinance 1990/Electricity (Registration) Regulations 1990.

**6. Electrical General**

Temporary electrical Site installations and distribution systems shall be in accordance with: -

- (1) Indian Electricity Rules
- (2) The Power Companies' Supply Rules;
- (3) Electricity and its subsidiary Regulations;
- (4) IEE Wiring Regulations (16<sup>th</sup> Edition);
- (5) BS 7375 Distribution of Electricity on Construction and Building Sites;
- (6) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites; and
- (7) BS 6164 Safety in Tunnelling in the Construction Industry.
- (8) Any other applicable national standards

**7. Materials, Appliances and Components**

All materials, appliances and components used within the distribution system shall comply with BS 4363 and BS 7375 Appendix A.

**8. Design Considerations**

- (1) Distribution equipment utilised within the temporary electrical distribution system shall incorporate the following features: -
  - (a) flexibility in application for repeated use;
  - (b) suitability for transport and storage;
  - (c) robust construction to resist moisture and damage; and
  - (d) safety in use.
- (2) All cabling shall be run at high level whenever possible and firmly secured to ensure they do not present a hazard or obstruction to people and equipment.
- (3) The installation on Site shall allow convenient access to authorised and competent operators to work on the apparatus contained within.

**9. Mains Voltage**

- (1) The Site mains voltage shall be as per the Electricity Authority, 415V/ 3 phase 4 wire system.
  - (a) Single phase voltage shall be as per the Electricity Authority, 230V supply.

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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- (b) Reduced voltages shall conform to BS 7375.
- (2) Types of Distribution Supply

The following voltages shall be adhered to for typical applications throughout the distribution systems:

  - (a) fixed plant - 415V/ 3 phase;
  - (b) movable plant fed by trailing cable - 415V /3 phase;
  - (c) installations in Site buildings - 230V /1 phase;
  - (d) fixed flood lighting - 230V/ 1 phase;
  - (e) portable and hand held tools - 115V /1 phase;
  - (f) Site lighting (other than flood lighting) - 115V /1 phase; and
  - (g) portable hand-lamps (general use) - 115V /1 phase.
- (3) When the low voltage supply is energised via the Employer's transformer, any power utilised from that source shall be either 415V 3 phase or / 230V. 1 phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.
- (4) Protection of Circuits
  - (a) Protection shall be provided for all main and sub-circuits against excess current, under and over voltage, residual current and earth faults. The protective devices shall be capable of interrupting (without damage to any equipment or the mains or sub-circuits) any short circuit current that may occur.
  - (b) Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with: -
    - (i) BS 88;
    - (ii) BS EN 60898; and
    - (iii) BS 7375;
    - (iv) Any other appropriate Indian Standards.

## **10. Earthing**

- (1) Earthing and bonding shall be provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises and to ensure that faults are rapidly cleared by installed circuit protection.
- (2) Earthing systems shall conform to the following standards: -
  - (a) IEE Wiring Regulations (16th Edition);
  - (b) BS 7430;
  - (c) BS 7375; and
  - (d) IEEE Standard 80 Guide for Safety in AC Substation Grounding.

## **11. Plugs, Socket Outlets and Couplers**

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Low voltage plugs, sockets and couplers shall be colour coded in accordance with BS 7375, and constructed to conform to BS EN 60309. High voltage couplers and 'T' connections shall be in accordance with BS 3905.

## **12. Cables**

- (1) Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required. Supply cables up to 3.3KV shall be in accordance with BS 6346.
- (2) For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to one of the following specifications appropriate to the duties imposed on it:
  - (a) BS 6708 flexible cables for use at mines and quarries;
  - (b) BS 6007 rubber insulated cables for electric power and lighting; and
  - (c) BS 6500 insulated flexible cords and cables.
- (3) Where low voltage cables are to be used, reference shall be made to BS 7375. The following specifications shall also be referred to particularly for underground cables:-
  - (a) BS 6346 for armoured PVC insulated cables; and
  - (b) BS 6708 Flexible cables for use at mines and quarries.
- (4) All cables which have a voltage to earth exceeding 65 V (except for supplies from welding transformers to welding electrodes) shall be of a type having a metal sheath and/or armour which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.
- (5) Armoured cables having an over sheath of polyvinyl chloride (PVC) or an oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring.
- (6) For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.
- (7) Cables which have applied to them a voltage to earth exceeding 12 V but not normally exceeding 65 V shall be of a type insulated and sheathed with a general purpose or heat resisting elastomer.
- (8) All cables which are likely to be frequently moved in normal use shall be flexible cables. Flexible cables shall be in accordance with BS 6500 and BS 7375.

## **13. Lighting Installation**

- (1) Where Site inspection of the Works is required during the nights, the Lighting circuits shall be run separate from other sub-circuits and shall be in accordance with BS 7375 and BS 4363.
- (2) Voltage shall not exceed 55 V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.
- (3) Luminaries shall have a degree of protection not less than IP 54. In particularly bad environments where the luminaries are exposed to excesses of dust and water, a

degree of protection to IP 65 shall be employed.

- (4) The Contractor shall upgrade the lighting level to a minimum of 200 lux by localised lighting in all areas where required by the Engineer.
- (5) Mechanical protection of luminaries against damage by impact shall be provided by use of wire guards or other such devices whenever risk of damage occurs.

#### **14. Electrical Motors**

- (1) Totally enclosed fan cooled motors to BS 4999: Part 105 shall be used.
- (2) Motor control and protection circuits shall be as stipulated in BS 6164. Emergency stops for machinery shall be provided.

#### **15. Inspection and Testing**

Electrical installations on Site shall be inspected and tested in accordance with the requirements of the IEE Wiring Regulations (16<sup>th</sup> Edition).

#### **16. Identification**

Identification labels of a type reviewed without objection by the Engineer shall be affixed to all electrical switches, circuit breakers and motors to specify their purpose.

#### **17. Maintenance:**

- (1) Strict maintenance and regular checks of control apparatus and wiring distribution systems shall be carried out by an electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems. The Contractor shall submit for review by the Engineer details of his maintenance schedule and maintenance works record.
- (2) All portable electrical appliances shall be permanently numbered (scarf tag labels or similar) and a record kept of the date of issue, date of the last inspection carried out and the recommended inspection period.

#### **18. Metering**

The Contractor shall install a separately metered and invoiced supply or supplies of electricity for:-

- (a) Site fabrication facilities;
- (b) Site workshops and work yards; and
- (c) Site offices and stores.

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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 9**

#### **RAILWAY ENVELOPE**

#### **HANDOVER AND ACCESS**

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**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 10**

#### **APPROVED MANUFACTURERS/ SUPPLIERS LIST**

**Referred Appendix F of Voume-3 Particular Specifications**

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 11**

#### **CURVE AND GRADIENT DETAILS**

##### **METRO CORRIDOR**

##### **Horizontal and Vertical Alignment**

All details with regard to the Horizontal and Vertical Alignment are shown on the plan & profile sheets of the drawings provided in Volume 5 of the tender document.

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 12**

#### **UTILITIES**

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**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 13**

#### **RELIABILITY, AVAILABILITY AND MAINTAINABILITY (RAM)**

**Deleted**

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 14**

#### **Typical Type Test Requirements**

##### **1.1 Electronic and Electrical Equipment**

The initial visual inspection shall be carried out to ensure that the equipment is of sound construction and, so far as can be ascertained, meets the requirements of the Specification.

##### **1.2 Initial Performance Test**

- i. The initial performance tests shall consist of a comprehensive series of measurements of the characteristics of the equipment to demonstrate that its performance is in accordance with its functional requirements, including detailed requirements of the Specification.
- ii. This test shall normally be performed at an ambient temperature of 40°C +5°C while supplied at its normal voltage and frequency, if relevant.
- iii. This test shall extend to demonstrating compliance with any limitation on self-generated vibration or interference as stated in the Specification.

##### **1.3 Modes of Testing**

- i. Electrical tests will generally be applied to the 'external terminals' of the item of equipment to be tested which are normally used to interface the subject equipment to other equipment or external circuits, e.g. power supply terminals, signal input/output terminals, frame (safety) earth terminals, etc. Tests may be applied in Common Mode and/or Series Mode, as described below.
- ii. Common mode tests generally involve testing circuits with respect to the equipment's frame earth. All accessible metal parts (intended to be connected to earth) are to be connected to the frame earth.
- iii. All the terminals of the circuit to be tested shall be connected together, where practicable. All terminals of circuits not involved in the test shall preferably be connected to earth.
- iv. For example, a common mode test on the AC power supply circuit of an item of equipment would involve connecting all the supply circuit terminals together (e.g. phase (s) and neutral) and applying the test between those connected terminals and the equipment's frame earth terminal. The terminals of all other circuits, e.g. signal input/output terminals, shall preferably be connected to earth.

- v. Series mode tests generally involve testing circuit connections with respect to each other.
- vi. Where an item of equipment to be tested has a large number of identical interfaces circuits series mode testing may be restricted to a representative sample of those interfaces, the proportion being to the agreement of the Employer's Representative.
- vii. The test is applied between terminals (other than the earth terminal) either associated with the same circuit (e.g. between power supply terminals) or associated with different circuits (e.g. between input signal terminals and output signal terminals). All terminals of circuits not involved in the test shall preferably be connected to earth.
- viii. For example, a series mode test on an RTU analogue input circuit would involve applying the test between the positive and negative analogue signal input terminals, preferably with all other terminals connected to earth.
- ix. For each item of equipment to be tested, there may be many combinations of terminals to which series mode testing could be applied. Not all combinations may be relevant or subject to the conditions against which a particular test is to be performed. However, the Contractor shall test all combinations unless specifically agreed otherwise by the Employer's Representative.

## **2 Mechanical Tests**

### **2.1 Drop Test**

- i. The drop test is intended to be carried out on units and sub-assemblies that are portable. It is not intended that it be carried out on complete racks of equipment.
- ii. Casings or dust covers, which have to be removed for servicing, shall be removed after subjecting equipment to this test to inspect for damage. The test is designed to reveal any weakness of assembly and to ensure that the component mountings are of adequate strength. It is not designed to check whether doors or windows made of glass will fracture and to this end meters, glass windows, etc., may be removed.
- iii. The equipment shall not be deemed to have failed the drop test if externally accessible components such as control knobs or connectors are damaged.

The Employer's Representative however reserves the right to ask for some

form of guard, to prevent such damage, to be fitted at the Contractor's cost.

- iv. Test conditions shall be in accordance with IEC 68-2-31. Information required for paragraph 4.2 of that test:
  - a. Visual inspection and function test to specification.
  - b. Assembled ready for installation.
  - c. Connectorised cables removed, casings or covers in place.
  - d. Not applicable.
  - e. All.
  - f. 25mm, 6 times.
  - g. 25mm, 6 times.
- v. Visual inspection and function test to specification.
- vi. Topple (or push over) test is not required.

## **2.2 Vibration Test**

- i. The vibration test is designed to reveal any parts or components of the equipment that may be prone to any resonance severe enough to cause possible damage or malfunctioning.
- ii. The test shall be in accordance with IEC 68-2-6 1982. Information required for Chapter 12 of that standard:
  - a. Measuring Points: If four or less fixing points are used for the specimen, these shall also be used as checkpoints. If more than four fixing points are used then those nearest the corners shall be used as checkpoints. The checkpoints shall be located as close as possible to the fixing points.
  - b. Transverse Motion: Any transverse motion in excess of that specified in the above standard clause 4.1.2 shall be noted and recorded in the test results.
  - c. Distortion: As defined in clause 3 in excess of the limits in clause 4.1.3 of the above standard shall be noted as defined in clause 4.1.3 paragraph 4 of the same standard.
  - d. Derivation of Control Signal Single point.
  - e. Tolerances at check points shall be as clause 4.1.4.2 of the above standard. Where these cannot be achieved, the actual values shall be recorded.
  - f. Monitoring of Specimen(s): The equipment shall be rigidly mounted in a jig so designed as to transmit the input vibration with minimum modification.

## **2.3 Vibration Test 1**

- i. Equipment intended for use with vibration isolators shall normally be tested with its isolator. When this is not possible, the equipment shall be rigidly secured to the vibrator and the input vibration levels modified to include transmissibility of the isolators.
- ii. Equipment under test is to be mounted in its normal operational attitude.
- iii. Frequency Range: See Chapter 6, Paragraph 5.5 (Equipment Requirements).
- iv. Vibration Amplitude: See Chapter 6, Paragraph 5.5 (Equipment Requirements).
- v. Special crossover frequency: See Chapter 6, Paragraph 5.5 (Equipment Requirements).
- vi. Type and duration of endurance:
  - a. Endurance by sweeping 6 hours, i.e. 2 hours per axis
  - b. Endurance at critical frequencies (as defined in the above standard clause 8.1): 1 minute at each frequency providing not more than four such frequencies exist per axis.
- vii. Pre-conditioning: None.
- viii. Initial measurements Functional test to the appropriate test procedure.
- ix. Axes of vibration: Three mutually perpendicular axes in turn.
- x. Force Limitation: Not required.
- xi. Test stages to be performed in the sequence below:
  - a. Vibration response investigation.
  - b. Endurance at fixed frequencies derived from vibration response investigation.
  - c. Endurance by sweeping.
- xii. The equipment functionality shall be verified throughout the sweep test to the appropriate test procedure.
- xiii. Action to be taken after vibration response investigation. If less than four critical frequencies are found in each axis, then endurance testing for the prescribed duration shall be performed at each frequency.
- xiv. Final response test not required.
- xv. Predetermined frequencies shall be derived from the vibration response investigation.



- xvi. Conditioning at the resonance frequencies of the specimen on its isolators (where fitted) shall be included.
- xvii. Final measurements Functional test to the appropriate test procedure.
- xviii. Any resonance liable to affect the performance or reliability of the equipment shall be reduced to an acceptable level by suitable modifications and the complete test repeated.

### **3. Environmental Tests**

#### **3.1 Dry Heat Test**

- i. The dry heat test shall be carried out on each complete piece of equipment or assembly, with all doors and covers being in place and closed as in normal operation.
- ii. Test conditions shall be in accordance with IEC 68-2-2. Information required for paragraph 44 of that test:
  - a. Laboratory ambient.
  - b. Visual inspection.
  - c. Assembled and mounted in rack, enclosure or cabinet ready for operation or installation.
  - d. On.
  - e. Maximum class temperature (see Chapter 6, Chapter 5.2, Equipment Requirements) for 16 hours.
  - f. At maximum class temperature after 16 hours, switch on and function test to specification.
  - g. Recovery at laboratory ambient.
  - h. Visual inspection and function test to specification.
  - i. None.

#### **3.2 Low Temperature Test (in case applicable for Kanpur ambient Temperature range)**

- i. The low temperature test shall be carried out on each complete piece of equipment or assembly, with all doors and covers being in place and closed as in normal operation.
- ii. Test conditions shall be in accordance with IEC 68-2-1. Information required for paragraph 33 of that test:
  - a. Laboratory ambient.
  - b. Visual inspection and function test to specification.
  - c. Assembled and mounted in rack, enclosure or cabinet ready for operation or installation.

- d. Off.
- e. Minimum class temperature (see Chapter 6, Paragraph 5.2, Equipment Requirements) for 16 hours.
- f. At minimum class temperature after 16 hours, switch on and function test to specification.
- g. Recovery at laboratory ambient.
- h. Visual inspection and function test to specification.
- i. None.

**3.3** *Change of Temperature Test*

- i. If both Dry Heat and Low Temperature Tests are required (as decided by the Employer's Representative) they may be replaced by a single test in accordance with IEC 68-2-14.
- ii. Information required for paragraph 2.9 of that test:
  - i. Assembled and mounted in rack, enclosure or cabinet ready for operation or installation.
  - ii. Minimum class temperature.
  - iii. Maximum class temperature.
  - iv. Per Minute.
  - v. One.
  - vi. Visual inspection.
  - vii. On.
  - viii. Hours.
  - ix. None.
  - x. Recovery at laboratory ambient.
  - xi. Visual inspection and function test to specification.

**3.4** *Damp Heat Test*

- i. The damp heat test shall be carried out on each complete piece of equipment or assembly, with all doors and covers being in place and closed as in normal operation.
- ii. Test conditions shall be in accordance with IEC 68-2-30. Information required for paragraph 10 of that test:
  - i. Maximum class temperature, two cycles.
  - ii. Visual inspection and function test to specification.
  - iii. Switched on, ready to use.
  - iv. None.
  - v. Variant 2.

- vi. At maximum class temperature after 12 hours, function test to Specification. At 6 hours after the temperature starts to fall a further function test to specification. Tests to be repeated during second cycle.
- vii. Laboratory ambient conditions.
- viii. None.
- ix. Visual inspection and function test to specification within 4 hours.

### **3.5 Driving Rain Test**

- i. The test conditions shall be in accordance with IEC 68-2-18 Method Rb 2.2.
- ii. Information required for paragraph 5.3.8 of that document:
  - a. Minutes/m2 for a minimum of 15 minutes.
  - b. No preconditioning of seals.
  - c. Visual inspection and function test to specification.
  - d. Table V1:  $\alpha = 60^\circ$ .  $B = 60^\circ\text{C}$ . duration = 10 minutes.
  - e. Table V2: diameter = 0.40mm. water flow =  $0.10 + 0.005 \text{ dm}^3/\text{min}$ . supply pressure = 80 kpa.
- iii. Equipment functioning throughout the test to be verified by testing.
- iv. Any ingress of water shall be reported to the Employer's Representative, the equipment shall be visually inspected and function tested to Specification.

## **04 Electrical Tests**

### **4.1 Supply Variations**

- i. Measurements of equipment performance and maximum VA consumption shall be made, for supply voltage and frequency variations in all possible combinations of upper limit, normal and lower limit as detailed in the Specification. Throughout these tests, the equipment shall function in accordance with the Specification.

### **2.3 Supply Interruptions**

- ii. The supply input to the equipment under test shall be interrupted for periods of 10 ms.
- iii. The tests shall be performed ten times at random for ac supplies and three times at random for dc supplies.
- iv. The equipment shall be capable of withstanding these interruptions of supply input without damage, interruption or resetting by the operator and shall continue to function and operate correctly in accordance with the Specification.

## **2.4 High Frequency Disturbance Test**

- i. The High Frequency Disturbance test is required to determine whether an item of equipment will continue to operate correctly when specified high frequency transients, representative of practical system conditions, are applied to the fully operating equipment.
- ii. The test to be applied is based on IEC 255-4, Appendix E.
- iii. This test shall be performed for all equipment required to operate in environments subject to Electrical Interference Class 2 or 3 (refer to Table 8-3) and shall be applied to the AC power supply terminals of that equipment.
- iv. Waveform: a damped oscillatory wave with the envelope decaying to 50% of peak value at the end of three to six cycles.
  - a. Frequency: 1 MHz tolerance + 10%.
  - b. Source impedance: 200 ohm tolerance + 10%.
  - c. Repetition rate: the test wave is applied to the equipment under test at a repetition rate of 400 per second.
  - d. Duration of test: 2 s tolerance + 10% 0% (see Sub-clause E5.2.7 of IEC 255-4, Appendix E).
  - e. Standard value of test voltage: Refer to Table 8-3.
  - f. Test voltage tolerance: +0 -10%.
- v. The test voltage levels are the voltages at the output of the test circuit before the equipment to be tested is connected to the test circuit terminals.
- vi. The test leads shall not be longer than 2 m.
- vii. The disturbance test shall be applied to the AC supply terminals of the equipment under test in series mode (refer to Sub clause 2.1.3).
- viii. The tests shall be carried out with the equipment operating under nominal supply conditions.
- ix. The equipment shall function in accordance with the Specification throughout the test.

## **2.5 Radio Frequency Interference**

- i. Portable radio communication transmitters are a common source of radio frequency interference when they are operated in close proximity to equipment. A field strength of 10 V/m shall be assumed to be present in the VHF and UHF bands.

- ii. These field strengths are approximately those expected at a distance of 35 cm from a 5 watt hand portable radiotelephone. These fields can induce currents of the order of 100 mA into cables, screens and metalwork.
- iii. Other possible sources are low level radiation from adjacent equipment including fluorescent lamps and signals from powerful but more distant radio, television and radar transmitters.
- iv. The test to be applied is based on IEC 801-3 over a frequency range of 27 MHz to 500 MHz. The Severity Level (Chapter 5) to be applied shall be as follows:
- v. The Contractor shall state to what field strength the equipment is immune, and include as an option the cost of testing to 10 V/m. The equipment functionality and performance shall not be degraded during or after the RFI test.
- vi. With regard to RTUs and tele-protection equipment, the command outputs shall be immune to mal-operation with the cubicle doors open when the equipment is subjected to the radiated field strengths mentioned above.

## **2.6 Electrical Stress Impulse Voltage Withstand**

- i. The Impulse Voltage Withstand test is designed to demonstrate that the equipment has been correctly designed to withstand, without damage, the electrical stresses to which it might be subjected in practice.
- ii. The test to be applied is based upon IEC 255-4, Appendix E.
- iii. This test shall be performed for all equipment required to operate in environments subject to Electrical Interference Class 2 or 3 (refer to Table 8-3) and shall be applied as follows:
  - a. To all AC power supply input and output terminals of all equipment.
  - b. To all signal input/output, communication interface and DC power supply terminals of RTU and tele-protection equipment.
  - c. For the withstand test, the impulse voltage is a periodic transient voltage without appreciable oscillations (see IEC Publication 60, High-voltage Test Techniques).
- iv. Impulse waveform: This shall be the standard 1.2/50 impulse specified in IEC Publication 60 and having the following tolerances:
  - a. Voltage rise time: + 30%.
  - b. Voltage falls time: + 20%.
  - c. Source impedance: 500 ohm tolerance + 10%.
  - d. Source energy: 0.5 J tolerance + 10%.

- e. Standard value of test voltage: Refer to Table 3.
- f. Test voltage tolerance: +0 -10%.
- v. The test voltage levels are the voltages at the output of the test circuit before the equipment to be tested is connected to the test circuit terminals.
- vi. The test leads shall not be longer than 2m.
- vii. Three positive and three negative impulses shall be applied at intervals of not less than 5s. Both common mode and series mode tests shall be performed (refer to Sub-clause 2.1.3).
- viii. After the above tests, the equipment shall be visually inspected and function tested to check compliance with the Specification.

## **2.7 Insulation Resistance (Across Isolating Barrier) Test**

- i. Where a barrier is used to provide isolation from external circuits, its insulation resistance shall be measured.
- ii. If the barrier is required to withstand high voltage stresses, then it shall be stressed at the specified voltage to demonstrate its withstand capability and a further insulation resistance test shall be made to ascertain that it has not been significantly degraded as a result of the stress being applied.
- iii. The insulation of all circuits that include contacts of switches, relays or contractors for isolation functions shall be tested for insulation resistance, R1. R1 shall not be less than 20 mega ohm when measured at 500 V dc.
- iv. For switches, relays and contractors, 500 V is to be applied between:
  - a. The opposite ends of each circuit with contacts in open position.
  - b. Both ends of each circuit to earth with contacts in closed position.
- v. For circuits intended for connection to 100 V ac or dc and above, 2 kV RMS shall be applied for one minute and this shall be followed by a further test for insulation resistance, R2.
- vi. Stress to be applied between:
  - a. The individual circuits of this type.
  - b. Each circuit of this type and all other circuits including earth. These other circuits can be strapped together electrically for the purpose of this test.
- vii. Final insulation resistance shall be such that either:
  - a.  $R2 > 20 \text{ megohm}$ , or
  - b.  $R2/R1 > 0.7$ .

For circuits intended to provide isolation against large differences in earth potential, the barrier shall, after the initial resistance measurement, be stressed

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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to the design voltage and this shall be followed by a further insulation resistance test.

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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**EMPLOYER’S REQUIRMENT**

**APPENDIX 15**

**MONITORING OF STRUCTURES, RISK ASSESMENTS & MITIGATION MEASURES**

**Deleted**



**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX - 16**

#### **EARTHING & GRID**

**Deleted**

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **EMPLOYER’S REQUIREMENT**

### **APPENDIX 17**

#### **FOUNDATION DETAIL AND STATIC & DYNAMIC WEIGHT OF VARIOUS EQUIPMENT**

**Deleted**

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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**Employer's Requirement**

**APPENDIX 18**

**Deleted**

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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## **Employer's Requirement**

### **APPENDIX 19**

#### **Schedule of Dimensions**

Employer Schedule of Dimensions shall be followed for the work. This Schedule of Dimensions is applicable to Under Ground, Elevated and At-Grade sections of Kanpur Metro which shall be with Standard Gauge (i.e. 1435 mm), 750V DC Traction system and current collection. The Rolling Stock shall be 2900 mm wide with sealed windows and doors closed while in motion.

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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**Employer's Requirement**

**APPENDIX 20**

**SUBMISSION FOR REVIEW REQUEST FORM**

**SUBMISSION FOR REVIEW REQUEST**

Reference No. \_\_\_\_\_ (see Paragraph 4.3.2) Date \_\_\_\_\_

Programme reference and scheduled date: \_\_\_\_\_

Submission Stage \_\_\_\_\_ (see Paragraph 3.5.1.1)

Title \_\_\_\_\_

We hereby submit for review by the Employer's Representative the documents or articles listed below:

*(Introduction and list of items submitted – see Paragraph 4.3.5.2 – continue on separate sheet if necessary)*

I confirm that the material submitted is in full compliance with the Contract.

Signed \_\_\_\_\_ (Contractor's responsible engineer)

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Employer's Representative's Response

Dated \_\_\_\_\_

The material submitted has been reviewed and the following decision is given:

“No Objection” / “No Objection Subject To” (see below) / “Rejected” (see below)

The following comments are made and a re-submission is to be made by the Contractor within 10 working days demonstrating fully how all of these are taken into account:

*(Employer's Representative's comments)*

Signed \_\_\_\_\_ (Employer's Representative)

## **Employer's Requirement**

### **Appendix 21**

#### **Schedule of Items to be submitted by Contractor**

This Appendix lists the principal items to be submitted by the Contractor for review by the Employer's Representative. This list is not exhaustive and the Contractor is reminded to satisfy itself of the requirements for all submissions whether or not they are included within this Appendix.

<b>Article</b>	<b>Reference Paragraph(s)</b>	<b>To be submitted</b>
Works Programme	2.4.1.2	Within 60 days of the Commencement Date of the Works
Submissions Programme	2.5.1	Within 30 days of the Commencement Date of the Works
Procurement and Manufacturing Programme	2.6.1	Within 60 days of the Commencement Date of the Works
Material Control Schedule	2.6.5	As stated in the PS, or if none is given, within 60 days of the Commencement Date of the Works
Factory Testing Programme	2.6.8	Within 60 days of the Commencement Date of the Works
Installation Programme	2.7.1	Preliminary version within 60 days of the Commencement Date of the Works. Full version as stated in the PS or as directed by the Employer's Representative
Testing & Commissioning Programme	2.8.1	Preliminary version within 60 days of the Commencement Date of the Works. Full version as stated in the PS or as directed by the Employer's Representative
Monthly Progress Report and supporting documentation	2.17.1	The 5 <sup>th</sup> day of each month.
Contractor's Project Plan	3.1.2	As stated in the PS, or if none is given, within 60 days of the Commencement Date of the Works
Particulars of agent	3.3.1.6(6)	30 days before the Commencement Date of the Works
Interface Management Plan	3.3.2 b)	Within 60 days of notification from the Employer's Representative of the identity of each Project Contractor
Detailed Interface Document	3.3.2 d)	Within 90 days of notification from the Employer's Representative of the identity of each Project Contractor
Contractor's Factory Testing Plan	3.5.1	As stated in the PS, or if none is given, within 60 days of the Commencement Date of the Works

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

<b>Article</b>	<b>Reference Paragraph(s)</b>	<b>To be submitted</b>
Test Reports	3.5.1.7	Immediately after the completion of Factory Testing
Procurement, Manufacturing and Delivery Plan	3.5.2	As stated in the PS, or if none is given, within 60 days of the Commencement Date of the Works
Contractor's Health and Safety Documentation	3.6.2.2	Within 30 days of the Commencement Date of the Works
Commissioning Plan	3.7.2.1	First draft within 180 days of the Commencement Date of the Works
Installation Test Schedule	3.7.2.2 b.(i)	As stated in the PS or if not given, not later than two months in advance of the Date scheduled for commencement of respective tests
Partial Acceptance Tests Plan	3.7.2.2 b.(ii)	As stated in the PS or if not given, not later than four months in advance of the Date scheduled for commencement of Partial Acceptance Tests
System Acceptance Tests Plan	3.7.2.2.b. (iii)	As stated in the PS or if not given, not later than four months in advance of the Date scheduled for commencement of System Acceptance Tests
Integration Tests & Commissioning Plan	3.7.2.2 b.(iv)	As stated in the PS or if not given, not later than four months in advance of the Date scheduled for commencement of Tests on Completion
Operation & Maintenance Manuals Plan	3.7.3.2	As stated in the PS or if not given, not later than nine months prior to the issue of the Taking Over Certificate for the Works
Training Plan	3.7.4.2	As stated in the PS or if not given, not later than six months prior to the issue of the Taking Over Certificate for the Works
Defects Liability Management Plans	3.7.6	Upon issuance of the Taking Over Certificate
Project Document Control Procedure	4.3.2	Within 28 days of the Commencement Date of the Works
Quality Manual	5.2.3	Within 30 days of the Commencement Date of the Works
Quality System Procedures	5.2.3	Within 30 days of the Commencement Date of the Works
Details of Quality Manager	5.2.6	Within 30 days of the Commencement Date of the Works
Proposed Corrective & Preventive Action Plan	5.2.7	Within 14 days of issue of CAR
Management Quality Plan	5.3	Within 30 days of the Commencement Date of the Works
Site Quality Plan	5.5	60 days prior to the commencement of the construction works
Reports of Quarterly Quality Audits	5.7.2	Every Three months
Quality Control Register	5.8	7 <sup>th</sup> working day of every month

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

<b>Article</b>	<b>Reference Paragraph(s)</b>	<b>To be submitted</b>
Packaging Materials & Procedures	8.4.1	As stated in the PS, or if none is given, within 60 days of the Commencement Date of the Works
Latest drawings, test procedures, specifications and quality documentation for inspection of equipment	9.2.7.4	At least 15 days prior to each First Article Inspections ( FAI )
Installation Tests Reports	9.4.3.3	Immediately after the completion of each test
Proposed Partial Acceptance Tests Records	9.4.4.7	As stated in the PS or if not given, not later than two months in advance of the Date scheduled for commencement of tests
Partial Acceptance Tests Records	9.4.4.9	Immediately following the successful Partial Acceptance Tests
System Acceptance Tests Records	9.4.5.8	Immediately following the successful System Acceptance Tests
Integration Tests & Commissioning Records	9.4.6.8	Immediately following the successful Tests on Completion of the system
Service Trial Records	9.4.7.8	Immediately following the successful Service Trial of the system
Summaries of Inspection and/or Test	9.6.1.1	7 <sup>th</sup> day of the following month
Operation & Maintenance documentation (Draft Version)	11.4.1	As stated in the PS or if not given, not later than 6 months prior to the issue of the Taking Over Certificate for the Works
Operation & Maintenance documentation (Final Version)	11.4.3	As stated in the PS or if not given, not later than 1 month prior to the issue of the Taking Over Certificate for the Works
Operating & Maintenance instructions and illustrated parts list (Final Submission)	11.4.3	At a date set by the Employer's Representative
Spare Parts List	13.1.3	As stated in the PS
Construction & Installation Plan	14.1.1	As stated in the PS, or if none is given, within 60 days of the Commencement Date of the Works, and in any case not less than 12 weeks before starting the construction of the Works on Site
Proposals for the construction of the Employer's Representative's Site Offices	0	Within 14 days of the Commencement Date of the Works
Particular Uses of Site	17.2.1	Within 14 days of the Commencement Date of the Works
Detailed written report of accidents, incidents and dangerous occurrence	18.6.4.1	Within 7 days of occurrence/accident



**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

<b>Article</b>	<b>Reference Paragraph(s)</b>	<b>To be submitted</b>
Name and qualification of safety representative for temporary site electricity	22.2.1	Not later than 4 weeks before appointment

**Employer's Requirement**

**Appendix 22**

**Request for Inspection of Works Form**

**CONTRACTOR**

**REQUEST FOR INSPECTION OF WORKS**

To the Employer's  
Representative

Date

\* Location ) Will be ready for your inspection  
 ) On  
 \* Description of Works ) At prior to  
 )  
 ) On at Hrs  
 \* Labour and plant to be  
 used

Signed

for Contractor.

Received by  
for Employer's  
Representative date  
time

**Filled in by Engineer**

Mr  
Mr  
Signed

Please arrange inspection  
Please check setting out

**Filled in by Inspector**

The above work was inspected and permission was given / not given to proceed with next operation.

\* The following remedial works were required

\* Contractor informed verbally (to MR  
by Mr On at hrs)

\* Remedial works inspected and permission given to proceed with next  
operation on at hrs)  
as supervised

by  
Signed  
Date

Time

Verbal or written permission by the Employer's Representative or his staff shall in no way relieve the Contractor of his responsibilities under the Contract.

\* To be completed if applicable.

**Employer's Requirement**

**APPENDIX 23**

**FIRST AID REQUIREMENTS**

**1. Provisions by others**

- (1) First aid bases will be located at the Contractor's principal Works Areas. The bases will consist of a treatment room fitted with two treatment couches, a hand wash basin, sterilising equipment and lockable cupboards to contain sufficient medical supplies for the Contractor's workforce, the Employer's Representative's site supervisory staff, the Designated Contractors working in the area and any visitors to the Site. The first aid post will be air-conditioned, with cooling capability sufficient to maintain the temperature of the inside of the building at 20°C.
- (2) A qualified doctor, nurse and assistant nurse will be in attendance at the first aid base during all times when work is being undertaken on the Site, including work by the Designated Contractors and periods when only emergency activities are being undertaken, such as during periods of inclement weather.
- (3) A fully equipped ambulance and driver will be provided at the first aid base during all working hours. The ambulance will be equipped with emergency life support equipment suitable for application in construction site accidents.

**2. Provisions by the Contractor**

- 2.1 The Contractor shall supply portable first aid boxes maintained fully equipped at each local site offices and any work locations where 20 or more persons work at a time.
- 2.2 In each site office and work location at least one of the Contractor's employees shall be trained in first aid and should be available at all working hours for purpose of attending to emergencies.
- 2.3 The Contractor shall be responsible for making his employees aware of the location and access route to the nearest first aid base and if necessary shall provide facilities for evacuating a workman by stretcher from the worksite.
- 2.4 The Contractor shall keep the first aid base personnel informed of the number and identity of staff working within the area of responsibility of each first aid base.

## **Employer's Requirement**

### **ATTACHMENT A**

#### **CONTRACTOR'S LABOUR CAMP**

##### **1. EMPLOYER NOT TO PROVIDE QUARTERS FOR CONTRACTOR'S LABOUR**

The employer shall not provide land /quarters for the use of the Contractor or any of his staff or labour employed on the Works. The same shall be arranged by contractor at his own cost. However, in case employer is in a position to offer land for contractor's labour camp/colony, the same shall be offered to contractor at the rental rates and terms & conditions decided by the employer.

##### **2. PROVISION OF LABOUR CAMP**

The Contractor, shall, at his own expense, make adequate arrangements for the housing, supply of drinking water and provision of bathrooms, latrines and urinals, with adequate water supply, for his staff and workmen directly or through sub-contractors employed on the Works at the location authorised by Engineer. No labour camp shall be allowed at any unauthorised/unapproved place.

The Contractor at his own cost shall maintain all campsites in a clean and sanitary condition. The Contractor shall obey all health and sanitary rules and regulations, and carry out at his cost all health and sanitary measures that may from time to time be prescribed by the Local/Medical Authorities and permit inspection of all health and sanitary arrangements at all times by the Employer, Engineer and the staff of the local municipality or other authorities concerned. Should the Contractor fail to provide adequate health and sanitary arrangements these shall be provided by the Employer and the cost recovered from the Contractor.

The Contractor shall at his own cost, provide First Aid and Medical facilities at the Labour Camp and at work sites on the advice of the Medical Authority in relation to the strength of the Contractor's staff and workmen, employed directly or through sub-contractors.

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

- Portable Fire Extinguishers.
- Manual Fire Alarms.
- Water Supply for use by the Fire Service.

The Contractor at his own cost shall provide necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers. He should also ensure that electrical installations are done by Trained Electricians. These installations shall be maintained and daily maintenance records must be made available for inspection of the Engineer.

##### **3. CAMP DISCIPLINE**

The Contractor shall take requisite precautions, and use his best endeavours to prevent any riotous or unlawful behaviour by or amongst his workmen, and others, employed directly or through sub-contractors. These precautions shall be for the

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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preservation of the peace and protection of the inhabitants and security property in the neighbourhood of the Works. In the event of the Employer requiring the maintenance of a Special Police Force at or in the vicinity of the site, during the tenure of the work, the expenses thereof shall be borne by the Contractor and if paid by the Employer, shall be recoverable from the Contractor.

The sale of alcoholic drinks or other intoxicating drugs or beverages upon the work, in any labour camp, or in any of the buildings, encampments or tenements owned or occupied by, or within the control of, the Contractor or any of his employees directly or through sub-contractors employed on the work, shall be forbidden, and the Contractor shall exercise his influence and authority to secure strict compliance with this condition. The Contractor shall also ensure that no labour or employees are permitted to work at the site in an intoxicated state or under the influence of drugs.

The Contractor shall remove from his camp such labour and their families, as refuse protective inoculation and vaccination when called upon to do so by the Engineer on the advice of the Medical Authority. Should Cholera, Plague or any other infectious disease break out, the Contractor shall at his own cost burn the huts, bedding, clothes and other belongings of or used by the infected parties. The Contractor shall promptly erect new huts on healthy sites as required by the Employer, within the time specified by the Employer, failing which the work may be done by the Employer and the cost recovered from the Contractor.

#### **4. LABOUR ACCOMMODATION**

The Contractor shall provide living accommodation that is equal to or exceeds the minimum criteria established in the following sub-sections, needed to house his staff, workers employed directly or through sub-contractors. The buildings shall be constructed so as to have a minimum life of not less than the length of the Contract.

- a. The roofs shall be watertight and laid with suitable non-flammable materials permissible for residential use under local regulations and for which the consent of the Engineer has been obtained.
- b. Each hut shall have suitable ventilation. All doors, windows, and ventilators shall be provided with security leaves and fasteners. Back to back units may be avoided.
- c. The minimum height of each unit shall be 2.10m and shall have separate cooking place.
- d. Suitable no. of common toilet/bath shall be provided.

#### **5. WATER SUPPLY**

The Contractor shall provide an adequate supply of water for the use of labourers in the Camp. The provision shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, tanks which be of metal or masonry shall be provided. The Contractor shall also at his expense make arrangements for the provision and laying of water pipe lines from the existing mains wherever available and shall pay for all the fees and charges thereof.

#### **6. DRAINAGE**

**LKE(02)-02: “Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Elevators and Heavy Duty Escalators including Maintenance during 2 Year Defect Liability Period (DLP) and 01 (one ) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transport System Project under the Contract LKE(02)-02.”**

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The Contractor shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy. Surface water shall be drained away from paths and roads and shall not be allowed to accumulate into ditches or ponds where mosquitoes can breed.

**7. SANITATION**

The Contractor shall make arrangements for conservancy and sanitation in the labour camps according to the rules and regulations of the Local Public Health and Medical Authorities.

The Contractor shall provide a sewage system that is adequate for the number of residents in the camp, and which meets the requirements of the Municipality Authorities.



**Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy-Duty Machine Room Less Elevators and Heavy-Duty Escalators including Maintenance during 02 (two) Years Defect Liability Period (DLP) and 01 (one) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transit System Project under the Contract LKE (02)-02**

## **Contract LKE (02)-02**

### **VOLUME 3**

#### **Part-A (Elevator)**

### **EMPLOYER'S REQUIREMENTS - PARTICULAR SPECIFICATION**

**Uttar Pradesh Metro Rail Corporation Ltd.  
Administrative Building, Vipin Khand, Gomti Nagar,  
Lucknow – 226010, Uttar Pradesh, India  
Website: [www.upmetrorail.com](http://www.upmetrorail.com)**





## CONTRACT: LKE (02)-02 EMPLOYER'S REQUIREMENTS - PARTICULAR SPECIFICATION

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# CHAPTER 1

## INTRODUCTION

## Chapter 1: Introduction

### 1.1 Scope and Purpose

1.1.1 This specification defines the objectives, guidelines and requirements for the contractor's design, manufacture, supply, installation, testing and commissioning of the Machine-room less Elevators, primarily for the use of Passengers including differently able & elderly persons and UPMRC staff at stations of Uttar Pradesh Metro network.

1.1.2 The works to be executed under the Contract include the design, manufacture, verification, delivery, installation, testing, including integrated testing and commissioning, technical support, maintenance, training of Employer's staff and documentation for a complete System necessary to deliver the requirements of this Specification.

### 1.2 Relevant Documents

1.2.1 This Specification should be read in conjunction with the General Conditions of Contract (GCC), the Special Conditions of Contract (SCC), the General Specification (GS) and any other document forming part of the Contract.

1.2.2 In the event of a conflict between the GS and this Specification, this Specification shall prevail.

1.2.3 In the event of a conflict between this Specification and any other standards or specification quoted herein, the requirements of this Specification shall prevail.

1.2.4 The order of precedence, with item 1 having the highest priority, is:

- 1 Particular Specification
- 2 General Specification
- 3 Indian Standards
- 4 International Standards referenced herein.
- 5 Other International Standards
- 6 Other National Standards.

1.2.5 Notwithstanding the precedence specified in clauses above the Contractor shall always immediately seek advice from the Employer in the event of conflicts between Specifications.

### 1.3 Design Service of the Works

1.3.1 The Contractor shall be responsible for the design service of the Works and shall



satisfy himself that the sizes, ratings and quantities of equipment as specified herein meet the functional and operational requirements of all the stations.

- 1.3.2 The contract price shall be deemed to include any additional equipment, accessories, assemblies, sub-assemblies, equipment of higher capacities or higher ratings for the systems and sub-systems necessary for the complete, safe, reliable and operable system.
- 1.3.3 The proposed capacities, sizes, ratings of equipment in elevator system, as a result of the design development shall be demonstrated by a proper design and testing / simulation study and subject to review by the "Engineer".

END OF CHAPTER

# CHAPTER 2

## OVERVIEW OF THE PROJECT

## Chapter 2: Overview Of The Project

### 2.1 General

This Chapter gives an overview of the Project and the information provided in this Chapter is for reference only.

### 2.2 Corridor Details

2.2.1 The Phase – 1B of Lucknow MRTS Project is expected to have following Corridors:

Sl.	Corridor/Sections	Expected date of commissioning
(a)	Thakurganj- Vasant Kunj (Elevated Section of Corridor-1B)	As per appendix 2B of GS
(b)	Charbagh – Chowk (UG Section of Corridor-1B)	As per appendix 2B of GS

### Agra & Kanpur MRTS Project

The Corridors details of Agra & Kanpur MRTS Project is as following:

Sl.	Corridor	Expected date of commissioning
(a)	Agra Corridor 1 & 2	As per appendix 2B of GS
(b)	Kanpur Corridor-2	As per appendix 2B of GS

### 2.3 Key Challenges

2.3.1 The following are the Key Challenges presented to the Contractor.

- a. Since these elevators are being utilized as passenger amenity, the usage of these elevators is quite heavy. Any dislocation of services or passenger trapping invites unavoidable adverse criticism from the travelling public. Being passenger service, the demand on availability of these elevators is quite high.

Based on experience, the failures have been analyzed and mainly failures of the following components have been observed:-

- V3F drive
- PCB
- Door

- Communication
- ARD

Considering the above, UPMRC is of the opinion that design aspects of these elevators are to be looked into to cater to the required level of service i.e. 10 Lakh or above operations per year. This will result in around 25 lakh operations of doors per year. This is besides the testing temperature and dust conditions prevailing in tropical climatic conditions in India, especially on the elevators which are provided (in open) from Ground – Concourse level

The elevators industry is expected to meet these challenges and design these elevators accordingly. These aspects will be thoroughly examined during Design.

- a) The specified level of Reliability, Availability, Maintainability and safety requirements of these systems shall be achieved and verified by the Contractor by analysis, simulation, testing and commissioning, and system demonstrations as required in this Specification.
- b) The Contractor shall carefully study the space layouts allocated for the installation of machine-room less elevators to ensure that all relevant safety clearances and rules are complied with and performance requirements are fully met.
- c) The space requirement given in the tentative layouts of various stations shall be critically reviewed by the Contractor to economise on space and also to provide a layout amenable to good maintenance and operation practices, to achieve an overall economic design.
- d) Various interfacing issues with other UPMRC's designated Contractors are required to be resolved to ensure timely completion of the Works. Whilst some of the interface issues have already been addressed, some of them are yet to be identified or finalised. It is the Contractor's responsibility to ensure that all interfacing issues are clearly defined and agreements sought from all other Contractors as well as from the local authorities in accordance with the GS and the interface requirements.
- e) The System Design shall meet the specified performance and operational requirements stipulated in this Particular Specification. The Contractor shall conduct Simulation Studies in early design stage, to ensure that the system capacity and equipment design meet the Employer's Requirements.
- f) The entire Scope of Works shall generally meet design requirements of fire safety in accordance with NFPA-130 Standard for Fixed Guide-Way Transit System and NBC code, with latest versions / amendments, except where amended by this PS.
- g) The entire installation shall meet the protective provisions relating to electrical safety and life safety described under various standards.

END OF CHAPTER

# CHAPTER 3

## SCOPE OF WORKS

## Chapter 3 Scope of Works

### 3.1 General

This Specification establishes requirements for the design, manufacture, delivery at Site, installation, testing and commissioning, operating and maintenance manual preparation and training of maintenance/operation personnel of the machine-room less Elevator system for stations of Uttar Pradesh Metro Network in Lucknow, Kanpur & Agra.

The Contractor shall be required to interface closely with the Detail Design Consultants appointed by the Employer and Designated Contractors working on this Corridor. The Contractor shall also be responsible for obtaining clearances from statutory authorities as per UP Lift & Escalators Act 2024 and future amendments, whenever required.

### 3.2 Scope

The Contract shall include but not be limited to the following Works: -

- a) Provision of machine-room less Elevators in stations and for the movement of Passengers including specially abled persons.
- b) All minor civil works including holes for armoured cable entry, louvers and cutouts (by providing proper size wooden blocks to civil contractor) or modifications required for installation of the equipment and restoring to final finishes. Minor civil work like chipping up to the 25mm in plaster shall be done by Lift contractor by themselves.
- c) Transportation of materials and equipment for installation purposes.
- d) Spare parts, special tools, testing and diagnostic equipment and measuring instruments.
- e) Training and Transfer of Technology.
- f) Documentation.
- g) Maintenance for specified period.
- h) Services.

The details of the above works are given in the relevant Chapters of this Specification.

### 3.3 Services

The Services to be performed by the Contractor shall include, but not be limited to, the following:

- a) Design, manufacture, supply, system quality management, installation, testing including integrated testing and commissioning of the complete system as brought out above;
- b) Presentations, reviews and audit support as specified in this Specification;
- c) Interface management as specified in this Specification;
- d) System operations and maintenance support services;
- e) Training for Employer's staff;
- f) Decommissioning, removal and/or disposal of temporary works;
- g) Prototyping;
- h) Defects liability of Permanent Works after commissioning as stipulated in the General Conditions of Contract (GCC) and Special Conditions of Contract (SCC); and
- i) Obtaining statutory clearances for the commissioning of Elevators from relevant civil authorities.

### **3.4 Documentation**

The documentation to be delivered by the Contractor shall include, but not be limited to, the following items: -

#### **3.4.1 Design Stage**

- a) Description of general design philosophy;
- b) System reliability, availability, maintainability and safety evaluation reports;
- c) Automatic fault identification and isolation arrangement;
- d) Determination of equipment ratings;
- e) Determination of space requirement;
- f) Design and proving protection devices/ systems and its validation,
- g) Type test reports for equipment selected;
- h) Detailed design drawings and reports;
- i) Detailed interface reports and interfacing design drawings;
- j) Hazard identification and control documentation.
- k) Specify values for Reliability, Availability, Maintainability (RAM) for equipments/ components in elevator.

#### **3.4.2 Construction Stage**

- a) Construction and Installation Plan including site safety plan,
- b) Factory Acceptance Test Plan for equipment;
- c) Quality Plans.

- d) Installation, operation and maintenance instruction of all equipment;
- e) Operation and Maintenance Manuals;
- f) Records and drawings of equipment installed;
- g) All other records of construction, including hidden parts;
- h) Site test report of equipment;
- i) As built drawings including interface drawings; and
- j) Other documentation as required, by the Employer.

### **3.5 Other statutory requirements**

- 3.5.1 The Contractor shall be fully responsible for obtaining relevant safety certificate or license or registration or any other documents required from statutory authorities for commissioning the regular operation of Machine-room less Elevators. The renewal of the license/safety certificate or any other statutory renewal during DLP and CAMC will also be the responsibility of the contractor. Fee, if any for obtaining such license/ certificate/registration shall be borne by the contractor.
- 3.5.2 The Contractor shall submit the relevant safety and clearance certificates obtained for each equipment from the statutory authorities to the "Engineer".
- 3.5.3 The Contractor shall provide adequate signage and graphics as being statutory requirements, for the safe and proper utilisation of each equipment, in adequate number exhibited at required locations.

### **3.6 Key Dates and Access Dates**

The 'Key Dates' and 'Access Dates' applicable to this Particular Specification are given in Chapter 21 of this Specification.

### **3.7 Provision of Works Areas**

The Designated Contractor shall provide the Contractor specified Works Areas at designated locations during construction purpose. The locations, specified area and probable date of access is given in the Chapter 21. The locations indicated are tentative and may change depending upon the availability and utilization of land. The Contractor shall hand over back the Works area to the designated Contractor after the expiry of specified period, reinstatement.

### **3.8 Items of Work Excluded from Contract**

The following items of work associated with the System will be provided by other Contractors and are excluded from the Contract. However, the Contractor shall provide timely inputs such as necessary drawings, instructions, hardware and materials to the relevant other Contractors as required.



- 3.8.1 The relevant Civil Contractors will provide Major Civil Works including access roads, fences and building services.
- 3.8.2 Earth mats and Earthing electrodes / Double earthing will be supplied (up to entry point in Lift Shaft ) and installed by Electrical Contractors. The extension of double Earthing inside Lift shaft from entry point to the required location to be provided by Elevator Contractor.
- 3.8.3 The incoming LT armoured cable from LT switchboard up to the Elevator main power panel/ ELCB shall be supplied (up to & inside the entry in lift shaft) and installed up to the entry in lift shaft by E&M contractor.

END OF CHAPTER

# CHAPTER 4

## DESIGN AND PERFORMANCE REQUIREMENTS

## Chapter 4: Design and Performance Requirements

### 4.1 General

- 4.1.1 The design, manufacture, supply, installation, testing and commissioning of the Machine room less Elevators shall meet the design and performance requirements within the design environments specified in this PS. Contractor shall do design and supply the System/Sub-System/ Components of internationally accepted benchmark for the design, construction, and operation of high-performance energy efficient buildings in compliance to IGBC (Indian Green Building Council) to obtain Platinum Level Certification and comply with ISO 50001. IGBC promotes a whole building approach to sustainability by recognizing performance in the five pillars of environmental design and human health and provides a road map to measure and document success for energy savings.

### 4.2 Design Environment

- 4.2.1 Climate Conditions/Operating Environment stipulated in clause 1.12 of General Specification shall apply.
- 4.2.2 Isoceraunic level: Average 30 thunderstorm days per year as per IS 2309:1989.
- 4.2.3 The stations are exposed to extreme weather conditions such as heat, dust, humidity and occasional seepage. The system design shall, take into consideration these conditions and ensure that performance of the system remains unaffected due to such conditions.

### 4.3 Basic Design Philosophy and Requirements

#### 4.3.1 Proven Design

- (a) The Contractor shall develop the design based on this specification and on proven and reliable Engineering Practices. The design details shall be submitted with technical data and calculations to the "Engineer" for review and approval.
- (b) The System, including all Sub-systems and Equipment shall be of proven design.
- (c) The Elevator Sub-systems and Equipment proposed by the Contractor shall have been in use at minimum two MRTS/RRTS/Railway/Airport/Sub-urban Railway Projects and have established their performance reliability over a period of at least two years in past 7 years. The performance certificate from the client/ User of the system is to be submitted in Bid submission.
- (d) Where similar equipment or Sub-systems of a different rating are already proven in service, then the design shall be based on such equipment. In case these stipulations are not fulfilled, the Contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered Sub-system.
- The design philosophy should meet the following criteria:
- (i) Application of state-of-the-art Technology.
  - (ii) Service proven design.

- (iii) Design life 30 years.
- (iv) Minimum life cycle cost.
- (v) Low maintenance cost.
- (vi) Use of interchangeable, modular components.
- (vii) Extensive and prominent labelling of parts, cables and wires.
- (viii) Use of unique serial numbers for traceability of components.
- (ix) High reliability and ensure Zero passenger trapping.
- (x) Low energy consumption.
- (xi) System safety.
- (xii) Adequate redundancy and factor of safety.
- (xiii) Fire and smoke protection.
- (xiv) Use of fire retardant materials.
- (xv) Environment friendly.
- (xvi) Adherence to operational performance requirements
- (xvii) Maximum utilisation of indigenous materials and skills, subject to quality conformity.
- (xviii) Specified values for Reliability, Availability and Maintainability (RAM) for equipments / components in elevator.

- 4.3.2 Adequate margin shall be built into the design particularly to take care of the higher ambient temperatures, dusty conditions, and high seasonal and general humidity, etc. prevailing in Lucknow.

#### **4.4 Design Management and Control**

- 4.4.1 In order to ensure that the requirements of this Particular Specification are met, the Contractor shall establish and maintain documented procedures using ISO 9001 to control and verify the design of the System and all its equipment. These procedures shall be subject to review by the "Engineer".
- 4.4.2 The Contractor shall establish and maintain a systematic, documented, comprehensive, and verifiable system integration process throughout the execution of the Contract.
- 4.4.3 This process shall ensure that interfaces and interaction between System, infrastructure, sub-systems, software, and operating and maintenance requirements have been identified and engineered to function together as a system.

#### **4.5 System Integration Process**

- 4.5.1 The Contractor shall systematically identify and formally document all design, manufacturing and operational interfaces between equipment within the System, and between the System and external systems, facilities, operations and the environment likely to affect or be affected by the System.

- 4.5.2 A mechanism and assigned project responsibility for interface management and control shall be provided, such that every identified interface has a defined resolution process that can be monitored.
- 4.5.3 The Contractor shall define methods to confirm compatibility between System equipment and carrying out integration tests at different stages of the design and interface management process to demonstrate that all equipment functions perform properly, both individually and as part of the complete System.
- 4.5.4 The contractor shall ensure that performance, availability and safety requirements are addressed in the design process and that the reliability and maintainability of all equipment will enable the service performance to be met.
- 4.5.5 The system integration process shall be capable of audit by the "Engineer/Employer".

#### **4.6 Interface Management Plan**

- 4.6.1 The Contractor shall submit to the "Engineer/Employer" for review an Interface Management Plan (IMP) and Detail Interface Documents (DID), in accordance with the General Specification, which defines how the Contractor will systematically identify and document technical interfaces. This will not absolve the contractor of the ultimate responsibility for ensuring timely & appropriate interface.

#### **4.7 Design Submission Requirements**

- 4.7.1 The Contractor shall perform his designs for the Contract in accordance with the requirements of this PS and the GS. The Contractor shall submit to the "Engineer/Employer" for his review, relevant design information as identified under each stage. Such submissions shall incorporate the relevant Standards applicable.
- 4.7.2 The design submission requirements are detailed in the General Specification.

#### **4.8 Performance Features Required**

- 4.8.1 The Contractor shall provide built-in diagnostics and remote monitoring functions for each microprocessor-based equipment and module of the systems such that the performance requirements can be demonstrated.
- 4.8.2 The reliability and maintainability processes and procedures shall be planned, integrated and developed in conjunction with the operating environment, and the design, development and production functions to permit the most effective and economical achievements of the systems and equipment design objective. The Contractor shall prepare RAMS analysis report based on the approved Elevators Design, which shall be validated by the contractor as per the actual performance data obtained during Defect Liability period (hereafter named as DLP). In case the contractor is not able to achieve specified / provided target of RAM, the contractor shall take necessary corrective measures either by way of change of design of the relevant equipment / component or software modification at his own expenses to meet the RAM requirement.

4.8.3 The systems shall meet or exceed the requirements for safety and reliability as specified. The reliability of the systems designed, supplied and installed is the principal element for availability. It is essential that the System reliability is as high as reasonably practicable.

4.8.4 A high design standard incorporating redundancy if practicable, flexible system arrangement, together with good quality products, and adherence to strict construction standards, are required to ensure high reliability of systems installed for smooth operation of train services.

#### **4.9 Reliability**

4.9.1 The Reliability requirements shall be subsidiary to the Availability and Maintainability requirements.

The reliability of equipment should be of the level that it does not result in harm or injury to passenger in the Elevators due to equipment failure. Any claim / damage / compensation claimed by the affected passenger / Elevators user on account of equipment failure or poor design or poor workmanship of work shall be recovered from the contractor. In addition, Employer shall impose a penalty of INR 15,000/- (INR. Fifteen Thousand Only) Per case. For non-achievement of reliability Target as defined in chapter -17, Penalty shall be imposed as per Clause 17.7 of Chapter-17 of this PS.

#### **4.10 Availability**

##### **Service Availability Targets**

- Quantitative targets have been set for the System availability to ensure that the reliability of the Systems does not jeopardize the reliability of services of the MRTS.
- The Systems shall be designed to ensure that failure of any major equipment, caused by an external accident or negligence of internal staff, will not lead to unavailability of the whole System, other than temporary outage of the failed equipment.
- All elements of the systems shall be able to be maintained during out-of-traffic hours to avoid interrupting passenger train services.

For non-achievement of Availability Target as defined in chapter 17, Penalty shall be imposed as per Clause 17.7 of Chapter 17 of this PS.

#### **4.11 Maintainability**

4.11.1 The Contractor shall submit maintainability analysis to assess the preliminary maintainability targets of the systems.

4.11.2 The Contractor shall state the maintainability requirements and demonstrate that System maintainability is sufficient to support the claimed System reliability and availability performance. The Contractor shall demonstrate that maintenance errors have been

considered, and, as far as is practicable, the risk of maintenance-induced faults has been mitigated by the appropriate design.

- 4.11.3 The equipment to be supplied by the Contractor must be designed for minimum or no maintenance. Maintenance activity required must be capable of being performed with minimum or no impact on the train service.
- 4.11.4 Maintenance activities may be classified into two areas, routine/ preventative and corrective. Other maintenance strategies such as condition monitoring may be incorporated.
- 4.11.5 Routine/preventive maintenance periods shall be limited to non-operational maintenance hours during the night or if essential during off peak periods.
- 4.11.6 To optimize speedy corrective maintenance, techniques employing automatic diagnostics test points, and rapid repair facilities shall be provided. MTTR (Mean Time To Restore) time measurement shall include on site diagnostics and rectification of the failure up to the point that the system is restored to full functionality. In the event that the failure cannot be rectified, the measurement shall include the time necessary to remove the failure piece of equipment from the system and replaced it with a functioning module.

The maintainability shall be measured by fault rectification time which should not exceed 4 hours since its reporting to contractor call centre or his representative by Employer.

**Failure: Elevators not available for more than One Hour for passenger service shall be registered as a failure provided:**

- (1) Failure is attributable to –
  - (i) Design defect
  - (ii) Equipment failure / replacement
  - (iii) Manufacturing defect.
  - (iv) Poor workmanship during erection or installation or maintenance
  - (v) Maintenance lapse during DLP

OR

- (2) "Accident" / Trapping resulted because of any or all of the above defects.

For non-achievement of Maintainability Target as defined in chapter -17, Penalty shall be imposed as per Clause 17.7 of Chapter 17 of this PS.

## 4.12 Safety

### 4.12.1 Safety Requirements

- The installation design shall incorporate measures to avoid presenting safety hazards to people.
- The Systems design shall incorporate measures to provide for its safe management and operation.
- The Systems shall not give rise, or be subject to, dangerous interactions within the railway or with other systems.

- The installation shall meet the fire safety requirements generally as per NFPA-130/ NBC.
- The design of the earthing system shall conform to IS 3043 : 1987

#### 4.12.2 Safety Targets

- The Contractor shall show that the Systems can be maintained safely. The Contractor shall prepare a Quantified Risk Assessment (QRA) to model the risk to (a) travelling public and (b) maintenance and operations staff. The QRA may be based on a comparison of System features and operating practices with other system metro systems for which risk levels are known.
- The contractor shall demonstrate that the systems have been designed to minimise the risk due to operator and maintainer error, considering both ergonomic aspects of the system designed to reduce the likelihood of the error, and protective measures to mitigate the consequence of such error.
- The Contractor shall demonstrate that risk to passengers, members of public, including trespassers is as low as reasonably practicable.

### 4.13 Conformity with Governing Specifications and other Statutory Requirements

4.13.1 The work shall be carried out in accordance with the following governing specifications and other statutory rules:

- Central Electricity Authority Regulation 2010 with latest amendments.
- Indian Electricity Act 2003 with latest amendments.
- Rules and Regulations prescribed by local authorities as applicable.
- Relevant, Indian Standards, IEC Standards, EN Standards, British Standards, and other National/International standards as applicable.

4.13.2 The Contractor shall furnish information asked for by a statutory body (e.g., Inspector of lifts, Commissioner of Railway Safety, etc.) in particular format as directed by "Engineer/Employer".

#### 4.14 Functional Requirements – Machine - room less Elevators

Machine-room less Elevators shall be provided in the stations to facilitate the movement of commuters, specially abled persons, and UPMRC staff and cash trolleys between the different levels of the stations from Ground level (G) to the Concourse (C) or from Concourse (C) to Platforms (P).

The Contractor shall verify the number of Elevators vertical rises, travels, stops, delivery routes and all other relevant information by co-ordination with the respective Civil Contractors. It shall be responsibility of the Contractor to provide the elevator suitable for the constructed shaft. No variation on this account will be payable.

#### 4.15 Not used

#### 4.16 Elevator Schedules

Refer volume-5 BOQ for Schedule of elevators to be supplied and execute.



- (i) The elevator rises may vary by  $\pm 0.50$  m based on site conditions, however the Contractor shall not be entitled for any extra payment on account of this variation. In case height of Elevator falls in two categories of rise / height, the lower band / category of height shall be applicable, e.g. Elevator with rise of 4.5m will be considered in the category of rise / height of 4m instead of band / category of 5m.
- (ii) Elevators shall have carrying capacity of 1000kg / 13 passengers, 1500 kg/ 20 passengers, 2000kg/26 passengers as per BOQ (Volume-5).
- (iii) The station wise number of lifts, type of Lift and height of travel within these bands are mentioned in the BOQ.
- (iv) Car and Landing Door of the Elevators shall be either Stainless Steel or of Glass.

## 4.17 Codes and Regulations

### 4.17.1 Local Codes, Regulations and Standards

Unless otherwise stated herein, the design, installation, testing and commissioning shall comply with the latest edition of all applicable standards issued by the Bureau of Indian Standards and other relevant local regulations applicable.

- IS 17900: All parts (Latest Version)
- IS 15330: Installation and Maintenance of lifts for Handicapped Persons – Code of Practice (Latest Version).
- IS 1860: Code of practice for Installation, Operation and Maintenance of Electric passenger and goods lifts.
- IS 1554 and IS 694 LSHF Cables.
- IS- 60529: Degree of IP Protection.
- National Building Code of India.
- CVC Guidelines.
- BS-476 Part 22:1987-Code requirement for Fire door rating
- Seismic Zone- Code Requirements as per IS 1893.
- All the codes and standards mentioned above should be as per the latest edition/amendment.

Additional requirements imposed by statutory or government authorities not listed above shall be complied with.

### 4.17.2 Additional Standards

Elevators shall comply with the requirements as per latest edition of EN 81 (All relevant parts of EN-81) and BS 5655 of the British Standards: Safety rules for the construction and installation of electric lifts. The provisions related to the application for differently abled persons stated in these codes shall also be complied with.

The Contractor shall also comply with the “Guidelines and space standard for Barrier free Built Environment for Disabled and Elderly Persons” published by C.P.W.D. (Central Public Works Department). India.

The contractor shall comply with the guidelines for safety of elevator circulated vide A. V. series circular no. 822, issued by Ministry of Urban Development and Poverty Alleviation, Govt. of India vide their letter no. C-31011/1/2001-AVII dated 7.12.2001 and Harmonized Guidelines and Space Standards for Barrier-Free Built Environment for persons with Disability and Elderly Persons.

Note: -

1. Contractor shall submit the relevant Codes referred in the design preparation in support of reference used and taken for design.
2. In case of any conflict between Standards and this specification, most stringent will be followed. The design in compliance to relevant Standards shall be submitted for review and approval by Employer. Employer decision will be final over the standard to be considered.

#### **4.18 Abbreviations**

The abbreviations used in this Specification are listed in Appendix - 'D'.

END OF CHAPTER

## CHAPTER 5

**NOT USED**

# CHAPTER 6

## DESIGN CRITERIA AND PERFORMANCE REQUIREMENTS – MACHINE-ROOM LESS ELEVATORS

## **6 Design Criteria and Performance Requirements - Machine-Room Less Elevators**

### **6.1 Introduction**

Uttar Pradesh MRT System shall be equipped with machine-room less elevators being used in transportation establishment for Passengers including differently able & elderly persons and UPMRC staff in locations as listed in the Particular Specification.

It may be noted that these elevators will be subject to rigged use as per passenger demand. Mostly these elevators will be two landing type. However, in some cases, Elevators may have extra landings i.e. G+1/G+2/G+3 floors or as applicable.

### **6.2 General Requirements**

6.2.1 Each Elevator shall have its own driving machine. The method of drive shall be Electric Traction with Gear less motor having VVVF Control & regenerative braking. (supporting detailed calculation of energy saving viz a viz cost saving shall also be submitted by the contractor during design stage.)

Note: The price in the Statement of Price-1 is without regenerative braking, adjustment price for regenerative braking has been provided in the SOP-6B. Engineer/Employer may decide to adopt regenerative braking at the time of detailed design stage.

- (i) The System, including all Sub-systems and Equipment shall be of proven design.
- (ii) The Elevator Sub-systems and Equipment proposed by the Contractor shall have been in use and have established their performance reliability over a sufficiently long period of time. In support of the performance certificate from the client/ user of the system is to be submitted.

6.2.2 All elevators shall be capable of operating satisfactorily and smoothly at a rate of 180 motors starts per hour or above for a period of not less than 20 hours per day, seven day a week, within the environmental conditions as stated in the General Specification and at the location where the elevators are to be installed. These elevators should be designed for minimum 13,14,000 (Thirteen lakhs and Fourteen Thousand) operations per year and with minimum failures as defined in this PS.

6.2.3 The design of the Elevators shall be such that no replacement of major component shall be necessary for a period of 20 years from the date of issue of Certificate of Taking Over. This is based on the requirements that detailed inspections and maintenance are carried out annually, whilst routine cleaning and maintenance are carried out as necessary. The elevators should be designed for minimum life cycle cost. Detailed life cycle cost analysis should be submitted. The necessary data shall

be collected by the contractor on his own end without any additional cost to UPMRC. Life of all components should be clearly mentioned in the bid. Major components are mentioned at clause-6.2.4

6.2.4 Major components shall mean replacement of car frame, car enclosure, car and landing doors, elevator shaft wiring (except travelling cables), guide rails, drive machine and driving sheave but parts attached to these components which are subjected to normal wear and tear are excluded.

6.2.5 Not Used

6.2.6 The design of the Elevators shall take into consideration fire prevention, elimination of dust and dirt traps, and easy accessibility for cleaning and routine maintenance.

6.2.7 The gear less drive machine shall be mounted on guide rails/bracket accommodated within the elevator shaft. The power switch gear and main control equipment shall suitably locate inside or near the Elevator shaft, the location of which is to be decided in coordination with the Designated Civil Contractors. No separate machine-room will be provided for machine room less elevators

The function of Elevator involves primarily for the movement of passengers including specially abled and elderly persons and UPMRC staff. The reliability of the Elevator is therefore of paramount importance.

Elevators intended to be procured shall have a carrying capacity (rated load) of at least 1000 kg / 13 passengers (or 2000 Kg/26 Passenger or 1500 kg/20 passenger). The nominal speed for the Elevators shall be 1.0 m/s in either direction.

- Shaft dimension for non-hanging type 1000 kg/13 passenger elevator shall be approximately 2500 mm (Width) x 1900 mm (Depth). Shaft dimension for hanging type 1000 kg/13 persons elevator shall be approximately 2500 mm (Width) x 2100 mm (Depth) i.e. for the Elevators with "Hanging – Pit" / "Floating – Pit" the dimensions of Lift shaft shall be increased by 200 mm in Depth.
- The shaft size for 26 Passenger Elevators shall be approximately 2850 (W) x 3150 (D) for 2000kg capacity and 2750 (W) x 3050 (D) for 1800kg capacity with Construction Tolerance +200/ -50.
- Shaft dimension for non-hanging type 1500 kg / 20 passenger elevator shall be approximately 2700 mm (Width) x 2500 mm (Depth). Shaft dimension for hanging type 1500 kg / 20 passenger elevator shall be approximately 2700 mm (Width) x 2700 mm (Depth), i.e., for the Elevators with "Hanging – Pit" / "Floating – Pit", the dimensions of Lift shaft shall be increased by 200 mm in Depth.
- The Contractor shall take all necessary measures to accommodate the elevators in the above shaft. The Contractor shall co-ordinate/interface with the Designated Civil Contractors for all matters related to shaft size. Any minor change in the shaft size (depth) to the tune of +250 mm shall have to be accommodated in the design

by the contractor by way of provision of suitable guide brackets/stainless steel channels without any additional cost to UPMRC. The contractor shall be responsible for any delay on this account.

For the Elevators with "Through Door Arrangement" the dimensions of Lift shaft shall be increased by 100 mm in Depth for 13 Passengers Elevators, 150 mm in Depth for 20 Passengers Elevators and 200mm in depth for 26 Passengers Elevators. For such cases, the Elevator contractor should provide the detailed design / requirements for such Lift shafts as per specific site conditions and interface with designated civil contractor to ensure that the Lift is constructed as per the design / requirements.

- 6.2.8 Elevator car shall have minimum internal dimensions as per relevant Standards considering rated load and shaft dimension. Dimension and Design in compliance to relevant code/ Standard shall be submitted for review and approval by Engineer/Employer.

The false ceiling height of the Elevator car shall not be less than 2300 mm. The Elevator and door shall be so configured that it is feasible to handle a person on a wheelchair.

- 6.2.9 Both the car and landing entrance clear opening width shall not be less than 1000 mm for 13 passenger, 1100 mm for 20 passenger and 1200 mm for 26 passenger lift and height shall not be less than 2100 mm. The door shall be of center opening type.

- 6.2.10 The approximate travels of Elevators are given in BOQ Statement of Prices. The Contractor shall verify the above and all other relevant information through co-ordination with the Designated Civil Contractors.

- 6.2.11 The approximate headroom of 4450mm and pit depth of 1650mm shall be provided in the shaft for 13 passengers elevators, 4600 mm Headroom and pit depth 1750 mm for 20 Passengers elevator and 4700 mm Headroom and pit depth 1800 mm for 26 Passengers elevator. The Contractor shall submit in their technical packages the requirement in respect of reaction load on the walls and in the pit and other relevant shaft requirements. The Contractor is required to interface with Designated Civil Contractor in respect of the Elevator shaft requirement. The Contractor shall co-ordinate with the Designated Civil Contractors to finalize all the details. The pit depth and overhead dimensions shall be such as to confirm the requirement of bottom and top clearances as per relevant IS.

- 6.2.12 The leveling accuracy shall be within  $\pm 5$  mm of the finished floor level.

- 6.2.13 The running clearance of each Elevator between the Elevator car threshold and landing door sill shall not be less than 15 mm but not more than 30 mm.

- 6.2.14 The software for elevator should be so designed that

- (i) The problem of man-trap and safety related requirements are completely addressed and the software enables the doors to open in all type of faulty situation. These features will be finalized during Design Stage, Bidder need to submit the write-up and design to review and approval by Employer.
  - (ii) Suitable provisions shall be made in hardware/software so that there should not be loss of any data due to power failure or any type of power disturbance etc.
- Various fault situation covered by the software shall be reviewed at design stage.

### 6.3 Electric Traction Drive System

#### 6.3.1 Traction Machine

The construction of all Elevator machines shall conform with latest IS 17900 and EN-81.

#### 6.3.2 Motor

- (a) Driving motor shall be of the AC synchronous/asynchronous axial type designed for special duty cycles required for Elevator operation with no slip rings. It should have a high starting torque, high power factor, efficiency not less than 85% and low energy consumption. **As per IEC 60034 – 1, Motor should be suitable for Duty Cycle S5 – 60%.**
- (b) For all type of elevators, the motor shall be capable of not less than 180 starts per hour without excessive temperature rise.
- (c) The maximum temperature rise of the winding shall not exceed 50 °C above ambient temperature when operated under normal condition.
- (d) Not Used.
- (e) Provision shall be made to enable the speed to be checked at main Control cubicle.
- (f) The motor shall carry a nameplate giving full details of its ratings and characteristics.
- (g) The motor used shall have Class 'F' insulation and shall be designed for 110% of rated load.

#### 6.3.3 Brake

- (a) The Electro-magnetic brake shall be of the spring applied and electrically released type.



- (b) The brake shall be capable of stopping and holding the Elevator car in its downward travel to rest with 125% of its rated load from the maximum governor tripping speed. In this condition the retardation of the Car shall not exceed that resulting from the operation of the Safety gear or stopping on the buffer.
- (c) Springs to apply the brake shoes (two nos.) shall be in compression and adequately supported. Power coating or other alternative Anti-corrosion measures to be ensured.
- (d) Brake linings shall be of renewable incombustible materials and shall be secured to the brake shoes that normal wear shall not weaken their fixings. Band brakes shall not be used.
- (e) No earth fault, short circuit or residual magnetism shall prevent the brake from being applied in the event of loss of power supply to the Elevator motor and control circuit.
- (f) A means of adjusting the brake plunger stroke and releasing the brake in emergency shall be provided.
- (g) The Elevator machine shall be fitted with a manual emergency device capable of having the brake released by hand Manually operated/ Battery operated and requiring a constant effort to keep the brake open. The manual emergency device shall be handle operated. The handle should be robust and able to bear the human intervention. The termination of brake cable at handle of manual emergency device should be double securing and fail safe. Alternative arrangement (if any) proposed during Design stage and in compliance with the requirement and Standard of Lift will be evaluated during detailed design stage.

#### 6.3.4 Driving Sheaves

- (a) The sheaves shall be manufactured in steel or SG iron and fitted with seal for life lubricated bearings.
- (b) The sheaves shall have machined rope/Belt grooves that can be reworked for future wear.
- (c) Adequate provision shall be made to prevent any suspension ropes/Belts leaving groove due to rope slack or introduction of foreign objects.
- (d) ~~Not used~~

**6.3.5 Alignment**

- (a) The brake plunger, collar, sleeve, motor, sheaves and all bearings shall be mounted and assembled so that proper alignment of these parts is maintained.
- (b) The assembly shall be reviewed and rectified when excessive noise is emitted during operation.

**6.3.6 Anti-Vibration Supports**

The whole traction machine shall be mounted on appropriate anti-vibration supports to minimize noise and vibration. The Train design Speed is 95 kmph therefore Contractor shall design and install the Elevators accordingly. Any failure on ground of the vibration, Contractor shall rectify the damages at their own cost and ensure no damages further.

**6.4 Hoisting Rope/Belt**

- 6.4.1 At least three (3) steel wire ropes or coated steel belts specially manufactured for Elevator use shall be employed for the suspension of Elevator car and counterweight. The diameter/dimension and specification of rope/coated steel belts for the car and counterweight shall conform to latest version/ amendments of IS: 17900.

A plate giving the number, size and ultimate tensile strength of the rope or steel/coated steel belt used shall be permanently fixed to the crosshead. Steel rope/coated steel belt of adequate size and number is to be provided whose capacity / strength will be verified at design / test stage. The coated steel belt shall be provided with continuous operating fatigue monitoring system as per IS 17900.

- 6.4.2 Before installation, manufacturer's certificates shall be supplied for each set of hoisting ropes/Belts with the data not limited to following: -

- (a) The type of wire rope
- (b) The diameter in mm
- (c) The manufacturer's rated breaking strength
- (d) The month and year the ropes were manufactured
- (e) The manufacturer's name

Note: One Set of Tools to measure the wear and tear of grooves shall be provided to Employer. Critical Limits of Grooves shall be defined during design stage.

- 6.4.3 The factor of safety based on maximum static load for car and counterweight ropes shall be at least 12.

6.4.4 The ropes/belts shall be attached to dead-end hitch assemblies, fitting to supporting beams, car frames, counterweights by means of suitable rope/belt termination. A locking device or anti-twist rope device shall be fitted to the roping system. Alternately approved arrangement for wedge type rope fastening may be used.

6.4.5 Compensation ropes or chains or any other arrangement shall be provided if necessary to achieve the leveling required and smooth starting. If chains are provided, they shall be galvanized and enclosed in canvas hose or other accepted means to reduce noise.

## 6.5 Counterweight

6.5.1 Guide shoes, having non-metallic renewable linings requiring minimum lubrication shall be provided at the top and bottom of the counterweight.

The counterweights shall be made of cast iron/ wrought iron/ steel and shall be appropriately secured and housed. They shall be of uniform density and physical dimensions.

**Counterweights shall be guarded by means of a rigid, galvanized steel sheet screen extending from a position 300 mm above the pit floor to a position at least 2.0 m above the pit floor or the height of the counterweight when the car is at top landing or whichever is more.**

6.5.2 The counterweight shall be balanced to 40% to 50 % ( $\pm 3\%$ ) of the rated load.

6.5.3 ~~Not used~~

## 6.6 Clearances and Run-by for Car and Counterweight

6.6.1 The top clearance of the car and counterweight shall be as stated in IS Standards.

6.6.2 The bottom run by of car and counterweight shall be as per relevant IS Standards.

6.6.3 When the car rests on its fully compressed buffer, there shall be a vertical clearance of at least 600 mm between the pit floor and the lowest structural or mechanical part, equipment or device installed beneath the car platform except guide shoes or rollers, safety-jaw assemblies and platform aprons, guards or other equipment. However, when the car rests on its fully compressed buffer, no part of the car or any equipment attached thereto shall come into contact with any part of the pit or any part of the equipment located therein.

6.6.4 The clearance between the car/counterweight and the hoistway enclosure shall be at least 20 mm except on the side for loading and unloading.

6.6.5 The clearance between the car and the counterweight shall be at least 25 mm. The clearance between the counterweight and the counterweight screen shall be at least 20 mm.

## **6.7 Guides and Fixings**

- 6.7.1 Planed steel tees shall be provided as guides for the Elevator car and counterweight, as appropriate, erected plumb and fixed securely to the Elevator shaft by steel brackets. The bracket shall be solidly fixed with the RCC beam/bonds. The guide rails shall be connected by steel fish plates
- 6.7.2 The rail contact surfaces of the connecting rail plates and back of the guide rail ends shall be accurately machined and fitted at site to form smooth joints.
- 6.7.3 The stem sections of all guides shall be tongued and grooved to provide matched joints. The guides and their fixings shall be able to withstand the forces imposed by a fully loaded car traveling at or higher than the tripping speed of the governor, due to the application of the safety gear, without permanent deformation or bending due to the uneven loading of the car. The guide rail brackets shall be hot-dipped galvanized.
- 6.7.4 Guide rail brackets shall be of steel and bolted securely to the building or structure steelworks. The brackets shall be designed and located such that the rail will not deflect more than 5 mm under normal operation. There shall be a minimum of two brackets per piece of guide rail and the distance between brackets shall not be more than half the length of each piece of guide rail. The bracket should be fixed to PCC blocks or RCC beams. This particular requirement is to be ensured during interface with designated civil contractor. It is the sole responsibility of the elevator Contractor to Interface with Civil Contractor, to satisfy himself about the Shaft strength (as per latest standards) before taking up Lift Installation, and get the strength of the shaft wall certified from Civil Contractor.
- 6.7.5 ~~Not used.~~
- 6.7.6 The fixing of guide rails to their brackets and to the building structure shall permit compensation, either automatically or by simple adjustment, due to normal settling of the building or shrinkage of concrete.

## **6.8 Elevator Car**

### **6.8.1 Guide Shoes**

- (a) Adjustable guide shoes shall be provided and properly fitted at the top and bottom on each side of the car frame and the counterweight frame. The guide shoes shall be either slipper type or roller guides as appropriate.
- (b) Slipper type guide shoes shall be of milled cast iron or steel frame type or sheet metal with non-metallic renewable liners, of low coefficient of friction and good wear resistance, which require minimal lubrication. A drip tray fabricated from galvanized steel sheet shall be provided.

**(c) Roller guides shall comply with the following requirements:**

- i. Each roller guide shall consist of three wheels tyred with polyurethane or a durable resilient material, each rotating on ball bearing having sealed-in lubrication, assembled on a substantial metal base. They shall be so mounted as to provide continuous contact of all wheels with the corresponding rail surfaces under all condition of loading and operation. The wheels shall run on three finished rail surfaces. The Contractor shall provide a means of adjustment of spring pressure and of play between shoes and guide rails.
- ii. The roller guides shall run on dry guide rails. Sheet metal guards shall be provided to protect the wheels on top of the car and counterweight. The roller wheels for the car shall not exceed 500 rpm and the roller wheels for the counterweight shall not exceed 1000 rpm at rated speed.
- iii. The car and the counterweights are to be statically balanced following fitting of all its equipment and finishes prior to fitting the guide shoes.

**6.8.2 Car Frame**

A suitable car frame fabricated from galvanized cold rolled steel, bolted, or welded together to form a rigid structure shall be provided. The deflection of the members carrying the platform shall not exceed 1/1000th of their span under static conditions with the rated load uniformly distributed over the platform. It shall be able to withstand the operation of the safety gear or any condition loading without permanent deformation and shall not transfer the load to the enclosure. The safety factor of the frame shall not be less than five (5).

**6.8.3 Car Enclosure**

Car enclosure required under this Tender are of two types: - (i) Stainless Steel door and side panels elevators, (ii) Glass door & two side glass side panel elevators (Anywhere in the tender, if it is mentioned as Glass Door Lift, it should be considered as Glass Door with two side Glass Panels as per Indication Drawing Shown in Appendix-G)

- (a) The car enclose shall be fabricated from scratch resistant Stainless steel of not less than 1.5 mm in thickness or any other material where specified and securely fastened to the car platform and so supported that it cannot be loosened or become displaced in ordinary service or on the application of safety gear or on buffer engagement. The design of the final finishes of the walls, ceiling and floor is subject to the acceptance of the "Engineer".
- (b) No wood or other combustible materials shall be used for any part of the Elevator car including car door and emergency trap door.
- (c) The enclosure shall be designed and supported such that when subjected to a pressure of 335N applied horizontally at any point over an area of 5 cm<sup>2</sup> on

the walls from the inside of the cars toward the outside, there shall be no permanent deformation and deflection shall not be more than 10 mm.

- (d) The enclosure shall be insulated to prevent the transmission of noise and vibration from the car frame.
- (e) For elevators of glass door with glass side panels, the car enclosure shall be Scratch Resistant Stainless-steel finish at rear side and framed transparent glass panels on both sides with minimum thickness 10mm.
- (f) The indicative drawing for Glass Door Elevators with glass side panels is attached as Appendix G.
- (g) Emergency trap door. The proposal shall be submitted to review and approval by Engineer/ Employer.
- (h) Access Trap Door as per EN-81.

#### **6.8.4 Car Platform**

- (a) The car platform shall be constructed from spray galvanized steel with steel flooring. The platform shall be designed on the basis of the rated load being evenly distributed with a minimum safety factor of five (5). The design of the final floor finish is subject to acceptance by the "Engineer".
- (b) The car platform shall be insulated to prevent the transmission of noise and vibration from the car frame to the platform.

6.8.5 The car roof shall be suitably constructed with galvanized sheet steel and reinforced to permit the maintenance and inspection of the Elevator shaft equipment to be carried out by maintenance personnel standing on the car roof. Perforated with mesh construction of the roof or wooden platform(s) on the car roof shall not be acceptable. The car roof shall be fitted with guard rails set as at suitable height and of suitable dimensions and strength to protect maintenance personnel in line with EN 81-20 and EN 81-50.

6.8.6 A toe guard shall be provided for the car doors conforming to Paragraph 8.4 of EN81 Part 1. The toe guard for elevators shall be made of galvanized sheet steel of not less than 1.5 mm thick and painted and shall be adequately braced at the back. The depth of the toe guard shall be sufficient to prevent any object from being trapped between the underside of the car platform and the landing during relevelling operation (with a minimum of 700 mm). Similar Toe Guard is also to be provided for all landings. In case of Glass door lifts, Facia Plate shall be extended with Landing Toe Guard so that shaft wall should not appear through Car door from inside Car Cabin. This Extended Facia Plate shall be Galvanized and Painted as required by Engineer/Employer.

### 6.8.7 Ventilation

- (a) Each Elevator car shall be adequately ventilated using Cross Flow Fans to achieve minimum standard of 20 air changes per hour. The fans shall be located above the suspended ceiling or recessed in the car ceiling as appropriate.
- (b) A low-speed fan of low noise shall be used. The noise from the fan measured at a distance of 1 meter away within the Elevator car shall not exceed 55 DBA (+5%).
- (c) The effective area of ventilation apertures shall be at least 1% of the car platform area as per EN 81-20 and latest relevant standards.
- (d) Fan shall automatically start on registering the command / Auto Call for 2 floors elevators. However, fan Switch shall be provided to disable auto-starting of the Fan when not desired.

6.8.8 The car door shall be provided with an electric contact arranged to prevent the normal operation of the Elevator unless the gate is in the closed position. The car gate shall be arranged to give the minimum clear opening width as specified.

6.8.9 The car junction box with IP Class 55 protection, for the traveling cables and car enclosure wiring shall be installed at the car top.

6.8.10 **Car Interior and Elevator Finishes** Unless specified elsewhere in this Specification, the following finishes for the Elevator shall be complied with:-

#### (a) Landing Finishes

- i. Landing Transom Panels - Scratch Resistant Stainless steel,
- ii. Architrave (Fascia/ Jamb) - Scratch Resistant Stainless steel/ Stone work,  
The fascia of minimum 300 mm width on every landing or as per site condition for fixing the Landing Plate, Indicators, and MAP etc. shall be of Scratch Resistant Stainless steel/ Stone work and shall be in scope of elevator Contractor.

- iii. Landing Doors
  - (i)-Scratch Resistant Stainless steel for Steel door elevators;
  - (ii) - For the glass Door elevators, Thickness of glass door shall not be less than 10 mm and with Scratch Resistant Stainless steel frames. The fire rating of the glass doors shall be minimum 1 hour

		and for Stainless Steel Door minimum 2 hour.
<b>(b) Car Finishes</b>		
i. Car Transom Panels		- Scratch Resistant Stainless steel frame,
ii. Car Door Frame		- Scratch Resistant Stainless steel,
iii. Car Wall		
1. Front Panels		- Scratch resistant Stainless steel,
2. Side Panels		(i)-Scratch Resistant Stainless steel for Steel door elevators (ii)-Framed transparent glasses (Frames Scratch Resistant Stainless steel, LHS and RHS frame must be symmetrical with each other) for glass door elevators Including the COP (Car Operating Panel).
3. Back Panels		- Scratch Resistant Stainless steel, Joints in all surfaces shall be coordinated. All fixings to be of the hidden secret type (Cover strips at joints are not acceptable).  Depending on site conditions, for some Concourse to Platform Lifts with Glass Rear Panel may be required. The Glass used shall be laminated toughened glass of minimum 10 mm thickness (subject to review during Design stage, considering the strength requirements). Glass shall be provided with reflective film in place of mirror up to half height to facilitate reversal of wheel chair. (Note:- Adjustment price as per SOP-6F of BOQ shall be applicable)
iv. Car Doors	(i)-Scratch Resistant Stainless steel for Steel door elevators. (ii) For the glass door elevators, Thickness of glass shall not be less than 10 mm and with Scratch Resistant Stainless-steel frames. The fire rating of the Car door shall be complying with the requirement as per latest National Building code.	
v. Car Floor anti-slippery	15mm thick Granite/ synthetic artificial stone having design distinguishable through grating of any suitable	



material which can take the desired load. However, the approval for the colour of granite/ artificial synthetic stone and its specifications will be obtained from the Employer during design/ proto type

testing. Contractor shall coordinate with Civil Contractor and match the lift Car floor granite with Station floor in front of Lift.

- vi. Car Ceiling - Scratch Resistant Stainless-steel panels with sufficient LED down lights or other energy efficient light. Ceiling design to be coordinated with the overall station design to the "Engineer" acceptance
- vii. Car Kick-Plates and skirting - Scratch Resistant Stainless steel,
- viii. Hand/grip rail - Polished Stainless steel, of straight through type & supported from minimum 3 places.

All stainless steel materials specified for car and landing finishes shall be of grade of 304 and shall be subject to the acceptance of the "Engineer".

The degree of ingress protection provided by both Car-door and Landing-door to the car and the internal machinery shall be IP-54.

All car interiors/architrave, doors and interfaces with civil structure and finishes shall be subject to the acceptance of the "Engineer".

#### 6.8.11 **Illumination of Cars and Lighting Fixtures**

The minimum illumination level at the floor of the Elevator car shall be 150 lux using energy efficient LED fittings. The light inside the car cabin shall be either of light yellow or white colour. It will be decided during the design evaluation.

#### 6.8.12 **Emergency Lighting**

In addition to the normal car lighting provided, a maintenance free emergency light fitting shall be provided in each elevator car, which may be the same type of fitting as the normal car light and shall illuminate immediately and automatically in the event of failure of the normal car lighting electrical supply. The fitting shall incorporate a permanently illuminated signal to indicate mains healthy and shall be connected to the emergency battery. The luminous intensity of the emergency lighting shall not be less than 100 lux measured at floor level and on the car operating panel(s).

6.8.13 Camera (CCTV) (IP-POE Type) inside the lift car shall be integrated with lift's RMS computer provided in SCR. Camera will be provided by UPMRC Designated Telecom Contractor. However, its cable shall be supplied and laid by Lift Contractor therefore Cable compatible to Camera in coordination with Telecom Contractor shall be supplied by lift contractor.

Integration of Camera with Station Camera Server will be done by Telecom Contractor. CCTV camera and other networking devices should be STQC certified and shall follow all statutory requirements and guidelines issued by Govt. of India time to time. Please follow Appendix-J for more details

6.8.14 TFT Monitor inside the Lift Car shall be provided with feature to upload external video as per Employer requirement through Pen drive without dismantling the TFT Monitor.

6.8.15 Energy Meter with recording feature of energy consumed and energy generated by Regenerative Braking shall be arranged and placed inside MAP/Electrical Panel near the Landing Door so that Energy reading can be taken from top floor.

## **6.9 Heavy Duty Elevator Doors**

### **6.9.1 Car and Landing Doors**

Heavy duty doors should be of Robust Design to cater to **13.14 Lakhs (Thirteen Lakhs and Fourteen Thousand)** operations of Elevators per year. Each elevator shall be provided with horizontal sliding doors complete with door frames and architraves, arranged in centre opening with two panels. Contractor shall propose the supplier/Vendor for Doors drive unit and get it approved by Employer. Adequate provision in doors shall be provided to avoid banging and swallowing during its design life.

Unless otherwise specified, the car and landing door panels shall be imperforate and fabricated from stainless steel hairline (grade 304) finish of at least 1.5 mm thick. The back of the door panels shall be treated with an anti-drumming compound which is non-combustible and shall not emit toxic fume when affected by fire. The compound shall be reviewed without objection by the "Engineer".

The requirements of Glass Door are specified in sub – clause 6.29 below.

The door shall be able to withstand horizontal or lateral load according to latest version/ amendments of IS: 17900.

The doors shall be provided with keyways for interlocks.

Door sills shall be made of machined SS block to provide anti-skidding surface, its bottom plate thickness shall be minimum 5.0 mm with non-slip wearing surface.

### **6.9.2 Door Hangers and Rollers**

The proven-ness and design of heavy duty doors shall be specifically evaluated during the detailed design stage.

### 6.9.3 Door Operators

Operation of Door shall commensurate with elevator motor starts/stop. The door operator for each Elevator shall consist of a motor, operating mechanism, linkages and switches to give adjustable or variable speed door operation and shall be adjusted to ensure smooth, fast opening and closing. The average door speed shall be between 150 – 250 mm/sec. The car and landing doors shall operate simultaneously and quietly while the Elevator car is levelling.

For the car and landing door made of glass panels with stainless steel hairline frame, stainless steel cover of not less than 1.5 mm thick or other suitable arrangement for headers shall be provided with "Engineer" approval to prevent the door locking devices, door tracks and mechanism from accumulation of dust.

The door-drive operator and Door Motor should be properly protected to prevent water ingress, dust, etc.

On "Without Attendant" mode, if no command is registered or due to some abnormality in Lift Safety circuit, after the expiry of a pre-set time interval of 10-30 seconds (Adjustable) the door shall re-open once for 30 seconds (Adjustable so as the commuter can come out) and close.

For Elevators on "With Attendant" operation, the car and landing doors shall open automatically but the closing of doors will be subject to the pressure on "Door Close" button. During the closing motion it shall be possible to reverse quickly and open the doors by releasing the "Door Close" button (Pressing the "Door open" button should not be necessary).

The door lock shall prevent the car doors from being opened by the door operator or by force when the car is moving or is not stopped within the unlocking zone of a landing. Electric interlocks shall be provided to ensure that elevator will not operate, if the car door is not closed and locked. If the car door is forced open, the Elevator shall stop and the alarm activated (even when the Elevator is out of order) until the door is fully closed. The audio visual alarm signal shall be sent to the relevant landing as well as to SCR and CC rooms. Call cancellation feature for lifts with more than two landings shall be provided. The detail shall be submitted for review and approval by Engineer/Employer.

### 6.9.4 Door Safety Devices

#### 6.9.4.1 Electrically Operated Proximity Detection Device

Electrically operated proximity detector devices(s) shall be installed on the leading edge of the car doors. The device(s) shall create a three dimensional zone of protection for the entire height of the door opening. This zone of detection shall extend

a short distance in front of the landing doors. The zone of detection shall move forward as the doors close and the presence of a person, if within this zone, shall activate the detector to stop the closing movement of the doors and re-open them before hitting the person. After a pre-set time interval (which is programmable) the doors shall start to close again in the absence of further interruption. A passenger entering or leaving the car shall not cause the doors to stop and re-open unless the doors' edge reaches a certain predetermined proximity to the passenger. The contractor shall consider the ambient condition inclusive of sunlight before deciding the sensitivity of the device, so as to avoid mal operation.

If the doors are prevented from closing by the pressing of hall and/or car buttons or a person in their path for an adjustable pre-set time, the safety devices, except the mechanical door safety edge, shall be rendered inoperative to cause door reversals. The doors shall proceed to close at a reduced speed and a buzzer located on the car shall sound before and during the closing.

#### **6.9.4.2 Photo Cells**

Two Photo cells shall be provided for each car door for preventing door closing when a passenger is entering or leaving the car. This should act as a backup protection to 3D-infrared curtain.

#### **6.10 Not Used**

#### **6.11 Car Operating Panel (COP)**

6.11.1 Car operating panels and car call buttons shall be ergonomically designed and of robust construction to the Engineer acceptance. The car operating panel shall be integrated and flush mounted, on one of the side panels. All buttons shall be of Jumbo Size with minimum dimension of 50 mm X 50 mm on the panel shall be of robust design and construction and flush with the panel. Car COP shall be fit-in type instead of screw fitted. Design shall be submitted for review and approved by Engineer/Employer.

6.11.2 The faceplate shall be made of scratch resistant stainless-steel grade 304 hairline-finishes. Specifications/features of various items to be provided in COP are following:

- (a) An alarm button in yellow colour with bell shaped symbol, when pressed, shall activate the alarm hooters and register the alarm condition through Remote Monitoring System at the SCR / CC room or as per requirement of employer **and also provide Audio visual indication at all Landings for the Alarm.**
- (b) An additional audio hooter shall be installed in the Station Control Room (SCR). This hooter shall automatically activate whenever the Alarm Button or

Intercom Button is pressed from inside any lift at the station. The Contractor shall ensure proper integration with the lift controller and SCR panel for reliable operation.

- (c) A red "Car Overload" indicating lamp with buzzer in both Hindi and English Language. "Car Overload" message in Red flickering fonts with yellow background shall also be provided along with voice announcement unit to announce message in English and Hindi languages in TFT installed inside the Car for C-P lifts.
- (d) Two vertical rows (where appropriate) of car minimum dimension of 50 mm X 50 mm on the call buttons for floor designations, bearing, numerals/ alphabets and Braille code next to each button for visually handicapped.
- (e) A "Door-Open" button which, when pressed, shall cause the closing door to reopen or when continuously pressed shall keep the door open.
- (f) A "Door-Close" button which, when pressed, shall cause the door to close to shorten the door opening time.
- (g) An intercom button connected with EPABX (self-illuminated feedback type), when pressed, shall allow direct communication with the personnel in the SCR / CC room, and main control cubicle. EPABX shall be designed to take simultaneous calls from all Lifts of a particular station. The contractor shall submit their features and proven vendor of intercom to Employer for review and approval.
- (h) An "ON/OFF" switch whereby the ventilation fan can be switched 'ON' and 'OFF'. Each button shall be of Jumbo type (50 X 50 mm) micro-push suitable for heavy duty and vandal proof type. The response light shall be either orange or red when illuminated.
- (i) A capacity plate engraved onto the car operating panel shall indicate the rated load in kilograms and the maximum number of passengers to be carried. The size and design of the lettering shall be subject to the acceptance of the "Engineer".

#### 6.11.3

A key operated switch shall be provided on the car operating panel at a suitable location to facilitate elevator operation as under.

- (a) One or more switches whereby the following modes of operation can be affected as desired:
  - i. Fully Automatic with Attendant operation.
  - ii. Automatic with Attendant operation.
- (b) Not used.

- (c) Not used.
- (d) "UP/DOWN" buttons which shall cause a car to travel in the desired direction. These buttons shall be operative during the "Attendant mode" as well as "Normal mode" operation.
- (e) An "ON/OFF" switch whereby the ventilation fan can be switched on and off.
- (f) The fireman switch shall be provided as per IS-17900 and statutory requirement. location of fireman switch should be at the level from where the exit is easily possible.

## **6.12 Big Size Car Position Indicator**

- 6.12.1 The faceplate of the big size car position indicator shall be made of stainless steel grade 304 hairline finished. The Stainless steel plate should be at least 2.5 mm thick and its mounting arrangement should have minimum two sunken screws. This plate should be pilfer proof. Floor numbers shall be digitally displayed using 5 x 7 square Dot matrix display or suitable LED display which should be easily and clearly visible even if sunshine fall directly on it. There shall also be an arrow in motion vividly and dynamically indicating car movement and direction. It shall also be capable of displaying simple message such as, floor names like "Concourse, Platform", "Out of service", under maintenance", "This landing is not in Use" etc. The surface of the display unit shall be non-glare type. A voice announcer, in English & Hindi shall be provided to indicate operation of the doors and the floors where the elevator stops and the direction of the elevator. It shall also announce "Overload", "Seismic", "Fire Mode", "Auto rescue don't panic you are safe in lift" function when applicable. The announcement shall be 100% synchronized with the actual operation of the elevator. During Voice announcer operation, other Speakers including TFT audio system should stop automatically.

## **6.13 Elevator Inter-Communication System**

- 6.13.1 The Contractor shall provide an Elevator inter-communication between the Elevator Car, main control cubicle and SCR/CC room consisting master and slave stations.
- 6.13.2 All stations shall be equipped with handsets except those slave stations installed inside the Elevator cars, which shall be of the hands-free type.
- 6.13.3 The power supply arrangements for handsets / intercoms shall be connected with UPS power supply of the station such so as intercoms working shall not be affected by the failure of main supply.
- 6.13.4 A master station shall be supplied and installed in the Station Control Room (SCR) /CC room. A single intercom system to handle the calls from all lifts shall be installed

and it shall be handset type with call identification facility at a particular Station. Call Waiting identification shall also be available.

- 6.13.5 A slave station shall be supplied and installed in the main control cubicle and also in each Elevator car. The loudspeaker and microphone unit of the slave station shall be concealed in the car operating panel. The necessary cabling, conduits including from SCR/CC room to main control cubicle etc. shall be provided by the Contractor with proper interfacing with designated Contractor. Routing shall be finalized with the designated contractors before fixing of the false ceiling in the stations. It should be possible to decipher the identity of calling Elevator at the SCR / CC room. The Lifts (inside and outside) should also be numbered at each station for the purpose of easy identification.

## **6.14 No-Smoking Notice**

- 6.14.1 A "SMOKING IS STRICTLY PROHIBITED" sign shall be supplied and surface mounted on the front return panel in each Elevator. The graphics, lettering and material shall be subject to the acceptance of the "Engineer".

## **6.15 Certificate Holder**

- 6.15.1 A framed and glazed panel made of stainless steel, suitable to display the Elevator certificate shall be provided above the car operating panel. This shall be subject to the acceptance of the "Engineer".

## **6.16 Hallway Equipment**

### **6.16.1 Landing Doors**

#### **(a) Fire Rating**

Stainless steel Landing doors shall have a minimum of 2 hours fire rating. Landing doors with glass panels shall have a minimum of 1 hour fire rating. These doors shall be suitably tested and provided with approved stickers.

#### **(b) Door Frames**

Door frames shall be of at least 1.5 mm thick scratch resistant stainless steel in hairline finishes and shall comprise head and jamb sections of the same material. The door frames shall be suitably braced and reinforced.

The frames shall be provided with adjustable wall anchors or comparable devices to permit bonding of these anchors or devices into the walls after the frames are in place. All frames shall be securely fastened to sills and hanger supports and shall be returned to the hoist way side to present a neat appearance.

c) **Door Sills**

Toe guards similar to those provided to the car door sill shall be provided beneath each landing door sill.

(d) **Supports and Covers**

Structural steel angles shall be furnished and of sufficient size to accommodate the door closing equipment. The angles shall be continuous and securely bolted to the sills and the building structure.

Hanger cover plates shall be made of galvanized steel, for elevators with landing as well as car door made of stainless steel. For other elevators having car door as well as landing door made of glass with scratch – resistant stainless steel frame, hanger cover plates shall be made of stainless steel. These covers shall be removable, and so arranged to ensure hanger accessibility from within the Elevator car for maintenance purposes.

Cover bolts and threaded screws shall be adequately strong, with long life and capable of frequent opening and closing.

e) **Self Closing**

Gravity or spring actuated self-closing device shall be fitted to the landing doors so as to automatically re-close the doors when manually opened by means of the emergency unlocking device. The gravity weight shall move freely and quietly within its enclosure fixed at each end of the door sill and be protected from falling into the elevator shaft due to whatever reason. This device shall not be accessible to public.

(f) **Locking Device**

- i. Each landing door shall be provided with an accepted locking and interlocking device to prevent the operation of the elevator unless all landing doors are closed and locked.
- ii. It shall not be possible to open the landing door from the landing side without a landing door key.
- iii. The locking device (door contact switch) shall have at least IP 20 protection.
- iv. The electric contacts of the door locking device shall open positively independent of gravity.
- v. Each landing door panel shall be provided with its own locking device.



- vi. Provision shall be made for opening of all landing door locks by means of a landing door key by an authorized person irrespective of the position of the Elevator car.

**(g) Fascia/ Toe Guard**

Where the gap between the car door sill and surface of the Elevator shaft wall exceed 125 mm, galvanized sheet steel fascia plates of not less than 1.5 mm thick shall be provided. These shall be fixed between the undersides of landing entrance sills and the top of the door hanger case to form a flush surface in the path of travel at the car entrance. The plates shall cover the whole width of the landing door and extend by 150 mm on each side of the door. It shall be rigid and properly reinforced. The fascia plate shall be painted in an accepted colour. For SS Lift, fascia Plate shall be of 750mm in height and for Glass Door it shall be of full height.

**(h) Door Profile**

To avoid the sticking of fingers in between Car frame and Car door, profile shall be provided & the gap after provision of profile if any shall not be more than 5 mm.

**6.16.2 Jumbo type Hall Call Buttons**

One (1) set of Jumbo type of minimum size 50 X 50 mm hall call buttons shall be provided for each Elevator at every floor served. The set of buttons shall be installed on the wall adjacent to each Elevator landing.

The faceplate shall be made of stainless-steel grade 304 hairline finishes. The Stainless-steel plate should be at least 2.5 mm thick and its mounting arrangement should have two minimum Sunken Screws. This plate should be **Pilfer** proof. The Jumbo type hall call buttons shall be micro-push type, suitable for heavy duty and vandal proof. The response light of the call buttons shall be orange or red, when illuminated. When an Elevator arrives at the hall, the illumination shall cease.

The Fireman switch shall be provided as per IS-17900 and statutory requirement.

**6.16.3 Hall Position Indicator**

One (1) set of hall lanterns shall be provided for each Elevator at every floor served. The set of lanterns shall be installed on the wall adjacent to or on top of each Elevator landing. The display shall be the same as the car position indicator. Speaker of Alarm shall be provided in this Hall Position Indicator Box.

Prior to the car's arrival, the hall lantern shall begin flashing/ Illuminate, and the chime shall sound twice.

The response light of the "UP" and "DOWN" indication lanterns shall be green and red respectively when illuminated.

#### **6.16.4 Elevator Designation Number Sign**

At each landing, Car Designation Number Signs shall be supplied and installed next to each Elevator by the Contractor. The Elevator No. with Station Name of elevator (as recorded on the elevator license) shall also be indicated on the plate.

The Number Signs shall be made of stainless steel grade 304 hairline finishes. They shall fit into the designated space to be coordinated with the civil contractor and shall be subject to the acceptance of the "Engineer".

6.16.5 The elevators equipment (i.e. Big size Indicators, landing call plate, MCB etc.), if any at Ground level should be pilfer proof.

**The Stainless steel plate of SS 304 grade for mounting the indicators and landing call buttons should be at least 2.5 mm thick and its mounting arrangement should have minimum two Sunken Screws suiting the design criterion.**

#### **6.17 Elevator Functions**

The Elevator shall incorporate the following functions.

##### **6.17.1 Landing Door Bypass:**

In case of fault in elevator due to landing door system not functioning properly, a suitable arrangement of landing door bypass shall be provided in elevator to rescue passenger safely from elevator car in conformance to EN81: latest Version

##### **6.17.2 Door Nudging Feature**

If the Elevator doors are kept open longer than the pre-determined time, an override alarm shall sound to alert the passenger that the doors must close so that system performance is not adversely affected.

6.17.3 **Not used**

6.17.4 **Not used**

##### **6.17.5 Next Landing**

The car shall automatically proceed to the nearest floor with a functioning landing door if the car doors fail to open at the designated floor.

##### **6.17.6 Door Load Detector**

When an object is caught in or interferes with the opening or closing of the doors, the doors shall reverse direction when an excess load is detected.

##### **6.17.7 Safety Door Edge**

When a passenger comes in contact with the door safety edge when the doors are closing, the doors shall re-open.

**6.17.8 Overload Holding Stop**

When the car load exceeds the pre-determined weight, in addition to the overload buzzer with the announcement of overloading, the Elevator shall not operate and the doors shall remain open. The load measuring device shall be proven product. The value of load measured by "load measuring device" shall be displayed in MAP on real time basis. The load measuring device should be of latest technology and of latest version. The complete technical features of devices that can be used for sensing the over load in the car should be most reliable and defined. The approval for the same shall be obtained from the Employer.

Load measuring device should be fail-safe type i.e. in case of any fault in load measuring device, lift should stop with the announcement of overloading and overload should be shown in the car/landing display.

**6.17.9 Electronic Door Safety**

When passengers are boarding or exiting the car as the doors are closing, the doors shall re-open before touching the passengers.

**6.17.10 Homing Service**

This function shall automatically home the respective Elevators to the pre-assigned floors. After transporting passengers to the assigned floor, the Elevator shall automatically home to its pre-assigned floor.

**6.17.11 Not used****6.17.12 Up/Down Selective Collective Automatic Operation & Auto Call Registration**

The elevator shall automatically respond to the call, when for 2 floor type elevators the hall- calls are registered. The elevator shall respond to the call when for more than 2-floor elevators hall -calls and car- calls are registered.

It shall respond to all registered hall calls and car calls in the direction of service. When no call is registered then after a pre-set adjustable period elevator car shall come to designated floor and open the door for 30 seconds (adjustable time) and then park the car there with doors closed.

**6.18 Operating and Safety Devices**

6.18.1 Each Elevator shall be provided with an overload device of accepted design, which shall operate when the load in the car exceeds the rated load. When activated, this device shall prevent any movement of the Elevator car and shall cause a warning buzzer on the car to be set off and illuminate an "Overload" signal. This device shall be incorporated in the car-operating panel.

6.18.2 The water sensors in the elevator pits shall be provided wherever pits are on the

ground level or below the ground level. The requirement of water sump in the elevator pits for such elevators shall be co-ordinated with the civil & E&M contractor.

## 6.18.3

An inspection control panel shall be fitted on the top of the Elevator car for maintenance purpose. The design of the inspection control panel shall comply with the following requirements and prevent the Elevator car from being operated accidentally: -

- a. It shall not be possible to control the Elevator car from any other position after the NORMAL/TEST change-over switch has been set to the TEST position. When in the TEST position, the UP and DOWN continuous pressure push buttons within this panel shall become operative.
- b. An ON/OFF switch shall be provided. It shall render the Elevator inoperative in any mode, when the switch is in the OFF position.
- c. The Elevator car shall only move when all safety devices are in the safe position.
- d. The Elevator car shall move in either direction only on continuous pressure of the appropriate direction button at a car speed not exceeding 0.25 m/s.
- e. Not used
- f. The control panel shall incorporate an adequately protected permanently located light fixture with a separate switch and a 15A switch socket outlet.
- g. A door operator ON/OFF switch shall be provided. The door operator shall only be operative when the switch is at the "ON" position.
- h. Associated with this control, a terminal stop limit switch shall be provided to stop the car from traveling in an upward direction not less than 1.8 m from the soffit of the Elevator shaft. When this switch is activated, it shall not stop the car from operating in the down direction.
- i. There shall be provision of LED lights inside the Shaft & in undercroft of car base which can be controlled from the top landing & from pit it should have an intensity of 200 Lux at floor level.
- j. All switches and buttons on the inspection control station shall be clearly engraved with their functions. All buttons and switches shall be shrouded against accidental operation, with the exception of the emergency stop button.

## 6.18.4

The Elevator shall be provided with a floor-leveling device, which shall automatically bring the Elevator car to stop within  $\pm 5$  mm of the level of the floor for which a stop has been initiated regardless of the load or direction of travel. In case of ARD mode, the car should stop within  $\pm 10$  mm of the level of floor, this is subject to the Engineer's Acceptance at the design stage.

An automatic re-leveling device shall be provided which returns the Elevator to the floor automatically (within +/- 5 mm) should the Elevator creep down or move up from floor level for any distance ~~6 mm to 50 mm~~ more than +/- 6 mm. This device shall be operative at all floors served whether the landing and car doors are opened or closed.

Unintended Car Movement Protection (UCMP) device shall be provided in Elevator controller to avoid the movement of car in open door condition beyond door zone.

Single Arm Brake Torque Test: Single arm brake torque testing function shall be inbuilt in the controller, and this function shall be provided in Quality check list.

- 6.18.5 Each Elevator car shall be provided with safety gear mounted on the lower member of the car frame structure. This safety gear shall be capable of operating only in the downward direction and capable of stopping the car with full load at the tripping speed of the over speed governor, by gripping the guides and holding the car stationary. The motor circuit shall be opened by a switch on the safety gear before, or at the same time the safety gear is applied. It shall be possible to release the safety gear by raising the Elevator car without the use of any special tools.

A mechanical device and electrical device shall be provided to prevent the car movement resulting from maintenance/ inspection that can be dangerous to persons carrying out maintenance/ inspection works from inside the car or car roof.

- 6.18.6 An over speed governor shall be provided, which is capable of activating the safety gear in the event of the Elevator exceeding the rated speed. The tripping of the over-speed governor for the safety gear shall not occur before 115% of rated speed and should not exceed 140 % of the rated speed. A mechanically operated safety switch shall be provided to disconnect the power supply to the motor when the governor is activated. The governor shall be adjusted to operate the safety gear in accordance with the recommended limits set out in IS. The governor rope shall be of steel and shall comply IS: 17900.

An over speed governor shall be provided to the Counter weight in case of Hanging pit. The Contractor is required to interface to the designated Contractor for the requirement of hanging pits.

- 6.18.7 A phase protection device and 3 phase as well as single phase earth leakage protection device shall be provided in the main control cubicle of each Elevator to prevent the Elevator car from moving in the event that there is a phase failure, or the phase of the power supply being reversed due to any reason whatsoever. These devices, when activated, shall cause a visual indicator to illuminate on the main control cubicle, until the fault has been rectified.

As in the case of Power failure (including single phasing/ unbalanced phase), elevator should operate in the Automatic Rescue Device (ARD) and BDT or Electronic Rescue

Tool (ERT) mode. This software for providing this feature is subject to the Employer's acceptance.

- 6.18.8 Two switches shall be provided in the Elevator shaft, one at bottom landing and other in the pit which, when in the "STOP" position, shall prevent any movement of the Elevator car, including inspection/ test operation, until both the switches are set to the "RUN" position. The switching positions shall be prominently labeled. The knob of these switches shall have luminous paint.

## **6.19 Electrical Requirements**

- 6.19.1 Each Elevator shall be provided with a main control cubicle to accommodate all electrical switchgear. A caution notice with the wording "Danger- 415V/240V A.C. Do Not Remove Cover Unless Incoming Supply is Switched Off" shall be affixed to the cover/ door. The size and shape of the main control cubicle shall be same as that of Maintenance Access Panel (MAP).
- 6.19.2 The Elevators shall be designed to operate on a  $415V \pm 10\%$  a.c. 3 phase, 4 wire,  $240V \pm 10\%$  a.c. 50Hz single phase power supply. Power supplies armoured cables up to elevator's main control cubicle, and routing done up to the entry point in the elevator's shaft shall be supplied by the Designated Contractors. The Contractor shall coordinate with the respective Contractors to incorporate their requirements. Main switch/MCB Box with ELCB etc. in unpaid area should be in lockable enclosure and in scope of elevator contractor. MCB box shall be IP-54. All ELCB's, MCBs & Switches should be as per Employer approved vendors. The shaft LED lighting (200 Lux as per IS), Ventilation arrangement and pit socket outlets shall be provided by the elevator Contractor. The Fixtures and cables will be get approved by the Employer.
- 6.19.3 There should be provision of light on the top ledge of elevator door on all landings to ensure proper illumination and their identification. The light should be LED type and with astronomical timer to control switching ON & OFF.
- 6.19.4 All switchgear and other auxiliary apparatus shall be of accepted design and labeled for identification. All PCBs shall be provided with conformal coating of military grade and type test reports as per relevant IEC to be submitted during Proto-type Testing.
- i. Relays, cards and all equipment must be suitable to withstand very heavy pollution level as per IEC 60815.
  - ii. All applicable electronic cards / items should have conformal coating complying to environmental parameters prescribed in IEC 60721-3-3 for minimum 3C2 class. Test certificate as per test method specified in IEC 60068-2-60 needs to be submitted before delivery of the material.
  - iii. However, to withstand very high polluted area conditions, the conformal coating should meet 3C3 class requirement as specified in IEC 60721-3-3. It should be tested for values of mixed gases (H<sub>2</sub>S, SO<sub>2</sub>, CL<sub>2</sub> and Nitrogen

- oxides as per concentration given in 3C3) in accordance with IEC 60068-2-60 standard for a minimum duration of 10 days. Test certificate to this effect, shall be submitted by the successful tenderer before delivery of the material.
- iv. All electronic cards, assemblies, sub-assemblies and components thereof used in equipment, relays, IED, PLC, AVR etc. supplied under the contract shall be of Industrial grade only as per relevant standards and shall be suitable for the ambient temperature range between - 0.6°C to 50°C. However, temperature inside the metal enclosed equipment placed in open sun may go up to 70°C (inside enclosure /surface).
  - v. All applicable cards must also be tested for Environmental test as per IEC 60571 and shall be done in accordance to IEC 60068. Details of tests are mentioned below: -
    - a. Dry Heat Test for Class T3
    - b. Low Temperature Test (Applicable for Lucknow region ambient temperature range).
    - c. Change of Temperature Test.
    - d. Cyclic Humidity Test.
    - e. Driving Rain Test.
    - f. Dust and Sand Test & Mould growth Test.
  - vi. Prior approval for specifications and makes of all components and sub-components proposed to be used for electronic cards, for the respective equipment, shall be obtained from the Employer. The contractor shall submit details of components' configuration in the card, block diagram of the card and waveform signature at the beginning and end of each such block for each electronic card used in the equipment along with O&M documentation.
  - vii. All Electrical / Electronic Cards' enclosures shall be suitably IP rated as per relevant application and shall be dust, moisture, and vermin proof.

6.19.5 The control wiring shall be laid out neatly and clearly in cable sleeves and all terminals and cables shall be properly sealed, labeled or marked or tagged for identification.

6.19.6 All casing, covers, trunking and armouring shall be thoroughly and efficiently earthed and adequate protection shall be provided to prevent fuses and circuit breakers from arcing to earth or between phases.

6.19.7 Maintenance Access Panel (MAP) should preferably be located at ~~Concourse level~~ top level of station. Maintenance Access Panel (MAP) & Shaft Electrification Panel (SEP) shall be IP55, Pilfer proof. MAP shall have data downloading facilities for fault diagnostic through RS – 485 port and USB Port. There should not be any loss of fault code/data even in the event of Power Failure. Fault data logging in MAP should have

date & Time stamping facilities of minimum 500 events. There should be provision of resettable type counter for the recording no of operation of the Elevators. Also, there shall be provision of lift data transfer including number of operations, energy consumption i.e. consumed & regenerated from open protocol either BACNET or MODBUS inside LED base RMS system through RS 485 or TCP / IP to Centralized Monitoring System by which Employer can access the data. Flexible controller to be provided for Communication whose setting can be changed.

- 6.19.8 In addition to above facility to transfer Fault Data/ Log through Short message Service (SMS) to designated contact numbers also to be provided. Details of scheme to be finalized during design stage, Initial cost of SIM card and monthly expenditure thereof to be borne by employer. However, Software cost to develop this features in the Controller etc shall be borne by Contractor.

6.19.9 ~~Not used.~~

- 6.19.10 The design of the contactors and relay contacts shall be such that the break and make contacts shall not be closed at the same time at any position of the armature. The operating conditions shall be as follows:-

- a. If, one of the break contacts (i.e. normally closed) is closed, all the make contacts are open.
- b. If, one of the make contacts (i.e. normally open) is closed, all the break contacts are open.
- c. The layout of cards in SEP should be maintenance friendly so that they are easily accessible to the maintainer. This would be evaluated during detailed design.

- 6.19.11 In the control and safety circuits, the operating voltage of the mean value in the case of direct current or the r.m.s. value in the case of alternating current, between conductors or between conductor and earth shall not exceed 250 V.

- 6.19.12 There shall be provision of surge protection, power filters and other necessary equipment to avoid failure of elevator equipment on account of quality of power. There shall be provision of Energy meter (Hour meter) to record consumption of Energy. The energy meter provided should be able to record re-regenerative energy and shall be provided in Electrical Panel. Downloading facilities of Energy Readings shall be provided too.

- 6.19.13 In the event of failure of the normal electrical supply, the supply to the alarm cum intercom system, emergency car lighting, and the ventilation fan shall be automatically switched to an emergency battery operated power supply (UPS) of E&M System. The



- Elevator contractor shall do the necessary interface with E&M contractor for Supply of Armoured Cable up to the Electrical Box of UPS (inside the elevator's shaft) & for routing of armoured cable upto the entry point inside the elevator's shaft. All hoistway and car top safety switches shall be rated to IP Class 55 (minimum).
- 6.19.14 All wiring and apparatus shall be subject to acceptance and suitable for the specified electrical supply. The insulation of all wiring including those within the controller shall be of flame retardant, low smoke halogen free (FRLSZH) type for underground stations only and FRLS for elevated stations complying with the special cable requirement of this Specification. (All wires shall be FR type and cables shall be FRLS type.)
- 6.19.15 All field wiring shall be multi-strand copper conductor type. No joints shall be permitted in any cables or wires in any location.
- 6.19.16 All lift wiring shall be run in galvanized conduit or steel trunking which shall be provided by the Lift Contractor. All conduit outlets shall be bushed with insulating bushes of accepted pattern. All wiring connections to switches and conduits shall be watertight. No Wire and Cable shall be visible from outside in case of Glass Lift
- 6.19.17 The arrangements of terminals at either end of flexible trailing cables shall be identical and the terminal blocks marked to identify the cables connected to them. The cable boxes and wiring for the car light and the alarm bell shall be entirely independent of the elevator control wiring. Flexible trailing cables shall be securely clamped at each end so that the weight is not supported by any fixing of the various cores. The outer sheath of these cables shall be of waterproof and flame-retardant material. A total of 10 or 30% of the total number of wires used whichever is more and 2 spare shield cables shall be provided per Elevator. The outer sheath of these cables shall be waterproof and flame resistance material which shall not emit toxic fume when affected by fire (i.e. Low Smoke Halogen Free) for underground stations only.
- 6.19.18 The compatibility of MCB and ELCB used for elevators shall be verified with the requirement of the elevators. The MCB & ELCB are in the scope of elevator Contractor. Termination of main incoming armoured cable on the MCB/ ELCB shall also be the responsibility of the elevator contractor.
- 6.19.19 Regarding harmonics generation in VVVF system
- OEM shall design the VVVF system in such a manner that generation of harmonics is minimal. OEM shall also provide suitable harmonics filters to eliminate harmonics. Ceiling limits for "total harmonics distortion" (THD) shall be as per IEEE 519-1992 and values mentioned at clause-11.4, Chapter 11 of this PS may be referred.

## 6.20 Provision for Computer based Remote Monitoring System (RMS)

- 6.20.1 The PC (Computer system) for RMS will be provided by the escalator contractor LKE(02)-02. The Elevator Contractor shall provide / receive the following status monitoring points and control points to the RMS with all necessary software and hardware including Graphics & Software for presentation of Lift running Status and other details on the PC: -
- a. Provision of elevator car alarm signal with buzzer.
  - b. Provision of elevator fault/trip signal
  - c. Provision of power available and failure status.
  - d. Provision of elevator under maintenance signal.
  - e. Receiving remote control signal for parking on / off operation.
  - f. Provision of elevator under working signal. (Dynamic Arrow/graphic as per Employer shall be provided).
  - g. Provision of Alarm accept button.
  - h. Provision of buzzer test button.
  - i. Provision of Fire Mode and its command from SCR.
  - j. Fault history display and its Download facilities from Computer at SCR.
  - k. Down Time.
  - l. Maintenance History and support (Pop signals for preventive maintenance)
  - m. Suitable rack/Trolley for placing the CPU under the counter in SCR.
  - n. Display of Lift's all Batteries including ARD charging status to monitor the status.
  - o. Display of CCTV (Camera) provided inside the lift Car.
  - p. Provision of Seismic Signal.
  - q. Provision of additional Buzzer with 70 dB.
- 6.20.2 The elevator fault / trip signal shall be activated whenever there is a fault in the elevator system, which causes a breakdown. The signal shall be latched on for at least 10 seconds. It shall only be reset after the fault is cleared. The Audio Visual shall be available in SCR, which is generally located at one side of the concourse or at Center of Station. (No additional payment on account of variation in distance will be made to contractor).
- 6.20.3 The alarm signal shall be activated with an audio repeated buzzing till it is reset whenever the alarm inside the elevator car is pressed.
- 6.20.4 A by - pass switch with illuminated indication, which shall de - activate the fault / trip

signal to RMS when switched "ON" and give a "Under Maintenance" signal to RMS in SCR shall be provided in the controller for maintenance purpose. The switch shall be labeled Hindi and English and shall be subjected to the acceptance by Employer's Representative's.

- 6.20.5 Upon actuation by remote switch from the RMS for parking on, the elevator shall complete the last landing or car call, if any, and return to the designated landing and stop there with both the car and landing doors open for 15 - 20 seconds and then close. The "Not in service" indicator shall be illuminated on the landing indicator automatically for a pre - determined time and then extinguished. The car light and ventilation fan shall be switched off automatically at the same time. The essential buttons e.g. door open, intercom and alarm bell etc. on the car operating panels shall be remained functional and illuminated when the elevators have been parked and locked out.
- 6.20.6 Upon actuation by remote switch from the RMS for non - parking, the elevator shall be switched back to normal operation and both the car light and ventilation fan shall be switched on automatically.
- 6.20.7 The contractor shall connect the contacts with screen wires and terminate at the terminals in the ITB to be located in SCR whereas the conduits from the Elevator shaft to the SCR will be provided by Respective Electrical Contractor. The Contractor shall coordinate and interface with Electrical contractor and / or his sub - contractor in association with conduits routing and sizing requirement. The connection from ITB to the RMS will also be provided by the Elevator Contractor.
- 6.20.8 Audible Buzzer with 70 dB(A) noise should operate whenever parameter "Under Fault" and "Alarm Button Pressed" become "On". The audible buzzer will become off with the press of "Alarm Accept Button" however visual indication should persist till the fault is cleared.
- 6.20.9 An actual prototype of Lift RMS should be demonstrated during prototype and its detail design and features shall be submitted for Engineer review and approval.
- 6.20.10 The contractor shall provide all wiring and apparatus shall be subject to acceptance of "Engineer" and suitable for the specified electrical supply. The insulation of all wiring including those within the lift shaft shall be of flame retardant, low smoke halogen free (FRLSZH) type for underground stations only and FRLS for elevated stations complying with the special cable requirement of this Specification.

## **6.21 Special Emergency Operations for Elevators**

- 6.21.1 The Elevator operation system shall be designed to provide the following emergency

operation. The Contractor shall provide the ITBs with terminals for the Designated Contractor to terminate the fire and power failure signals. The Contractor shall provide the cabling up to the ITB.

#### **6.21.2 Emergency Operation of Elevators in the Event of Power Failure**

In the event of power failure or power interruption or single phasing or unbalanced phases (or any problem in the power supply which affect the normal operation of the lifts), the supply to all Elevators shall be automatically switched over to the emergency power supply i.e. To Automatic Rescue Device (ARD) and the Elevators shall be brought to the designated floor and shall park there with the doors remaining open. The speed of lift in ARD mode shall be preferably between 0.2 m/s to 0.3 m/s, subject to review during detailed design stage and prototype testing. In case Power supply to the lift is restored through DG set/ Alternate source before the lift reaches designated floor even then ARD will complete its function and lift doors open at designated floor to evacuate the passenger. Thereafter, Elevator should resume normal operation automatically, once power supply is restored.

As a backup to ARD, Manual Rescue arrangement shall be provided. Manual Rescue operation shall be possible even when total load of Lift Car with passengers becomes equal to load of counterweights (i.e. balance load condition).

Further, a separate arrangement/ device should be provided to rescue the passenger in any condition (i.e. Load balancing of Lift, Electrical failure in Lift etc.)

#### **6.21.3 Emergency Operation of Elevators in the Event of Fire**

In the event of fire when any fire detection device is activated, all Elevators shall automatically be brought to the designated floor (Ground Floor in case of Ground to Concourse lift and to Concourse in case of Concourse to Platform Lift or as per requirement of Employer) and shall park there with the doors remain open. All Elevators shall automatically be rendered inoperative after it has been brought to the designated floor. The essential buttons such as "Door Open", intercom and alarm bell etc. on the car operating panels shall remain functional and illuminated. Normal operation of the elevators shall be manually reset by the operation of a reset key switch.

#### **6.21.4 Emergency Operation of Elevators In the Event of Power Failure and Fire**

In the event of power failure and fire, the operation of the Elevators shall be in accordance with the "Emergency Operation of Elevators in the Event of Fire" and the power supply shall be from the emergency supply panel at the stations.

- 6.21.5 A battery back-up device to home the Elevators to the landing in the event of power failure shall be provided. This shall be battery operated and shall be able to move the elevators with any load from no load to full load at reduced speed to the landing and

open the doors, which shall be achieved by provision of Automatic Rescue Device (ARD) and Battery Drive Tool (BDT) or Electrical Rescue Tool (ERT). The elevators door shall remain partially closed until resumption of power supply and the Elevators shall automatically reset to normal. The direction of travel shall depend upon the load in the Elevator which shall be provided by defining different loading conditions such as more than 50% / less than 50%/at 50%. During this operation all safety features of the Elevator shall remain operational. The rescue time of the device from the time of power failure to the time the doors fully open shall not exceed two minutes. However, the ARD start time can be adjusted from 0 to 30 sec depending upon resumption of emergency supply from alternative source/ DG sets. The requirement of ARD will be finalized during the design stage depending upon availability of power from DG set. The landing accuracy shall be less than +/- 10.0 mm. The capacity of the battery when fully charged shall be capable of operating the Elevator at rated load from one landing to another for a minimum of 3 6 trips without further charging. To ensure the same new battery shall be capable to perform the test for 6 trips without intermediate charging at the time of commissioning. The battery shall be housed in a cabinet/ rack with a corrosion proof finish. The health of battery and inverter shall be monitored continuously and in case of any problem, elevator shall go to home landing and park there keeping doors open and out of service shall be displayed. The device shall immediately stop the Elevator and prevent its further immediate movement, if there is a short circuit or open circuit in the inverter output. The rating of the battery shall be approved by the Employers during the design stage. The power supply indication in MCB for ARD shall be of red colour to properly distinguish it from other power supplies in MCB's. Over and above the ARD system, a manual lever and push button shall be provided for manual rescuing.

This device shall not modify the Elevator design and all its original safety features. The device shall be an additional accessory to the Elevator and shall not in any way affect the performance of the Elevator.

The Electrical circuit of different rescue arrangements shall be fully redundant and totally independent.

The performance of the charger and charging rate shall be equivalent to that of the UPS unit. Maintenance free batteries conforming to the relevant Indian or international standard shall be provided.

## **6.22 Elevator Monitoring and Fault diagnostic system**

- 6.22.1 An Elevator monitoring and fault diagnostic system shall be provided for each Elevator by the Elevator Contractor. This system shall provide an auxiliary output port on the controller for plugging the laptop & USB for down loading historical data, the exact requirement of which shall be reviewed at design stage.

6.22.2 Not used.

**6.22.3 Centralized Remote Monitoring System (RMS), Guided Troubleshooting & Intelligent Trouble Shooting Directory (TSD) for Lift**

The Lift Contractor shall provide a complete Remote Monitoring System (RMS) for all lifts, enabling centralized monitoring, real-time fault reporting, and intelligent troubleshooting at both the Station and the Operation Control Centre (OCC). The system shall comply with the following requirements:

**a. Data Monitoring**

The RMS shall continuously monitor and record at least the following lift parameters:

- Voltage
- Current
- Energy consumption of each lift
- Number of start/stop operations (trip counter)
- Run time counter
- Brake operation counter
- Failure Trend for each Lift
- Down Time and Up Time
- Energy regeneration (if applicable)
- Any other data point required by the Engineer

The above data shall be visible at the Station RMS Terminal and at the OCC RMS Workstation.

**b. Centralized Fault Reporting to OCC**

All lift events, alarms, faults, safety-device activations, warning conditions, energy data, and operating status changes shall automatically be transmitted in real time through:

**Lift → Station SCR → S&T Network → OCC RMS Workstation**

Every transmitted event shall include, at minimum:

- Station name
- Lift number
- Fault code
- Fault description/message
- System involved (e.g., Drive System / Doors / Brake System)
- Subsystem involved (e.g., Drive Motor, Main Drive, Car Door, Brake Coil Circuit)

- Specific equipment/device involved (e.g., Contactor, Door Coupler, Tension Switch, Brake arm-switch)
- Time of occurrence and time of clearance
- Lift status (Running / Fault / Out of Service / Maintenance Mode / Fire Mode)
- Direction of travel (Up / Down)
- Any other information required by the Engineer

The RMS shall store data during communication failures and automatically forward it once the network is restored.

A minimum of **30 days of local data storage** shall be provided.

### **c. Troubleshooting Guidance**

For every received fault or event, the RMS shall display clear troubleshooting instructions for the Operator, including:

- Station name
- Lift number
- Fault code
- Fault description/message
- Systems, subsystems, and devices involved in the fault
- Possible causes based on the fault details
- Step-by-step actions that can be safely performed by the Operator at the station
- Conditions under which the lift can be safely restarted
- Clear indication of faults that must only be attended by the Contractor
- Necessary safety precautions

Troubleshooting guidance shall be displayed at both:

- The Station SCR RMS Terminal
- The OCC RMS Workstation

### **d. Intelligent Trouble Shooting Directory (TSD)**

The lift controller shall include a microprocessor-based Trouble Shooting Directory (TSD), available at both the station and the OCC. The TSD shall include:

#### **(i) Functional Block Diagram (FBD)**

- A detailed FBD showing the internal fault-detection logic of the controller
- Automatic highlighting of the exact logic path related to the fault

- Ability to view upstream and downstream logic steps

**(ii) Fault-Tree-Based Troubleshooting**

- Automatic reference to an internal fault tree for each fault
- Troubleshooting instructions updated dynamically based on the fault tree
- Grouping of related faults belonging to the same subsystem

**(iii) Editing, Upgrades, and Security**

- TSD shall be editable and upgradable throughout the contract period
- Editing rights shall be restricted to authorized maintenance personnel
- All new fault codes, updated logic sequences, and device changes shall be incorporated at no extra cost
- The Contractor shall train station staff and maintenance teams on how to use the TSD, read the FBD, and follow diagnostic steps

**e. Contractor Responsibilities**

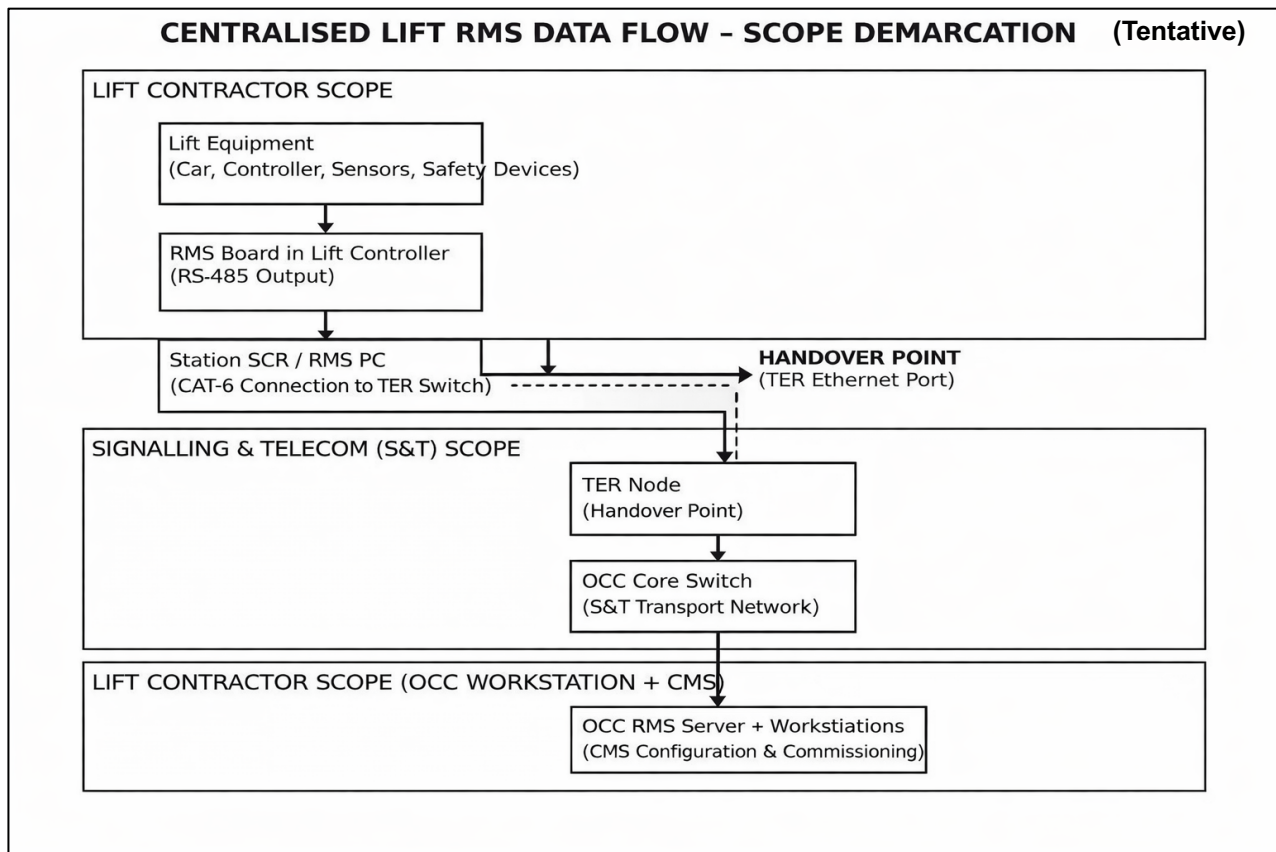
The Lift Contractor shall:

- Provide complete mapping of all systems, subsystems, and equipment for every fault
- Submit the full fault tree diagrams and FBD logic during the design stage
- Integrate the RMS with the S&T network for communication up to the OCC
- Ensure all RMS terminals (Station and OCC) always remain synchronized
- Supply all required documentation, training, diagnostic tools, and software. Software provided shall be

**Note:** Please refer Appendix-I also for additional details.

**Tentative Scheme:**





#### 6.22.4 Retention for Non-Delivery of RMS System

Delivery, integration, and commissioning of the Remote Monitoring System (RMS) with all specified features shall be treated as a critical contractual obligation.

If the RMS system, complete in all respects and fully compliant with the Technical Specifications (including centralized monitoring at OCC, fault reporting, data monitoring, and troubleshooting features), is not delivered and commissioned within the stipulated contractual timeline, the following shall apply:

##### (i) Retention of Payment

An amount equal to 10% of each running bill of SOP-1 shall be retained by the Employer until the RMS system is fully delivered, integrated, tested, and commissioned to the satisfaction of the Engineer.

##### (ii) Recovery Clause

If the Contractor fails to deliver and commission the RMS system even after the completion of the contract period, the retained amount shall be recovered by the Employer, and the Contractor shall have no claim whatsoever on the retained or recovered amount.

##### (iii) Release of Retention

The retained amount shall be released proportionately to the station commissioned only after successful commissioning and acceptance of the RMS system by the Engineer, supported by complete documentation, training, and demonstration of all specified functionalities.

## 6.23 Not Used

## 6.24 Pit Facilities

- 6.24.1 Spring/PU/Oil buffers shall be provided in the Elevator pit.
- 6.24.2 A safety switch to prevent the car from moving when the governor rope tension weight is out of position shall be provided.
- 6.24.3 Fixed cat ladders shall be provided between the bottom landing and the pit floor by the Contractor.
- 6.24.4 Two stop switches, one at bottom landing level in the shaft and the other in the pit shall be provided, which, when in the "STOP" position, shall prevent any movement of the elevator car including movement during inspection operation, until both the switches are set in the "RUN" position. The switch shall have a mushroom head (red). It shall be locked off when pushed and reset manually.
- 6.24.5 First stop switch shall be accessible from the lower landing on opening of the landing door and the second switch from the pit floor. A stainless steel faceplate of not less than 2 mm in thickness, indelibly marked "Pit Stop Switch" in both English and Hindi characters and with legends to show the "STOP" and "RUN" positions shall be provided and fixed immediately adjacent to the switch. The knob of these switches or plate shall have luminous Paint.
- 6.24.6 The contractor shall do all necessary interfacing for ensuring proper drainage system. Designated Civil Contractor shall provide drainage. But, to ensure proper drainage of Lift Pit / Roof of Lift Shaft shall be the Elevator Contractor responsibility before starting the Installation. Interface table is attached at Annexure-A.

## 6.25 Corrosion Protection

- The Contractor shall take into consideration, the corrosive effect of the atmosphere in the Elevator design.
- 6.25.1 All steel components shall be hot dipped galvanized in accordance with BS 729/ ISO 1461, with minimum thickness of 85 µm.
  - 6.25.2 All mechanical and cast-iron assemblies shall be cleaned and painted. The running surfaces of car guides shall be treated with an accepted rust preventive compound.
  - 6.25.3 All parts constructed in sheet steel shall be either galvanized by the hot dipped process or fabricated from hot dipped galvanized sheet steel.
  - 6.25.4 All hardware, fastenings, nut bolts, screws, shims and other hardware shall be electroplated (8 micron Zn coating with yellow passivation as per IS 10117. Salt spray test as per IS 9844 for 120 hour shall also be submitted.  
However, all visible screws and fastenings shall be of stainless steel. Epoxy painting will be permitted only on site damage repairs
  - 6.25.5 Wherever galvanization on ferrous components has been damaged in handling the

same shall be given two coats of zinc chromate primer and two coats of aluminum paints conforming to IS 2339.

6.25.6 The contractor shall provide all parts, hardware fastenings, screws, components, assemblies and shims conform to latest Indian Standards.

6.25.7 Galvanization shall comply with the standard mentioned below: -

- |          |  |
|----------|--|
| ISO 1459 | - Metallic Coatings - Protection against corrosion by hot dip galvanizing – Guiding Principles;                              |
| ISO 1460 | - Metallic Coatings - Hot dip galvanized coatings of ferrous materials –Gravimetric determination of the mass per unit area; |
| ISO 1461 | - Hot dip Galvanized coating on fabricated ferrous products – Specification & test Method;                                   |
| ISO 2064 | - Metallic and other non-organic coatings – definitions and conventions concerning the measurement of thickness;             |
| ISO 2177 | - Metallic Coatings measurements of coating thickness – coulometric method by anodic dissolution;                            |
| ISO 2178 | - Non-magnetic on magnetic substrates – measurements of coating thickness – magnetic method;                                 |
| ISO 2859 | - Sampling procedures and tables for inspection by attributes.   |

## 6.26 Provision for the Specially abled persons: -

All Elevators shall be provided with following features:

- (a) Elevator control buttons at locations and height specified in IS.
- (b) Hall call buttons at locations and height specified in IS.
- (c) Handrails, straight through type, having minimum 3 supports, shall be provided on the side walls of the Elevator at height & locations specified in IS. An international symbol of access of the Specially abled shall be permanently and conspicuously displayed at each and every Elevator landing next to the Elevator entrance. The Signage is to be made part of the Architrave work. Braille notations indicating the floor levels shall be

incorporated next to each button at the handicap COP and handicap hall call buttons.

- (d) A digital voice system for announcing the car position, opening/closing of doors, direction of travel and messages shall be provided as per IS. The contractor shall handover the software/editable file (in electronic form) having all contents to UPMRC and also provide adequate training for altering/modification in above said digital voice system.
- (e) A laminated framed safety mirror of at least half of the size shall be installed on rear panel of both glass and stainless steel car door type elevators at appropriate position. To facilitate easy reversal/ exit of person on wheel chair from the elevator without the need of rotating the wheel chair in the elevator.
- (f) Kick Plate at Skirt Level on all three side of Car Panels shall be provided to protect the Car Panels from Wheelchair contact.

## **6.27 Miscellaneous**

6.27.1 Circuit wiring diagrams shall be provided for all electrical circuits. They shall be in A1 size paper suitably treated to prevent deterioration from dirt or age.

6.27.2 A data plate shall be attached to the cross head members of the car frame giving the following information: -

- (a) Contract load of the Elevator,
- (b) Speed of the Elevator,
- (c) Year of manufacture.

A Do's and Don'ts instruction plate shall be provided only after approval of Employer. There should two different plates one outside and one inside the car. These plates should be very friendly and simple.

The instruction plate inside the car shall be provided for guiding the passenger how to act at the time of lift stopping.

6.27.3 Special tools required for the operation, servicing, maintenance and repair of the Elevator shall be provided and the list of such tools shall be submitted in Technical package.

6.27.4 Fault diagnosis procedures and circuit diagrams of the printed circuit board, detail information, software and technical data shall be provided to assist in trouble shooting for breakdown during normal operation and maintenance.

**6.27.5** A maintenance barrier shall be provided for elevator landing entrance which shall prevent people from entering the elevator car. The barrier shall be painted yellow, made from Aluminium/ Fibre Reinforced Plastic(FRP) and be of minimum height 900

mm. The barrier should be on wheels with lock and easy to handle and shift over a distance of 100 meters with 1 person. The design of maintenance barrier shall be approved by the engineer before it is delivered at site.

The contractor shall ensure that there is no water seepage inside MAP and elevator car even due to heaviest of rain.

6.27.6 Provision of supplying and installing signage at each landing shall be in the scope of the elevator contractor. The signage at each landing shall be flushed in to the landing architrave panel. The elevator contractor shall interface with other designated contractors on his own for the provision of architecture signage other than the provided in the architrave. The architrave Signage's shall be LED based, and their cable shall be FRLSOH. Design and its fitment will be approved during design approval stage

6.27.7 The elevator contractor shall ensure that the architrave supplied by him matches with the stone cladding (provided by civil contractor) at each landing of the elevator.

6.27.8 The elevator contractor shall supply and install the indication board and board for Specially abled commuters on the architrave. (Interface table is modified to that extent)

#### 6.27.9 **Accessories**

Each Elevator shall be provided with Two sets each of all necessary keys for the landing door, operating panel, etc.

Two sets of maintenance barrier shall be provided per station.

### 6.28 **Earthing**

All the Elevators shall be provided with earthing arrangements as per: -

IS- 1860; latest version.

IS- 3043; latest version.

Indian Electricity Rules; latest version

IS: 14665; latest Version.

### 6.29 **Special Requirement for Elevators with car and landing doors made of glass panels with stainless steel hairline frame**

6.29.1 Detail design of the elevators of Glass door with stainless steel hairline/Scratch Resistant frame shall be carried out by the Contractor and reviewed without objection by the "Engineer" before fabrication.

6.29.2 Prototype landing and car doors made of glass panels with stainless steel hairline/Scratch Resistant frame shall be pre-assembled in factory for inspection before delivery.

- 6.29.3 Car roof shall be stainless steel cover panels exposed to public view with a collapsible maintenance platform or any other suitable arrangement with "Engineer" approval above. It shall be able to sustain two persons and be able to resist a vertical force of 2000N at any position without permanent deformation. Permanent, hinged and foldable safety balustrades or any other suitable arrangement with "Engineer" approval forming an integral part of car top maintenance platform shall be provided. The design shall be subject to the review of the "Engineer".

Glass shall comply with the following requirements:

**(a) General**

- i. All glass shall be clear float glass.
- ii. Glass thickness shall not be less than 10 mm (with manufacturing tolerance of +1mm to -0.2mm as per IS 2553, part-1). The selection of glass thickness and type shall be in accordance with the information contained in BS: 6262, BS 952: Part 1, BS: 6206 and European Standard EN-81, Annex J or equivalent international standard.
- iii. Particular regard shall be given to adequacy of glass thickness to withstand the calculated design loads and types of location to satisfy safety recommendations. Any reduction in strength characteristics due to acid etching, etc. shall be taken into account.
- iv. Where the edge of laminated glass is to be exposed, the interlayer material must be shown to be resistant to the effects, including clouding and delaminating, of moisture absorption and contact with normal industrial strength cleaning solutions.
- v. The Contractor shall conduct a thermal stress analysis of the glazing system, undertake thermal calculations and make due allowance for toughened glass.
- vi. All glass shall be manufactured and processed in a factory where the quality control procedures comply with ISO 9000 (BS 5750, or equivalent international standard) and are independently maintained.
- vii. No glass shall be used which contains scratches, chips, bubbles or other blemishes which are likely to lead to failure at loadings less than which the unit is designed to withstand.
- viii. The glass shall be free of all discernible body and surface faults, and no glass which exhibits discernible optical or reflective distortions shall be used.
- ix. Unless reviewed without objection by the "Engineer", all glazing shall be marked with permanent identification in accordance with BS 6206, and in a position visible but not prominent at the bottom left hand corner of the glazing unit.
- x. Glazing shall be provided with edges that are ground, have a frosted appearance and arises chamfered and polished.

- xi. Toughened glass shall be tempered on a roller hearth furnace and shall conform to Class 'A' Classification of BS 6206 or equivalent international standard. Vertical toughening shall not be permitted. Glass panel of landing door shall have minimum one hour fire rating.
- xii. All toughened glass shall be heat soak tested to prevent the risk of spontaneous glass breakage due to nickel sulphide inclusions and other impurities. The method of heat soak testing shall be determined by the glazing manufacturer, such that after testing the probability of failure in service shall be less than one in 130 tonnes of glazing. The Contractor and glazing manufacturer shall, after testing, demonstrate by statistical analysis of test data that the probability of failure is not greater than the specified value.
- xiii. All edgework, holes and notches in the toughened glass shall be completed before the toughening process.
- xiv. Permissible roll distortion inherent in toughened glass shall be restricted to the horizontal plane when glazed/ installed, and local defects such as tong marks shall not be permitted.
- xv. Dimensional tolerance on panel size shall be  $\pm 1$  mm of the theoretical dimension required.

**(b) Glass door elevator cars is to meet the following performance criteria:**

- i. Laminated glass with one pane of toughened glass and one pane of heat strengthened glass.
- ii. Glass panels to be capable of resisting applied loads when supported at each corner by a bolt fitted within a hole drilled in the glass. The details shall be reviewed by the "Engineer":

Applied loads:

Dead	Self-weight of glass. Dead loads imposed by adjacent glass panels (if any).
Live	Normal to panel $0.75 \text{ KN/m}^2$ . Live loads $0.75 \text{ KN/m}^2$ @ mid pane.
Impact	Equivalent to 50 Kg baggage trolley @1.8m/sec.

- iii. Laminated toughened glass shall be capable of resisting point impacts, to the toughened face, equivalent to an 85 mm hardened steel ball freely dropped from a height of 3 m, carried out in accordance with BS 5544.
- iv. The glass shall remain in place if either one or both panes break.

- v. The glass shall be free of bow sufficient to cause visual distortion when viewed normal to glass.
- vi. Maximum deflection under applied loads 15 mm.
- vii. Statistical/failure rate of glass under normal operating load <0.4%.
- viii. Deleted
- (c) All glass shall be marked to identify that it has been tested and inspected to manufacturer's standard which is reviewed without objection by the Employer's Representatives.
- (d) **The tolerance of glass shall be within:**
  - i. Panel size + 3 mm.
  - ii. Step in laminated edge + 3 mm.
  - iii. Bolt holes position + 2 mm.
- (e) A typical 5 mm gap shall be allowed between adjacent glass panels and between edges of glass panel and stainless-steel corner. The gaps shall be sealed with a suitable sealant material. Extent of seal shall be from the base of the floor to the top of the glass walls. All areas of glass edges subject to contact with the sealant shall be treated with a separator chemical to mitigate the chemical reaction between the PVB interlayer and sealant. The Contractor shall conduct standard test from the glass manufacturer to demonstrate compatibility between sealant and PVB interlayer, the width of edge de-lamination is not to exceed 1 mm under simulated exterior exposure for a period of 2½ years.

### 6.30 Special Cable Requirements

- 6.30.1 All cables used except those within the enclosed controller shall comply with the following requirement: -
- 6.30.2 All Control cables shall be rated for minimum grade of 650V and all power cables for minimum grade of 1000V. In case of 24 Volt DC, Insulation rating of Cable shall be min of 250 Volts.
- 6.30.3 The conductor shall be of stranded conductor composed of plain annealed copper wire complying with IEC 228, Class 2.
- 6.30.4 The insulation shall consist of an extruded layer of cross-linked polyethylene complying with IEC 502.
- 6.30.5 All cables shall be manufactured from fire retardant, low smoke, halogen free materials (FRLSZH) for underground lifts. The Contractor may propose to use cables



manufactured from fire retardant materials (FRLS) only in elevated stations and above ground open areas.

6.30.6 Fire retardant, low smoke, halogen free materials shall meet the following requirements: -

- (a) London Transport Executive Three Meter Cube Smoke Emission Test, using optical measuring instruments. The maximum value of absorbance AO (ON), AO (OFF) shall be 0.8 & 1.2 respectively.
- (b) The US National Bureau of Standard Smoke Chamber Test, used to evaluate plaque samples of materials of constant thickness (NFPA-258 Smoke Generation of Solid Materials 1982). The maximum specific optical density shall 170 under the non- Polluted condition.
- (c) The flame propagating criteria of US IEEE Standard 383, with a minimum test short circuit time of five minutes, in the IEEE Standard 383 test.
- (d) IEC 332 Parts 1 and 3, Category 'B', tests on single and bunched cables under fire conditions.
- (e) Limiting Oxygen Index of at least 30, to ASTM D-2863.
- (f) A temperature index (TI) of 260°C to ASTM D-2863.
- (g) All insulation is to be moisture and heat resistant, with temperature ratings appropriate to the application conditions, and in no case lower than 90°C.
- (h) When a sample of the cable is subjected to a combustion test for the determination of the amount of halogen acid gases (other than hydrofluoric acid) as set out in IEC 754 - Part 1 the halogen acid evolved shall not exceed a maximum of 0.5%.

Fire retardant materials shall meet the requirements of item (c), (d), (e), (f) and (g) only.

The above tests shall be certified from Independent Test Lab. The test sample cable shall be taken from material of assigned elevator in Lucknow MRTS only. These tests may be witnessed by UPMRC Representative.

6.30.7 The above requirements shall be met without compromising the anti-termite, pest-resistant, mechanical and electrical properties of the cables both during and after installation to meet the other requirements of this Specification.

### **6.31 Noise Generation**

6.31.1 The whole of the elevator assembly, including the opening and closing of the car and landing doors shall be quiet in operation and shall be free of rattling or squeaking noises. Elevator door operation shall be smooth to avoid the transmission of impact noise to the surrounding structure.

6.31.2 Noise levels resulting from the operation of the elevator, including direct sound

transmission, breakout noise and re-radiation of structure borne noise shall not exceed 55 dB(A) (fast response) at 1.5 m from the elevator shaft and 1.5 m above the floor.

6.31.3 Machinery noise level under normal operating conditions shall not exceed 70 dB(A) at 1 m from the equipment in free field.

6.31.4 The total noise level in a moving elevator car shall not exceed 55 dB(A) with ventilation fan operating.

## 6.32 Ride Comfort Parameters:-

Apart from noise (whose permissible value is mentioned above in clause 6.31.4), lateral quaking, acceleration, jerk and vertical vibration are the other parameters based on which 'Ride Comfort' and its quality is measure .These parameters are defined below (definition as per ISO 18738):-

- i. **Lateral Quaking** : A sideways acceleration/ deceleration measured in gal.
- ii. **Acceleration/deceleration:** A rate of acceleration/ deceleration measured on the z-axis velocity and expressed in meters per second squared ( $m/s^2$ ).
- iii. **Jerk** : The rate of change of z-axis acceleration/ deceleration, attribute to lift motion control and expressed in meters per second cubed ( $m/sec^3$ ).

The contractor by performing suitable tests as per ISO 18738 shall ensure that following permissible values of above parameters shall be achieved for satisfactory ride comfort quality: -

S. No	Ride Comfort Parameter	Unit	Permissible value
1.	Maximum Lateral Quaking (in any of X or Y direction)	Gal	12 Pk - Pk
2.	Acceleration/ deceleration (adjustable)	$m/s^2$	0.5
3	Maximum Jerk	$m/s^3$	2.0
4.	Maximum Vertical Vibration (in Z direction)	Gal	20 Pk-Pk(1-100 Hz)

Note: - The permissible values given above for various 'Ride Comfort Parameters' are indicative only. The actual values shall be those prevailing in the elevator industry at the time of commissioning of the elevators and the contractor has to ensure that those values are achieved.

The contractor shall submit the "Ride Comfort Report" whose acceptance shall be subject to Engineer's approval.

**6.33****Simulator:**

The Contractor is required to develop / get the simulator developed through trade to meet the following.

The Elevator Troubleshooting and Maintenance Simulator shall be capable of simulating the heavy duty MRL elevator with maximum possible realism. Broadly the simulator should be able to achieve following objectives:-

- (a) To understand the overall construction of the Machine Room Less (MRL) elevator along with identification of various parts .
- (b) To understand the construction and functional characteristics of drive system components.
- (c) To understand the construction and functional characteristics of Pit components.
- (d) To understand the functioning of the Drive module, SEP and braking resistor module.
- (e) To understand the system of isolation of faulty subsystem / equipment.
- (f) To understand the functioning of various instruments, their importance, normal and abnormal values.
- (g) To improve the trouble shooting techniques as per Troubleshooting Document for ELEVATOR.
- (h) To maximize Student : Instructor ratio

**6.33.1****Hardware: -**

The hardware of the simulator shall comprise a Physical System, Simulation System and Learning Resources.

Brief description of various hardware resources is as follows: -

**6.33.1.1****Physical System****6.33.1.2****Elevator door/s complete with Drive Assembly**

A scale model of one cabin door (only top portion of approx. 3ft) complete with all major components inside the cabin is to be provided. The landing door will be stationary and will have a structure made from Aluminum extrusions. The Cab Door will be only top portion of actual door (approx. 3ft). The Cab Door will travel up by approx. 3 ft. to the top floor. The remaining floor will be simulated on the computer screen. The total travel distance will be around 3ft. The cabin will be having following simulated components:- i Internal Component

ii External Component

**6.33.1.2.1 Internal Components**

Following components made in the cab will be simulated:

<b>Sr. No.</b>	<b>Components</b>
i.	Car operating Panel
ii.	Intercom
iii	Fan
iv	Alarm
v.	Position Indicator
vi.	Door Operator
vii	Door safety device

**Note:**

The above mentioned hardware components should be simulated in software also.

**6.33.1.2.2 External Components:**

The outer and inner sheet metal work will be done in composite Aluminum prepainted sheets. It will broadly appear externally and internally to the maximum extent possible as of original car.

**6.33.1.3 Elevator landing door complete with Drive assembly.**

A model of one landing door (portion of approx. 3 ft height) is provided. The landing door will have a structure made from Aluminum extrusions which should resemble with the actual system.

All the relevant components in the Landing door should be simulated and should be able to behave in line of actual component.

**6.33.1.3.1 Internal Components**

Following components made in the cab will be simulated:

<b>Sr. No.</b>	<b>Components</b>
i.	Door Operation

**Note:-** The above mentioned hardware components should be simulated in software also.

**6.33.1.3.2 External Components:**

The outer and inner sheet metal work will be done in composite Aluminum prepainted sheets. It will broadly appear externally and internally to the maximum extent possible as on original car.

The car will be “to scale” version of the actual car having following components:-

Sr. No.	Components
i.	Landing Call Station
li	Position Indicator
lii	Door Operator

**6.33.1.4** A full size drives Assembly with Dummy Hoisting and Dummy Counter weights.

#### **6.33.1.5 Simulation System**

##### **6.33.1.5.1 Instructor Panel with Software**

**Instructor Software will consist of following: -**

- i. Instructor Software
- Features ii. GUI on screen iii.
- Fault List

##### **6.33.1.5.1.1 Instructor Software Features:**

**The software should be such that-**“The system of isolation of faulty sub-system / equipment through simulation and complete functional testing of elevator through simulation should be possible. Understanding /Analysis of normal/abnormal values of various parameters along with all the on-board instruments displaying them should be possible.

Broadly software should have following features:-

- a) Instructor should have the control over the operation of the software.
- b) Instructor should be able to select modes of operation i.e. Operational mode or Troubleshooting mode.
- c) In Troubleshooting mode instructor should be able to select symptom.
- d) Each symptom will have certain number of faults related to it.
- e) Remedial action of fault selected should be displayed on instructor screen.
- f) Timer should start as soon as exercise starts, also result of exercise should be displayed at the end of the exercise, e.g. whether fault is removed or not.

#### **6.33.2 Learning Resources: -**

Complete system documentation along with training manual, having following features: -

- i. e-Learning Software.
- ii. 3D Remedial / Replacement of major Components in virtual 3D environment.
- iii. Wall Charts.

- iv. Documentation (interactive Training Manual)

### 6.34 TFT Screen: -

The TFT screen should have following specification:

Sr. No.	Item	Specification
1	Display Type	TFT (Thin Film Transistor) Tamper & Sabotage Proof
2	Power Consumption(W)	15 to 25 W
4	Screen Size(inch)	12.1'
5	Resolution(mm)	1024x768
	Display Area(mm)	246(H) x185 (W)
8	Vertical visual angle	+80°/ -80°
9	Horizontal visual angle	+80° / -80°
10	Luminance(cd/m <sup>2</sup> )	500
11	Contrast Ratio	700:1
12	Overall dimension(mm)	290x250x57
13	Mounting Dimension(mm)	241x274
14	Internal memory	4 GB
15	External Memory	USB, But program can be saved in in-built memory
16	Supporting file formats	MPEG 1/2/4
17	Boot Time	25 sec
18	Temperature Range	0 to 50° C
19	Humidity Range	10-90 %RH
20	Speaker	External speaker

The TFT screen should be compatible with all formats of videos including HD quality. It should have features for multiple display on screen at one time i.e. along with Videos, Data and time on one side, Instructions at lower part of display etc.

END OF CHAPTER

# CHAPTER 7

## QUALITY ASSURANCE AND SYSTEM ASSURANCE

## **7 QUALITY ASSURANCE AND SYSTEM ASSURANCE**

### **7.1 General**

A Quality Assurance programme shall be developed and implemented as a means of determining compliance with the Employer's Requirements. This programme shall comply with the requirements as set out in ISO 9000. The programme shall include but not be limited to the procedures necessary to ensure that all equipment, materials, systems and sub-systems are properly specified, designed, purchased, recorded, inspected, installed and tested at all appropriate stages. The procedure shall also ensure that handling, storage and delivery arrangements are satisfactory.

### **7.2 Quality Assurance Programme**

The Contractor's quality assurance programme shall include as a minimum, the following functions:-

7.2.1 Inspection System: A system for in-process inspection of work operations and manufacturing as well as installation processes, including observations, measurements and tests, to ensure conformance with the requirements of the Contract.

7.2.2 Calibration System: A system for periodic calibration and control of the accuracy of precision instrumentation and gauges.

7.2.3 Record System: Data and records essential to the operation of the quality programme shall be maintained by the Contractor and made available to the "Engineer" upon request. These records shall include work performance, inspection and testing observations and the number and type of deficiencies found. In addition, records shall be maintained for monitoring work performance, inspection and testing which indicate the acceptability of work or products and the remedial action taken in connection with deficiencies.

7.2.4 Supplier Control System: A system for ensuring that all supplies and services procured from suppliers (subcontractors and vendors) conform with the requirements of the Contract.

7.2.5 Manufacturing Control System: A system for providing necessary control over manufacturing operations to ensure that the final product conforms with all requirements of the Contract. This system shall include controls for the following areas:



**(a) Materials**

Suppliers' materials and products shall be subject to inspection to demonstrate conformance with the technical requirements.

**(b) Production Process and Fabrication**

The Contractor's quality assurance programme shall ensure that all machinery, wiring, batching, shaping and basic production operations (of any type) together with all processing and fabricating are accomplished through documented work instructions. These instructions shall be the criteria for acceptable workmanship.

**(c) Completed Item Inspection and Testing**

The quality programme shall ensure that there is a system for final inspection and testing of completed products. Such testing shall provide a measure of the overall quality of the completed product and be performed so that it simulates, to a sufficient degree, product end use and functioning.

The contractor shall do the testing of "RIDE COMFORT" with EVA Meter and submit the analysis report stating the limits of ride quality parameters with each elevator's ride quality measured parameter and ensure the ride quality as per relevant standards.

**(d) Statistical Quality Control and Analysis**

Statistical methods may be utilised for planning, analysis, tests and quality control whenever such procedures are suitable for maintaining the required control of quality.

Sampling plans shall be subject to the acceptance of the "Engineer" prior to use.

**(e) Indication of Inspection Status**

The Contractor shall maintain a positive system for identifying the inspection status of products. Identification may be accomplished by means of stamps, tags, routing cards, move tickets or other control devices acceptable to the "Engineer".

**7.2.6**

Installation Control System: A system providing necessary control, monitoring, inspection of the progress, quality of work and protection of equipment, to ensure that the equipment is installed according to the requirements of the contract.

The system shall include but not be limited to the following, which shall be subject to the acceptance of the "Engineer" prior to use:

**(a) Shop Drawings**

All layout and shop drawings giving detailed layout of equipment, structural cut-outs, supports, openings, all dimensions, tolerances setting, etc. (Refer Clause 4.7 of PS).

**(b) Assembly Procedures and Drawings**

This shall show details of all installation and assembly procedures, including tolerances, tightening torque, alignment, precautions, etc.

(Refer Clause 4.7 of PS)

**(c) Inspection Checklist**

Checklists giving all items to be checked and inspected with tolerances setting, etc.

7.2.7 The Contractor shall submit checklists to demonstrate compliance with all applicable standards.

### **7.3 Systems Assurance**

The Tenderer shall demonstrate a clear understanding of all the requirements of this Clause in his tender submission.

7.3.1 General

- a) The Contractor shall develop and implement the requirements for Systems Assurance. These requirements shall be applied also to subcontractors and suppliers and shall be carried out during the design, manufacture, installation, testing and commissioning phases of the Works.
- b) The Contractor shall prepare and submit for review and acceptance by the "Engineer" a Systems Assurance Plan thirty days after Contract Award.

- c) The System Assurance Plan shall define the Contractor's approach, procedures and schedules for conduct of Safety Engineering, Reliability Engineering and Maintainability Engineering. Human Factors Engineering is an integral part of Systems Assurance and shall be considered and reflected within the Systems Assurance Plan.
- d) The Contractor shall pro-actively engineer the systems to meet the safety, availability, reliability and maintainability performance requirements listed below and demonstrate that the requirements have been met by the system installed.
- e) In the process the potential hazards to safety, availability, reliability and maintainability performance should be further minimised where design options permit.
- f) The deliverables listed below are intended to provide the "Engineer" with a sound basis for acceptance of the safety, availability, reliability and maintainability performance; progress information; confidence that the design is proceeding with a low risk of failing to meet the performance requirements; information that will aid the planning of work schedules; and part of the foundation of the safety case for operation of the line.

~~7.3.2~~ ~~Not used~~

### 7.3.3 **Safety Engineering**

- a) The Contractor shall as part of the safety engineering activity prepare analyses of identified potential hazards to ensure resolution of hazards. The following analyses shall be prepared and submitted by the Contractor:
  - i) Subsystem Hazard Analysis (SSHA)
  - ii) Interface Hazard Analysis (IHA)
  - iii) Operating and Support Hazard Analysis (O&SHA)
  - iv) Quantitative Fault Tree Analysis (FTA)
  - v) Failure Modes, Effects and Criticality Analysis (FMECA)

- b) The Contractor shall prepare a Fire Safety Design Report for review and acceptance by the "Engineer". At a minimum, this report shall contain documentation of the specific fire hardening and life safety features and attributes the Contractor has incorporated in the elevator design; especially those relating to: -
  - i) Structural fire resistivity
  - ii) Choice of electrical wiring and insulation for vital safety critical circuitry.
  - iii) Flammability, smoke emission, and toxicity characteristics of selected materials.
- c) Further, the information presented by the Contractor shall be supported by the history of tests conducted and by approved test certificates from accredited laboratories which attest to the materials' characteristics and behaviour.

#### **7.3.4 Reliability, Availability and Maintainability (RAM) Engineering**

- a) Reliability, availability and maintainability requirements and goals shall be developed as defined in clause 17.7 of PS.
- b) Final reliability, availability and maintainability predictions shall be verified by testing after system design has been completed.
- c) The subsystems and equipment shall be designed to maximise system availability during traffic hours, to minimise the amount of maintenance required and to ensure that any maintenance can be easily and quickly carried out at minimum cost.
- d) The Contractor shall perform RAM analysis up to the point of interface with other systems.
- e) Reliability block diagrams shall be developed which show each equipment element that is essential to the performance of the system, including element interrelationships. Block diagrams shall be revised to keep current with design iterations.

- f) The Contractor shall develop a reliability model consisting of reliability block diagrams and probability of success equations. The model shall show the relationships required for system success. The Contractor shall revise the model to keep current with design iterations.
- g) The Contractor shall provide RAM prediction and apportionment in accordance with established techniques or standard or properly documented and verifiable field failure data for identical or similar equipment. The standards used or the source of field data shall be identified.
- h) Quantitative RAM assessments to all significant functional levels of the system, subsystems or equipment shall be allocated. Maintainability analyses during design, development and testing shall be used to evaluate the degree of achievement of the maintainability requirements. The Contractor shall identify the standards by which these allocations are made.
- i) The Contractor shall develop predictions to judge the adequacy of the proposed design to meet quantitative RAM requirements and shall identify design features requiring corrective action during early stages of design and development.
- j) The Contractor may submit existing analyses which are properly documented and verifiable for equipment and applications which are identical or manifestly similar. The documents used for calculating the Reliability, Availability and Maintainability shall be certified by the Customer whose data's are used. Existing data need not conform to the agreed format but shall contain the same data presented in a neat, concise and logical manner.

7.3.5 Not used

7.3.6 Not used

END OF CHAPTER

# CHAPTER 8

## DESIGN SERVICES

## 8 DESIGN SERVICES

### 8.1 Design Requirements

The Contractor shall perform all design functions necessary for the development, manufacture, installation and site testing of elevators as described in this Specification.

- 8.1.1 The design of each component shall achieve the minimum service life given below. The failure rate of the components shall not exceed 5%. Failure rate is defined as the number of failures (during the service life) divided by the total quantity of the components in one section.

<u>Elevators</u>	<u>Service life(years)</u>
(i) Safety gear rope /Coated Steel Belt	8
(ii) Governor	20
(iii) Anti Creep device	20
(iv) Hoisting chain/hoisting rope	8
(v) Contactors/relays	10
(vi) Traction machine/motor	20

The Service life of each equipment shall be specified by the firm in the design submission.

- 8.1.2 The Contractor shall prepare and submit drawings, which clearly illustrate details of equipment down to sub-assembly and component level, equipment locations and configurations. Drawings shall indicate plan views, elevations, sections, charts, tables, schematics and diagrams with legends, dimensions, part numbers, tolerances, setting clearances, materials, etc., as required to cover the facilities being provided under the Contract. Drawings shall also be prepared showing circuit wiring for each of the systems included in the Contract.

- 8.1.3 The Contractor shall prepare and submit specifications to provide a clear description of the functional requirements such as, loading, materials, clearances, tolerances, of all equipment and its components planned for use in the Contract. The specifications shall indicate acceptable levels of performance, the expected normal life span, and the mean time between failures (MTBF) for the equipment, materials and workmanship, with due consideration given to the service and environment to which such equipment will be subjected. The Contractor shall identify, by manufacturer and model or part number, each component, which he plans to install under the Contract.

- 8.1.4 The Contractor shall prepare and submit a Quality Assurance programme in

accordance with requirements contained in the Specification.

- 8.1.5 The Contractor shall submit all applicable data, criteria, standards, directives and information used as a basis for the design of the elevators.
- 8.1.6 The Contractor shall comply with the drawings and graphic standards identified in the Employer's Requirements.
- 8.1.7 The Contractor shall submit the design calculations for the following, to demonstrate how the operational requirements are achieved.
- (a) Structural loading to pit and shaft wall.
  - (b) Heat dissipation value for the elevator
  - (c) Power requirements and efficiency of motor/machine.
  - (d) Any other information necessary or asked by the Employer
- 8.1.8 The Contractor shall submit catalogues and/or samples for all parts and components used in this Contract as per Employer's Requirement.
- 8.1.9 The Contractor shall prepare equipment layout plans and other documents necessary to facilitate the design interface co-ordination with other System-wide and Designated Contractors. These plans shall, (if necessary) be incorporated in design drawings but they must be prepared at appropriate times and in sufficient detail to permit successful co-ordination of space provisions for the elevators.

## **8.2 Endorsement Requirement**

All drawings, calculations, test certificates, technical information, data and analysis submitted in this Contract shall be endorsed by the Contractor's registered Professional Engineer. The design certificate & drawings shall confirm to Performa (Refer clause 4.7 of PS).

## **8.3 Co-ordination with Designated Contractors**

The Contractor shall co-ordinate with the Designated Contractors, shall finalise and agree with the Designated Contractors all relevant matters relating to the equipment including but not limited to the following:

- a) space requirements, including tolerances for construction of the civil works.
- b) fixing requirements
- c) loading
- d) interface with architectural finishes



- e) cabling routes, termination details including providing information to the Designated Contractors.
- f) information on embedded parts, box-outs, etc. to enable the Designated Contractors to provide the necessary works.
- g) equipment access route and temporary/permanent lifting requirements.
- h) lighting requirements
- i) power requirements
- j) ventilation requirements
- k) fire protection
- l) drainage requirements

**8.4 Interface with BMS System-** For the purpose of integration of elevator data in station BMS System over RS 485/ ethernet port the status of elevators are to be incorporated in the station BMS (if required by the Engineer). The details of remote monitoring required for the elevators are mentioned in Appendix-I of these specifications. The Elevator contractor shall interface with the E&M /BMS contractor for the same and shall provide the necessary volt free contact and remote control interface for BMS.

**8.5 Integration with Fire Alarm System (FACP)-** The Lifts in Elevated as well as in Underground Metro Stations will be integrated with Fire Alarm Control Panel.

END OF CHAPTER

# CHAPTER 9

## INSTALLATION

## 9 INSTALLATION

- 9.1 The Contractor shall be responsible for the timely and proper setting out of the Works which shall include verifying the positions, levels, dimensions and alignment of elevator pits, supports, shaft, walls and floor openings, etc. Any error in the civil construction in so far as they relate to the Works shall be immediately brought to the attention of the "Engineer" and the Designated Contractor to allow prompt rectification by the Designated Contractor so as to avoid delays to the Works. The Contractor shall not be entitled to claim for any additional costs incurred by him arising out of such errors in the civil construction, if such additional costs could reasonably have been avoided had the Contractor carried out timely and proper setting out of the Works. The method adopted for installation shall be in accordance with relevant standards with latest versions/ amendments stated at Clause 4.17 of this specification.
- 9.2 The Contractor shall be responsible for all aspects of the Work required to install the equipment, including the provision of all lifting facilities such as frames where the provision of hooks is not possible. The Contractor shall co-ordinate with the Designated Contractors on the necessary precautions to be taken by both the parties to prevent damage to any part of the civil works during installation. The Contractor shall take all necessary pre-cautions including transportation of various part of elevators on rubber typed wheel and handling these with proper equipment so that floor finishes are not damaged by the Contractor during erection of Elevators at the stations. In case any floor finish is damaged by the Contractor the same shall be made good by the Contractor in full panel / area at his cost, so as to maintain uniformity.
- 9.3 The Contractor shall ensure that levelling of all landing equipment shall be within  $\pm 1.0$  mm. The vertical alignment of all door jambs, doors etc. shall be truly plumb to within  $\pm 1.0$  mm.
- 9.4 Guide rail shall not be skewed. The distance between guide rail shall be within  $\pm 0.5$  mm. Guide rail joints shall be smooth to within 0.1 mm. It shall be erected plumb within  $\pm 1.0$  mm.
- 9.5 The Contractor shall provide protection, such as plywood box-up etc., to protect the door, the jamb, decking, from being damaged until the work is handed over at no additional cost. Any damages to the equipment will be the sole responsibility of Contractor and the firm shall replace the damaged part without any extra cost. The

complete equipment will be inspected and tested at the time of taking over of the equipment.

- 9.6 All Elevator landing door gaps shall be less than 4 mm.
- 9.7 The Contractor shall be responsible for the installation of all guide rail brackets, separator, sill supports, hanger brackets including drilling and all related materials. The contractor shall verify and satisfy themselves in respect to the loading capability of the shaft wall holding the bracket etc. If the Contractor feels that load test is necessary/ required, then he can arrange the same in co-ordination with civil contractor.
- 9.8 Electrification Panel of elevator shall be fully protected against the ingress of grit, dust and moisture and maintenance friendly enclosure.
- 9.8.1 All equipment shall be fully protected against the ingress of grit, dust and moisture during delivery, storage and installation.
- 9.9 The equipment shall be delivered to Site in accordance with an accepted installation programme with a minimum temporary storage period to avoid damage.
- Access into the station will be either by train or by road depending on site environment and constraints.
- 9.10 The Contractor shall design the equipment to comply with the Site access restrictions and shall ensure that the largest piece of equipment can be brought into the station through the access opening/entrances and passage ways. Method Statement of Installation shall be submitted for Employers review and approval at least 30 days prior to the starting the installation. As part of the preliminary design submission the Contractor shall submit to the "Engineer" for acceptance a General Method of statement for Installation However, Contractor will submit schedule of tests giving full details of all tests to be carried out
- 9.11 Where the structure does not permit the provision of lifting points, the Contractor shall make his own arrangements to provide the required lifting facilities such as "A" frames or similar arrangements to carry out installation work at no extra cost.
- 9.12 Once the elevator shaft is handed over to the contractor to commence installation, he shall be responsible for providing fencing and barricades to protect his working areas during the installation period for the safety of his workers and other personnel working in the station until the taking over of the lift by UPMRC.

END OF CHAPTER

# CHAPTER 10

## TESTING AND INSPECTION

## **10 TESTING AND INSPECTION**

### **10.1 General**

- 10.1.1 As part of the preliminary design submission the Contractor shall submit to the "Engineer" for acceptance a schedule of tests giving full details of all tests to be carried out.
- 10.1.2 Tests at places of manufacture to be witnessed by the "Engineer" shall be grouped together so far as can be arranged so that as many tests as possible can be witnessed on each visit.
- 10.1.3 The Contractor shall prepare and forward to the "Engineer" an original and four copies of all Test Reports as soon as practicable after completion of each test whether witnessed by the "Engineer" or not. All test data shall be certified by the Contractor's Professional Engineer.
- 10.1.4 The Contractor shall perform all applicable test specified in these specifications as per the relevant standards. Any test required as per the applicable safety standards but not specified in this specification shall be performed without any extra cost to UPMRC

### **10.2 General Requirements for Type Tests and Acceptance Tests**

- 10.2.1 The Tenderer shall provide details of any type and acceptance tests, which have been carried out on equipment offered, or any additional tests he recommends.
- 10.2.2 In general, certificates of previous type tests may be accepted at the discretion of the "Engineer", provided that they are for identical equipment and conditions. Where appropriate, new and/or modified components to meet the requirements of this Specification shall be made available for type testing.
- 10.2.3 All applicable Type tests as per the relevant standards on equipment shall be carried out strictly as specified in the Specification and procedure of testing shall be submitted to "Engineer" for No Objection.
- 10.2.4 The "Engineer" shall have right to witness tests and inspections on individual materials, components, or sub-assemblies, and details of these shall be agreed between the Contractor and the "Engineer".
- 10.2.5 At the conclusion of all type tests, the Contractor shall compile all the test data together with any observations made during the tests, file them into a type test binder and submit it to the "Engineer" for acceptance and record.

### **10.3 General Requirements for Tests during Manufacture**

- 10.3.1 The Contractor shall carry out all applicable tests during manufacture as specified and propose any additional tests to be carried out as per relevant safety standards. These

tests shall be subject to the acceptance of the "Engineer". Routine tests shall be integrated with the manufacturing programme. The "Engineer" will, at his discretion, witness the routine tests during the period of manufacture, or accept the records of the Contractor's in-house quality control scheme, where appropriate, as sufficient evidence for the execution of the routine tests.

10.3.2 Routine tests shall be carried out strictly as specified in the test specification as outlined in Clause 10.4.

10.3.3 On completion of the manufacture of items or sub-assemblies, and following completion of the manufacturer's own tests and inspection, the "Engineer" shall be invited to witness such tests as he deems appropriate. The Contractor shall schedule the routine tests to meet the manufacturing programme, whether or not the "Engineer" will be present at the tests, provided advance notice has been served to the "Engineer" in accordance with Clause 9.8 of GS.

10.3.4 The "Engineer" will determine and advise the Contractor of those tests where certification by the manufacturer may be acceptable in lieu of witnessed tests.

10.3.5 Before equipment is dispatched, the "Engineer" will signify his acceptance by signing certificates releasing such equipment from the place of manufacture or test.

10.3.6 Methods of packing and shipping shall be as specified in the Employer's Requirements, the "Engineer" reserves the right to visit the manufacturers' or packers' premises to ensure that accepted methods are employed.

#### **10.4 Test Specification**

10.4.1 The Contractor shall submit for acceptance by the "Engineer", test specifications for type tests, routine tests, tests on site, final acceptance tests and commissioning. The specifications shall detail the methods of conducting the tests, the tools and instruments used. Reference to the accepted documents and drawings shall be included in these specifications. The records/results shall be tabulated in a prescribed format applicable to this Contract.

10.4.2 Nothing in this Specification shall prevent the "Engineer" from calling for extra tests.

10.4.3 These test specifications shall include the design values of all quantities to be verified, with allowable tolerance or limits. Summary drawings or diagrams shall be included with the test specifications to show the dimensions and tolerances of all structural assemblies and sub-assemblies. In the case of welded fabrications, key diagrams giving all weld data shall be provided to enable systematic inspection to take place.

10.4.4 Verification of accuracy shall be required for all tools, apparatus, testing jigs, measuring instruments and 'go' or 'no go' gauges used for the purpose of routine tests.

10.4.5 All test instruments shall be calibrated not more than one year prior to their use. The Contractor shall submit calibration certificate or other documents for proof of Compliance.

## **10.5 Testing of Materials and Details**

10.5.1 Where materials or components used in this Contract are not covered by separate test specifications, samples of such materials, or up to two per cent of such components shall, if desired by the "Engineer" be tested at the Contractor's expense at an approved laboratory.

10.5.2 The Contractor shall supply the material required for testing free of charge and shall supply and prepare the necessary test pieces, labour and appliances for making all tests, and for carrying out all gauging and weighing on his premises in accordance with the terms of this Specification. If the Contractor is unable to provide approved facilities at his own factory for making the prescribed tests, the Contractor shall bear the cost of carrying out the tests elsewhere, at a place subject to the "Engineer" acceptance.

Such radiographic examination of welds or castings as the "Engineer" deems necessary shall be carried out.

## **10.6 Not Used**

## **10.7 Elevator Prototype Tests**

10.7.1 One complete Elevator shall be available for the commencement of witness testing after Contract Award. The selected Elevators shall be representative of their various types.

10.7.2 A complete Elevator system including traction drive system, in addition to the controller, Elevator car enclosure, landing and car doors, protection devices and call fixtures shall be assembled on a test rig or inside a test tower to undergo a comprehensive running and functional testing in accordance with the accepted test specification to verify compliance with the Specification.

10.7.3 The tests shall include the following minimum requirements.

- a) Verification of the suitability of the traction drives system, its efficiency, etc.
- b) Verification of the car operation and response to call fixtures, door operation including the safety edges, all indications and signaling features, and car top control features;
- c) Weight tests on safety gear and measurement of electrical readings and verification of the operating speed under various loading conditions;
- d) Verification of riding comfort and leveling accuracy under various load conditions.



- e) Verification of the fault indication and fault diagnosis features.
- f) Verification of the construction of the various control panels to the specification shall be done. Insulation resistance and high voltage tests shall be conducted in accordance with the test specification.
- g) Any additional testing as required by BS 5655 Part 10.
- h) A 12-hour duty cycle test, during which the Elevator shall run continuously with the contract load for 12 hours and shall travel up and down with intermediate stops such that the number of starts per hour as specified.
- i) Complete functional tests on the isolating transformer and ripple filter.
- j) Operation of the battery back-up device and the battery operated power supply.
- k) Simulation of the emergency homing sequence during fire and power failure.

## **10.8 Not Used**

## **10.9 Elevator Type Tests**

10.9.1 Elevator Contractor shall ensure that Type Test Certificate for elevator equipments / components should not be older than 05 years, if any certificate is older than 05 years, the same must be got revalidated from time to time during the contract period (excluding Defect Liability Period) at his own cost from independent third party laboratory.

Further the following tests to be performed at his own cost (except boarding & lodging of employer's representative) from independent third party laboratory and may be witnessed by UPMRC representative.

### **10.9.2 Motor**

#### **Frequency of Tests**

One unit selected by the "Engineer" for each range of motors supplied for this Contract.

If the quantity of the same range of motor exceeds forty, an additional motor shall be selected from the second batch by the "Engineer" to repeat the same tests described below.

If a separate motor is used for achieving maintenance speed, the same requirements shall also apply to the maintenance motors.

In general, all tests shall be conducted in accordance with the relevant parts of BS 4999.

#### **Scope of Tests**

- a) Insulation Test
  - i) Insulation resistance of windings using 1000V megger shall not to be less than 200 M Ohm.
  - ii) Insulation resistance of thermistors subject to 1000V for 5 seconds shall not be less than 200 M Ohm. Windings shall be earthed.
  - iii) Main and slow speed winding shall each be pressure tested to 2000V r.m.s. for 60 seconds. During this test, thermistor wires shall be grounded to earth.
  - iv) Cold resistance of both high and low speed windings shall be recorded.
- b) Dynamic Tests
  - i) No load current and speed shall be recorded at rated voltage and frequency for both high and low speed windings.
  - ii) Full load, 75%, 50% and 25% load tests shall be carried out on both high and low speeds at rated voltage and frequency. Current and speed shall be recorded for each. Input power, efficiency, slip and power factor shall be established and recorded for each.
  - iii) Temperature rise test on full load shall be carried out on high speed windings only. Voltage shall be 415V. Frequency shall be as rated. iv) Ambient, air outlet, casing, output power and temperatures shall be recorded at 15 minute intervals for the first two hours and 30 minute intervals subsequently until temperature levels off.
  - v) Voltage, current, frequency, output power and temperatures shall be recorded at 15 minute intervals for the first two hours and 30 minute intervals subsequently until temperature levels off.
  - vi) When the temperature has leveled off, the motor shall be switched off and the winding temperature rise shall be established using the resistance method as specified in BS 4999 Part 101.
  - vii) A momentary overload of 200% full load shall be applied for 15 seconds. The motor shall not stall or abruptly change speed.
  - viii) A locked rotor test shall be carried out at rated voltage and frequency for both high and low speed windings. Current and torque shall be recorded in both cases.
  - ix) The speed/torque characteristic and the starting current characteristic shall be produced from the results obtained.

## 10.9.3

## Controller

## Frequency of Test

One of each type of controller shall be type tested.

## Scope of Tests

## a) Physical Construction Checking

The construction of the control cubicle shall be checked against the approved drawings. Facilities to padlock incoming fused isolator shall be checked.

Verification of the protection classification shall be conducted and/or provided.

## b) Pressure Test

i) Earth leakage circuit breakers shall be tested on both poles. The current and time required to trip shall be recorded. Similarly, the dc earth leakage unit shall be tested and values to be recorded.

ii) Pressure testing at 2000V ac r.m.s. for 60 seconds between: phase to phase and phase to earth.

iii) Control wiring itself shall be pressure tested at 1,500V ac r.m.s. for 60 seconds between control/auxiliary wiring and frame. Insulation tests shall be carried out before and after the above tests by a 1000V insulation tester. The insulation resistance thus measured shall not be less than 200M ohm. iv) All protection on electronic circuits shall be tested by a 500 V installation tester.

Wiring to all electronic components shall be meggered. Megger setting shall be at the discretion of the "Engineer".

v) Verification of the protection circuit shall be carried out in accordance with the approved procedures.

Temperature rise during the tests shall be recorded and verified.

## 10.9.4

**Braking System****Frequency of Test**

One of each type of brake provided shall be required to undergo type testing.

**Scope of Test**

A full dimensional check shall be carried out to verify compliance with the manufacturing drawings and a full functional test shall be carried out. A demonstration of brake adjustment and setting shall be carried out.

**10.9.5 Elevators Inter-communication System**

Two of each type of Elevator-Inter-Communication Systems shall be type tested. A full functional test shall be carried out to verify compliance with the specification.

10.9.6 (a) Door endurance testing shall be done for 4 million operations of Door Assembly and based on this testing, an analysis shall be done to modify the existing List-A (Predictive Replacement Plan is based on Door Testing) in Appendix-H Maintenance requirement.

**(b) Testing of Fire rating of Landing Door:**

Stainless Steel and Glass door of Lift shall be got tested for fire Rating as prescribed in BS 476 Part 22.

**10.9.7 Cable Testing**

Sample of cables used in lift collected from site shall be got tested as per relevant standard at third party lab.

**10.10 Hoist Rope/Belt**

Manufacturer test Certificates shall be submitted for review of Engineer.

**10.11 Elevator Routine Tests**

The following are the minimum requirements of the routine tests.

**10.11.1 Driving Machines**

Random Check:

Verification of the insulation resistance of the windings using a 1000 Volts megger test. A high voltage test to 2000 Volts r.m.s. for one minute of the stator winding shall be conducted.

A dynamic test for every driving machine shall be conducted for a period of 4 hours continuously without stopping, except for changing of direction, 2 hours in each direction, at contract speed and 25% load conditions. The test is to ensure no undue vibration or abnormal temperature rise occurs in any component.

**10.11.2 Power units**

100% check :

The assembled power unit shall be checked in accordance with the accepted test specification along with surge protectors, power filters etc.

**10.11.3 Main Control Cubicle**

100% Check:

The complete control cubicle shall be checked with a simulator to verify correct wiring connection and function of the electrical/ electronic devices.

Verification of the insulation resistance of the control wiring and electronic components shall be conducted in accordance with the accepted test specifications.

#### **10.11.4 Call Button and Fixtures**

Random Check:

The call button shall be checked at random to confirm the manufacturing quality.

The assembled fixtures shall be inspected and functionally tested accordance with the accepted test specifications.

#### **10.11.5 Hoist Rope/Belt**

Sample of Hoist Rope / Belt collected from site shall be got tested as per third party Lab. A manufacturer's certificate or sample test will be acceptable to the "Engineer".

#### **10.11.6 Safety Gear**

Manufacturer's certificate or test report on the assembly will be accepted by the "Engineer".

#### **10.11.7 Car Enclosure and Door Assembly**

Random Check:

The assemblies shall be checked at random to ensure the correct dimensions and layout. Quality of the finishing shall be inspected to ensure the correct type of materials have been used for fabrication.

Protection of the finished assembly shall be inspected in accordance with the accepted test specifications.

For Glass Elevators, the Contractor shall fabricate and erect a prototype Glass Elevators and carry out strength, deformation and stability testing compliance with European Standard EN 81. In addition, the assembly shall be subject to pendulum impact test according to DIN 52 337 with the following fall heights.

Fall height 0.7m, pendulum impact test with a soft impact body (PW), (sack filled with 45 kg of shot);

Fall height 0.5m, pendulum impact test with solid impact body (PH), (pear-shaped steel ball 10kg).

The Contractor shall provide certification of the test results. Only the complete absence of breakage, permanent deformation, delimitation, dislodging of panels or fixings, and loss of stability will result in a successful test finding.

#### **10.12 Not used**

### **10.13 Elevator Site Checking and Inspection**

A test and inspection specification shall be prepared for each of the following critical phases of work. Forty-eight hours notice is required prior to completing these phases to enable the "Engineer" to carry out any checks he deems necessary. The following are the minimum requirements:

- a) Setting out the plumb lines;
- b) Erection and alignment of guide rails; rail brackets
- c) Erection and alignment of landing doors; jamb, sills, header etc.
- d) Erection of Elevator shaft and Elevator pit equipment;
- e) Erection of car enclosures;
- f) Positioning of machine equipment and control cubicles;
- g) Installation of the hoist ropes; and governor rope
- h) Erection of landing fixtures and car fixtures;
- i) Installation of hoistway and machine room trunking prior to installation of wiring;
- j) Installation of wiring and cabling
- k) Installation of car fixture and car top equipment
- l) Earthing and bonding checks

### **10.14 Not used**

### **10.15 Elevator Commissioning and Acceptance Tests**

10.15.1 Tests shall be carried out on each Elevator in accordance with the relevant portions of BS 5655, which shall include but not be limited to the following: -

- (a) Readings on starting current, running current and supply voltage shall be taken at the rated speed of each Elevator in both directions of operation under no load, 20%, 40%, 60%, 80% and full load conditions.
- (b) Both power and control wiring of the controller shall be tested between lines connected together and earth at 1000V 50Hz. This voltage shall be applied and maintained for one minute. The control wiring shall be separately tested between poles and earth. Immediately following each test a 1000 Vdc. Insulation tester shall show an insulation resistance of not less than 3 M ohms. All field wiring shall withstand a 1000 V megger test on site and each conductor shall show an insulation resistance to earth of not less than 3 M ohms.

- (c) The overspeed governor shall be tested to ensure that it will activate when the speed exceeds 15% of the nominal speed.
- Functional tests on the safety gear with no load at rated speed by manually tripping the governor.
- The Elevator car shall be operated up and down several times including tests to demonstrate the levelling operation.
- Additionally, to prevent rodents from entering the OSG wheel, an OSG guard should be installed.
- (d) Test on the car and landing doors system
- (i) Checking of the condition of the landing and car door for smooth operation,
- (ii) Functional tests on the door closing time, door speed, re-opening, safety edge, proximity detection landing and car door contacts of the door lock.
- (e) Functional tests on all the landing call buttons, indicators and all function provided in key-switch operated cabinet mounted below the car operating panels.
- (f) Functional tests on the emergency call buttons.
- (g) Functional tests on the final limit switches, terminal slow down and terminal over travel limit switches.
- (h) Functional tests on the following safety switches and devices:-
- (i) Overload device.
- (ii) Phase protection device.
- (iii) Anti-creep system.
- (iv) Emergency lowering and raising devices.
- (v) Pipe rupture device.
- (vi) Over current protection device.
- (vii) Counter weight safety (if applicable)
- (viii) Remote Monitoring System(RMS)
- (i) Functional test on the car top maintenance panel.
- (j) Testing of the Intercom system.
- (k) Compress buffer test.
- (l) Running clearance tests.
- (m) Functioning test of Elevator management, monitoring and fault diagnostic system.
- (n) Noise/ sound level test of equipment and installation.

- (o) Functional tests of battery backup device.
- (p) Complete function tests on track machine, motor brake and control equipment.
- (q) Floor leveling accuracy and re-leveling at different loads.
- (r) Tests on Emergency Power and Fire operation.

Temperature readings of elevator controller and equipment shall be taken every fifteen minutes for at least 2 hours or the duration of test whichever is longer.

- (s) Functional tests of all features and functions not included in the above but required in the Contract.

#### **10.15.2 Twelve Hour Run**

Each Elevator shall be subject to a 12-hour duty cycle test, during which the Elevator shall run continuously with the contract load for 12 hours and shall travel up and down with intermediate stops such that the number of starts complied with the specification.

#### **10.16 Interface and Integrated Tests**

The Contractor shall co-ordinate and carry out interfacing and integrated testing together with other System-wide Contractors to ensure that the all integrated systems function as desired.

#### **10.17 Certificate of Taking Over**

The final acceptance tests of each item of equipment shall be undertaken in the presence of the "Engineer", in accordance with the test specification. Any defects and/or deviations discovered without prior written approval during the tests shall be rectified at the Contractor's own expenses. These shall be entered into a defects list agreed between the Contractor and the "Engineer". The Certificate of Taking Over will not be issued until these tests have been completed and the defect list substantially reduced to such an extent that the "Engineer" considers that the equipment is safe for operation.

#### **10.18 Certification**

Upon completion of each elevator the Contractor shall submit to the Employer, a Certificate of Supervision issued by the Contractor's Professional Engineer, in a format acceptable to the "Engineer".

END OF CHAPTER



# CHAPTER 11

## ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS

## 11 ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS (EMC)

### 11.1 General

The requirements stated below must be read in conjunction with the other EMC requirements mentioned in GS.

The contractor shall take adequate measures to reduce conducted, induced, and radiated emissions, especially the levels of harmonics, to acceptable values as specified by the relevant international standards or by the concerned statutory authority.

### 11.2 Not Used

### 11.3 Inter-System EMC

11.3.1 The various electrical systems installed on the Railway under Construction will after installation interact with each other by mutual coupling and all plant and systems shall be designed so that there is no malfunction due to interference.

11.3.2 The Contractor shall ensure that all equipment supplied shall have minimum Radio Frequency Interference introduced onto the main network and comply with the Electromagnetic Compatibility (EMC) requirements of the following standards:

EN 50081-1 : EMC Generic Emission Standard

EN 50082-2 : EMC Generic Immunity Standard

BS EN 12015 : Electromagnetic compatibility- Product family standard for lifts, escalators and passengers conveyors- Emission.

BS EN 12016 : Electromagnetic compatibility- Product family standard for lifts, escalators and passenger conveyors- Immunity.

### 11.4 Harmonic distortion

The total harmonic distortion (THD) caused by the elevator equipment to the supply mains at the power supply input terminals of the elevator shall not exceed the following values when the elevator is travelling up at full load and rated speed:

Rated load Current ( $I_L$ )	THD (%)
$200A \leq I_L < 400 A$	< 12.0
$20A \leq I_L < 200A$	< 15.0
$I_L < 20A$	< 20.0

### 11.5 Installation and Mitigation Guidelines

IEC1000-5 series of guidelines must be observed wherever applicable.

### 11.5.1 Earthing

An earthing system should be designed to assure personnel safety and protection of installations against damage. It should also serve as a common voltage reference and to contribute to the mitigation of disturbances.

To achieve the primary goal of assuring personnel safety and damage control, a low impedance path must be made available to large currents generated due to lightning or power system fault. The potential differences (touch and step voltages) between any two points must be as low as possible. Safety considerations also require the chassis or enclosure to be earthed to minimise shock hazards to passengers and the maintenance staff.

To achieve the secondary goal of providing protection for sensitive and interconnected electronic and electrical systems, earthing should be designed to minimise the noise voltage generated by currents from two or more circuits flowing through a common earth impedance and to avoid creating earth loops susceptible to magnetic fields and differences in earth potentials.

Earthing shall also be designed to accomplish the following minimum requirements:

- i) Protect personnel and equipment from electrical hazards, including lightning, where practical.
- ii) Reduce potential to system neutrals.
- iii) Reduce or eliminate the effects of electrostatic interference and electromagnetic interference arising from within the system.
- iv) Provide a single-point earthing method for all equipment enclosures, cabinets, drawers, assemblies and sub-assemblies.
- v) Provide a clean zero-volt reference point for signals in computer and related equipment.

### 11.5.2 Bonding

Bonding all exposed metallic parts of all equipment and connecting them to the earthing network is a way for meeting safety requirements and minimise noise voltages due to potential differences.

Direct bonding should be used wherever practical. Where indirect bonding via bonding strap is used to connect two isolated items, the bond must satisfy the following minimum requirements and prevailing international standards, for example, IEC1000-52.

- i) Low bonding resistance from DC to at least 2 GHz.
- ii) Low bonding inductance from DC to at least 2 GHz.
- iii) Proper bonding procedure, including appropriate surface treatment before and after the bonding process is adopted.
- iv) Proper use of bond material to reduce electrolytic corrosion.

**11.6 Reliability, Availability and Maintainability**

All elevators shall be subject RAM conditions as laid down in clause 17.7, Chapter 17 of this PS and shall always be under good running and maintainable condition within the environmental conditions prevailing in the General Specification, where the elevators will be installed.

END OF CHAPTER

CHAPTER 12

MATERIALS AND WORKMANSHIP

**NOT USED**

## CHAPTER 13

## INTERFACES

## **13. INTERFACES**

### **13.1 Interfaces**

The Contractor shall interface the design and construction of the Works with that of other contractors, principally the Contractors for the Designated Contracts as defined in the General Conditions of Contract. The Contractor shall keep the "Engineer" fully informed in respect of such interfaces, such information being given to the "Engineer" in a manner and form and at such intervals as stated in the Contract or as required by the "Engineer".

#### **Contract Package for:**

##### **Signaling, Communications and Train Control**

This contract provides for signaling and automatic train control systems including equipment in the station control rooms and the Operation Control Centre (OCC) such as train mounted control equipment, relay room equipment, independent telephone networks including automatic switching centers and exchanges, main trunk cables, direct telephone lines, communication equipment, emergency telephones, closed circuit television, radio communication and all non-power SCADA system.

##### **Automatic Fare Collection**

This contract provides for the revenue control system at stations, including automatic ticket vending machines, barriers, manual control and checking equipment and electronic linkages to station control rooms and the Central Control room.

##### **Rolling Stock**

This contract provides for air-conditioned rolling stock in rakes of up to 3 coaches.

##### **Civil, E&M and VAC**

The Contract provides for Civil and E&M works including the stations & tunneling. The E&M works include stations lighting, 415V AC distribution, tunnel ventilation, station air-conditioning, fire protection system etc.

The Contractor shall co-ordinate with these Contractors for design as well as installation related issues as part of his interface responsibilities. The relevant Contractors shall be referred to as Designated Contractors in this specification.

### **13.2 Interface Responsibilities**

The responsibility for specification and provision of the requirements for the works which interface with Designated Contractor's equipment are tabulated in interface matrix given in Appendix 'A' of this PS

The Appendix "A" describes the interface requirements between Designated

Contractors, which includes Civil Contracts, E&M Contract etc. and this Contract.

This Appendix shall be read in conjunction with the relevant clauses of the Employer's Requirements. The Contractor shall be responsible for ensuring that all requirements of the specifications pertaining to interfaces are properly satisfied.

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 (IMP) after the commencement of the Works and throughout the execution of the Works to ensure that:

- a) All interface issues between the contractor and the Designated Contractors are satisfactorily identified and resolved; and
- b) All the construction tolerances at the interface shall meet the requirements of the respective specifications relating to the interface points.

Where details of the contractor's design of this contract 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 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 works.

The Contractor shall take a lead in developing the Interface Management Plan. The IMP will be prepared in conjunction with the Designated Contractors to cover all aspects of the implementation of the interface works required. The IMP will define the interface works necessary to complete all the works in this contract and is not limited to those listed in the summary table attached.

Should it appear to the "Engineer" 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 the progress of the Works, are mutually consistent and conform to other provisions of the Contract.

The Contractor shall review the details of interface works and notify the "Engineer" of any amendments to the summary table required in the process of his works. Unless such requests are reviewed without objection by the "Engineer", the Contractor shall design and construct the works in accordance with the provisions outlined in the Appendix "A".

### **13.3 Scope of Work of Interface Management Plan (IMP)**

The information and scope of works to be provided by the Contractor include but are not limited to those outlined in the Appendix 'A' of this PS. The Appendix A only defines those tasks at the interface point and is not a complete itemization of the Scope of Work

The Designated Contractors shall liaise with the Contractor in the design, installation, testing and acceptance of works.



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.

Where the Contractor's 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 "Engineer" for review and shall copy the same to the Designated Contractors.

END OF CHAPTER

# CHAPTER 14

## SITE ARRANGEMENTS

## **14. SITE ARRANGEMENTS**

### **14.1 General**

14.1.1 In addition to the general conditions and provisions of the Site as described in the General Specification, this Section of the Specification sets out the site arrangements, conditions and requirements for the delivery and installation of the elevators supplied under this Contract.

14.1.2 Methods and procedures may vary depending upon site conditions which shall be discussed and agreed with the "Engineer" during the planning and installation stage but the Contractor shall make provision for alternatives in the methods and procedures provided that the basic criteria for delivery and installation as described below remain unchanged.

14.1.3 The conditions and requirements set out in this Section of the Specification shall not relieve the Contractor of his responsibility to deliver the equipment in time to meet the approved program as defined in Chapter 21 of this Particular Specification and to install the Plant in accordance with the Specification.

### **14.2 Access and Power on Dates**

14.2.1 The Contractor shall note that no exclusive possession of the Site will be granted. The Contractor will be required to work with the Designated Contractors, the Interfacing Contractors and other contractors.

14.2.2 The Contractor shall take note of the access and power on dates shown in the "Engineer" Preliminary Programme and Project Calendar. Except approved by the "Engineer", the Contractor shall not have exclusive access to the designated areas.

### **14.3 Works Areas**

14.3.1 The Contractor shall coordinate with the Designator Civil Contractor for the works areas allocated within the site in which he may erect offices, workshops and stores. The area allocated for the Contractor and the period of availability are shown in Appendix 'C'.

14.3.2 The Contractor shall allow for transportation of all materials and equipment to the Works Areas and from the Works Areas to the Site.

14.3.3 The Contractor shall note that works trains are not intended for transportation of material and equipment except to those locations where road access would not normally be available. The Contractor shall coordinate with the relevant Designated Civil Contractors for delivery of major equipment by road access.

14.3.4 General attendance and other services will be made available at the Works Areas in accordance with the General Specification.

14.3.5 The Contractor shall be responsible for the cleanliness and tidiness of the Site after each period of work.

14.3.6 The period within which the area will be available to the Contractor is shown in Appendix 'C'. The Works Area shall be returned to the Employer no later than the date specified for the completion of the Works. The Contractor shall remove all facilities erected by the Contractor at the Works Areas before returning the Works Area to the Employer.

#### **14.4 Delivery**

##### **14.4.1 Methods of Delivery**

The method of delivery of elevators to site shall be by road, and access to the Works Areas through a station entrance, and/or temporary access openings if provided, and via a route within the Site. The Contractor shall be responsible for arranging access into the Site with the Designated Contractors for the stations' works. The Contractor shall co-ordinate the routes and time of entry into the stations with the Designated Contractors. The delivery route within the stations shall be agreed between the Contractor and the Designated Contractors. The access plan of each station shall be submitted for the "Engineer" Approval.

The locations and size of the access openings and the size of working area around each opening will depend on site and local traffic conditions and shall be agreed by the "Engineer". The method of delivery for each station shall be governed by the overall installation programme of Lucknow MRTS and be subject to the "Engineer" Approval, whose decision shall be final.

##### **14.4.2 Delivery, Access to and Through the Site**

The Contractor shall make provisions to deliver his equipment by vehicles into the working area around the access opening. In the event that the working area is not large enough or the local traffic conditions cannot permit any container vehicle to gain access into a particular working area during normal working hours, the Contractor shall make arrangements to deliver the equipment by trucks and unload the equipment within a limited working area allocated by the "Engineer".

When it is unlikely that a mobile power crane can be used within the vicinity of the access opening due to restricted site conditions, the Contractor shall arrange to maneuver his Plant by smaller traction equipment from the unloading working area into the access opening and Works Areas.

Transportation, unloading and delivery equipment such as hoisting frames, gantries, lifting tackles, chain blocks, trolleys etc., required for delivery, shifting and equipment access to the Works Areas shall be provided by the Contractor, unless otherwise specified herein or as Approved by the "Engineer".

The Contractor shall provide a Schedule of major deliveries of Plant for each station to the "Engineer" at least 2 months prior to the first delivery.

Each elevator shall preferably be hoisted into position in the hoistway immediately after delivery to Site. Long period of storage inside the station will not be allowed, unless written permission has been received from the "Engineer".

The Contractor shall provide adequate means to protect completed architectural finishes during delivery and shall make good any damage caused by delivery of the equipment.

## **14.5 Installation**

14.5.1 It is desirable that the installation time of Elevators on Site shall be kept to a minimum and the proposed design shall take due account of this requirement.

14.5.2 The Contractor's attention is drawn to the restrictions on working area available on Site and shall make his own arrangements to store materials and equipment off-site or at the Depots until such time as they can either be incorporated into the Works or stored within the working area assigned to him.

14.5.3 The Contractor shall co-ordinate with the Designated Civil Contractor for the hoisting points and confirms acceptability before commencing installation. When it is not possible to provide such hoisting points due to its particular location. In such case, the Contractor shall provide suitable hoisting frame, gantries or the like for hoisting. Safe working load of such equipment shall be stated and relevant testing certificates shall be submitted for the "Engineer" Approval.

14.5.4 All other lifting equipment such as lifting tackles, chain blocks etc., required for installation purposes shall be provided and installed by the Contractor.

## **14.6 Care of Works**

14.6.1 The Contractor shall protect the equipment within his own reasonable control,

particularly in normal construction site conditions such as dust, dirt, plastering and small particles which may possibly damage the equipment, stainless steel decking and panels, if they are not properly protected. Such damage, if occurring, shall not relieve the Contractor of his responsibility to repair and/or replace these parts, depending on individual conditions, to the satisfaction of the "Engineer".

- 14.6.2 The contractor shall provide adequate protection to the Elevators during the Stop Work Period and before handing over of the complete installation to the Employer.  
The protection shall not be removed unless instructed by the "Engineer".

## **14.7 Material Recovery**

- 14.7.1 The Contractor shall remove all redundant materials and cables from Site. The Contractor shall handle all redundant equipment with care and deliver to a location designated by the "Engineer" where it shall be stored in a neat and orderly fashion.

- 14.7.2 Recovery work shall occur after the completion of every stage of the above mentioned Works and as directed by the "Engineer".

END OF CHAPTER

## CHAPTER 15

### PACKAGING, SHIPPING AND DELIVERY

## **15 PACKAGING, SHIPPING AND DELIVERY**

### **15.1 General**

15.1.1 All the stipulations laid down in the GS shall apply.

### **15.2 Packaging and Shipping**

15.2.1 All equipment Goods and materials shall be properly inspected to ensure that there are no defects before shipment. An inspection tag bearing the words "INSPECTION PASSED" giving reference number to the inspection date and details to permit verification of inspection details shall be attached to those items inspected satisfactorily.

15.2.2 The four adjacent sides of each package shall be marked with permanent paint with the following information:

CONSIGNEE

COMMODITY

CONTRACT No

SHIPPING MARK

15.2.3 Appropriate caution notices such as "FRAGILE", "HANDLE WITH CARE", "KEEP DRY", "KEEP UPRIGHT" along with visual display symbols internationally accepted shall be conspicuously displayed on the outside surfaces of boxes, crates and packages.

### **15.3 Delivery**

15.3.1 The Contractor shall be responsible for transportation and delivery of materials to site or to the storage space and shall continue to be responsible for its safe storage, handling, erection and commissioning.

END OF CHAPTER



## CHAPTER 16

NOT USED

## CHAPTER 17

# MAINTENANCE REQUIREMENTS

## **17. MAINTENANCE REQUIREMENTS**

### **17.1 Maintenance**

In addition to his obligations under the Conditions of Contract, the Contractor shall provide maintenance services throughout the Defects Liability Period (DLP) and also for the specified period for all the elevators supplied under the Contract. Maintenance work shall include attendance to all service calls, work described in approved Maintenance Schedule, and the followings:

17.1.1 All defects shall be remedied either when observed on the weekly service call or on an attendance to a service call. Service shall include all work necessary to maintain the entire elevator system in good working order at all times.

17.1.2 The Contractor shall maintain adequate quantity of consumable and contingent spare parts as per agreed list at site in order to minimize the shut down time due to repairs and maintenance. All parts rendered defective, including replacement of indicator lamps and programmable circuit board, shall be replaced by the Contractor. The list of these consumable & contingent spares (DLP spares), tools and ~~mandatory spares~~ are enlisted in appendix "E". Any additional spares, tools and test equipment are required the same may be indicated by the Firm in their Technical Offer. The employer may revise the list of spares in proportion to the elevators quantity proposed by contractor at the time of submission of the Preventive Maintenance Schedule (PM) & Corrective Maintenance (CM) procedure, as mentioned in 17.1.10. Bidder is advised to follow the Spare Policy.

17.1.3 The Contractor shall mobilize competent personnel to rectify stoppages at any time during the day or night when being called on by the Employer within a time of half an hour (maximum). Repairs shall be carried out on a 24 hours per day, 7 days per week basis until the faulty unit / elevator is put back in service.

17.1.4 The Contractor shall carry out periodic testing and examination of equipment safety devices as may be required by the provisions of any enactment in force relating thereto or of any enactment, regulations or by-laws of any local or other duly constituted authority which may be applicable to such tests and to provide such copies of the test certificates, duly signed by a Registered Elevator "Engineer" and Registered Elevator Contractor, as may be required. A master schedule of such planned tests shall be submitted to the Employer at least two months before commencement of the DLP.

- 17.1.5 The Contractor shall submit the quarterly and half-yearly reports on the condition of the equipment in an agreed format (format will be finalized during design stage). If a defect appears or damage occurs during the relevant DLP, the contractor and the Employer's representative shall jointly inspect the Elevator. Such reports shall include event logs and performance data collected from the associated indicative panel stored on Pen Drive or other agreed medium, over the reporting period. Such data shall enable off-line individual and fleet statistical analysis to be performed on a lap-top Personal Computer supplied by the Contractor.
- 17.1.6 A report in duplicate shall be sent to the Employer immediately following every call out, indicating the time of call out visit, cause, remedial action taken and the time that the service was restored. The monthly summary of failure report along with the analysis giving details of nature of fault, remedial action taken etc. in the approved format shall be provided.
- 17.1.7 Reports on routine visits are not required except where necessary to draw attention to defects of a minor nature, which could not be rectified during the routine visit. Records of each routine visit and call-out visit, together with details of the work done or action taken, shall be entered on a log book which shall be provided by the Contractor and retained in the location as decided by the "Engineer".
- 17.1.8 Before the expiry of the Defects Liability Period, the Contractor shall perform a loading test for each elevator to re-confirm that the function of the system is being met and shall undertake corrective adjustment if necessary. This test may be incorporated into the half-yearly equipment survey maintenance works.
- 17.1.9 The Contractor shall provide a maintenance plan and a major component replacement programme for review and acceptance by the "Engineer" 90 days before the programmed commencement of the Defects Liability Period.
- 17.1.10 The Maintenance service shall include all Preventive/Scheduled & Corrective Maintenance. In this context, the Contractor shall submit a PM Schedule and CM procedure for Approval, 3 months before the commencement of the DLP.
- 17.1.11 In order to ensure that the system will meet the RAM targets and Customer Service requirements using the minimum resources, the Contractor shall

conduct a detailed Maintenance Requirement Analysis to derive a complete list of preventive maintenance schedules and procedures under the Contract. The Maintenance Requirement Analysis shall identify for each system function the potential functional failures, the failure consequences and the appropriate maintenance approach. RAM analysis shall be submitted quarterly during 2 years DLP.

Based on the Maintenance Requirement Analysis, the Contractor shall indicate in the Maintenance Plan, the final preventive maintenance programme, the proposed skill and manning level, spares level and special tools require. The proposal shall be fully traceable to the maintenance Requirement Analysis output.

The Maintenance Requirement Analysis shall be submitted as part of the maintenance plan, under the main contract tender submission. However, tenderers will be allowed to defer submission of this Analysis, latest 12 months before the commencement of the Defect Liability Period, by presenting formal written request for such deferral.

#### **17.1.12 Accommodation for Emergency Service Report Centre**

An Office of approximately 10sq.m will be provided by the Employer as the emergency service report centre. The Premise will be located at (4-5 Places in the Lucknow MRTS network) on the stations as determined by the Employer.

### **17.2 Employer's Maintenance Strategy**

#### **17.2.1 Maintenance Strategy**

The Contractor shall ensure that the system designed, installed and commissioned is supportable throughout the service life of the System to address, as a minimum, the following:

Design errors in the System;  
Operational changes;  
Environment changes; and  
Changes in infrastructure.

According to the maintenance strategy, all equipment and infrastructure supplied for the 'Project' must be designed for minimum or no maintenance. Maintenance activities required must be capable of being performed with little or no impact on the train service. In addition, the maintenance work systems shall ensure safety of personnel and equipment.

- 17.2.2 The Contractor, upon noticing any defects, deficiency in quality and quantity of spares and materials shall without delay, arrange for alternative source of supply and submit his proposal to the "Engineer" for review.

### **17.3 Maintenance during DLP**

During the 2 years' DLP period, the contractor shall carry out all type of preventive and breakdown maintenance. The preventive maintenance would be done during non-traffic hours whereas breakdown maintenance would be done whenever breakdown occurs. The contractor should post his supervisor and maintenance staff at a key places (4-5 Places in the Lucknow Metro network) on the stations as determined by the Employer.

The acceptable response & attention time also needs to be mentioned for minor & major breakdowns.

#### **17.3.1 Maintenance Management System (MMS) and Maintenance Arrangement**

During non-operation time, sections of line will be closed for maintenance work. The minimum time for possession periods is 6 hours. Ideally, this time shall be the free time available for maintenance.

#### **17.3.2 Competency of Personnel**

During the DLP the Contractor shall depute sufficient trained and competent personnel for maintenance purpose.

Such persons shall have their generic competence established and must demonstrate their specific competence and knowledge in the particular systems, environment and procedures.

The Contractor shall provide evidence of specific competence and knowledge, which shall include:

- assessment and certified training in particular applications and operations;
- recording of competence and work in the license holders logbook; and

- receiving or in receipt of sufficient and current exposure to the area of work that the holder is licensed for.

Routine spot checks on licensing may be carried out from time to time by the "Engineer" qualified personnel on the proficiency of the Contractor staff.

In the event of a failure, the Contractor shall undertake the management and investigation necessary to identify and rectify the cause.

#### 17.3.3 Testing and Re-commissioning of System and Equipment

In the event of a failure requiring modifications to the System, the Contractor shall undertake any testing and re-commissioning required. Any such modification shall be submitted for review by the "Engineer".

#### 17.3.4 Temporary Alterations to Restore Service

The Contractor shall undertake any temporary modifications necessary to maintain service. Any such modification shall be submitted for review and acceptance by the "Engineer".

#### 17.3.5 Discrepancies between Installation and Design Records

Should the Contractor discover inconsistencies between the maintenance drawings and documentation and the installed equipment, the Contractor shall correct all such errors within two weeks.

#### 17.3.6 Communications

The Contractor shall ensure that adequate communication facilities are provided to its staff during the DLP.

#### 17.3.7 Location of Staff

The Contractor shall be responsible for locating staff such that the Contractor meets its obligations.

#### 17.3.8 Storage of Equipment and Materials During the Maintenance Period

The Contractor shall ensure that no equipment is stored along the trackside.

The Employer will provide defined storage locations for the support of the different levels of Maintenance.

The Contractor shall satisfy itself and the "Engineer" that the storage

locations for equipment and materials will meet the performance requirements of this PS.

#### 17.3.9 Maintenance Regimes

The Contractor shall produce a maintenance regime for the equipment that shall comprise two constituent parts, corrective and routine/preventative maintenance.

Corrective maintenance shall be available 24 hours per day, able to respond to all foreseeable circumstances.

The maintenance regime shall cover all parts and equipment of the system designed, installed and commissioned by the Contractor.

The Contractor shall take into account the requirements of the operations and maintenance when determining and proposing its maintenance regime.

#### 17.3.10 Scope and Hours of Coverage

The regime and structure of corrective maintenance shall be robust in design.

The Contractor shall provide full 24 hour On-Call coverage and shall be such that initial response and rectification of failure are in accordance with the following:

- assistance for first line corrective maintenance within 30 minutes, upon request of first line maintainer;
- Within 24 hour from notification for second line maintenance where spare parts replacement is involved; and
- Within 2 weeks including transportation time for third line maintenance where replacement or repair of component from factory is involved. Any extension to this time shall be agreed with the "Engineer" and a replacement provided.

All elements of First Line preventative maintenance shall be carried out and completed during non-traffic hours without interrupting train services. Similarly, all elements of second line & third line maintenance also needs to be completed during non- traffic hours.

#### 17.3.11 Failure Investigations

The Contractor shall conduct failure investigations.

Disputes between the Contractor and other Contractors will be resolved by the "Engineer".



The Contractor shall make available to the Employer all test and failure data as required.

## **17.4 Software Support**

### **17.4.1 General**

The Contractor shall submit to the "Engineer" for review, the software support plan at least 90 days before commencement of software installation.

Employer will have the right, for multiple use of the Software. Employer at his discretion may download the software on multiple PCs as per the requirement. For this purpose, no specific password, Key Number etc should be required from the Contractor / Software firm.

All changes, bug fixes, updates, modifications, amendments, new versions shall not result in any non-conformance with this Specification.

The Contractor shall submit all new versions to the "Engineer" for review at least 2 weeks prior to their installation.

The new versions of software shall not degrade the operation of the System.

### **17.4.2 Security Obligations**

Within 14 days of the installation of any software into the Permanent Works by the Contractor, the Contractor shall submit to the "Engineer" for retention by the Employer two backup copies of the software, which shall include any specified development tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers.

Any software item delivered by the Contractor to the "Engineer" pursuant to the above Paragraph shall not be translated or modified by the Employer without the prior consent of the Contractor unless:

- the owner of the software becomes insolvent or has a receiving order made against it or makes an arrangement or assignment or composition with or in favor of its creditors (including the appointment of a committee of inspection) or goes into liquidation or commences to be wound up or has a receiver, liquidator, trustee or similar officer appointed over all or any part of its undertaking or assets or if distress, execution or attachment is levied on, or if an encumbrance takes possession of, any of its assets or any proceeding or step is taken which has an effect comparable to the foregoing in any relevant jurisdiction; or
- the owner of the software ceases to trade; or

- the owner of the software assigns copyright in the software and the Contractor fails within 60 days of such assignment to procure in favor of the Employer, a license from the new owner in the same terms as that required by the Contract; or
- The Contractor is in breach of any of his obligations under the Contract.

#### 17.4.3 Error Correction

The Contractor shall inform the "Engineer" immediately when a fault is discovered within delivered software or documentation.

On receipt of a request from the "Engineer" for identification or further diagnosis of a failure or fault, the Contractor shall provide appropriate resources.

The Contractor shall provide written details as to the nature of the proposed correction to the "Engineer".

#### 17.4.4 Training

The Contractor shall provide training for Employer's staff to enable the Employer to make proper use of any new versions.

#### 17.4.5 Fixes or Patches

The Contractor shall notify the Employer promptly of any fixes or patches that are available to correct or patch faults.

The Contractor shall detail any effect such fixes or patches are expected to have, upon the System.

#### 17.4.6 New Versions

The Contractor shall ensure that all new versions are fully tested and validated on the simulation and development system prior to installation.

The Contractor shall ensure that all new versions are fully tested and commissioned once installed on the Site.

The Contractor shall deliver to the Employer any new version, together with the updated Operation and Maintenance Manuals.

The Employer shall not be obliged to use any new version and that shall not

relieve the Contractor of any of its obligations.

Any effect upon the performance or operation of System that may be caused by a new version shall be brought to the Employer's attention.

#### 17.4.7 Routine and Corrective Maintenance Procedures

Routine and corrective maintenance procedures shall be supplied for all equipment. The format shall be as follows:

- Uniform format and layout irrespective of equipment supplier;
- Colour coding for each activity;
- Cross referenced to the Operation and Maintenance Manuals; and
- Document control information.

#### 17.4.8 Operation Activities

All operational activities shall comply with the Employer's safety rules, and requirements of the Operation and Maintenance Manuals. The Contractor shall recommend in detail the frequencies for preventive and corrective maintenance, and what items of work are to be carried, including but not limited to the following;

- Step-by-Step procedure to carry out the task;
- Diagrams and flow charts for illustration, if applicable; - Precautions for the maintenance personnel to follow; and
- Estimated duration and manpower required.

#### 17.5 **Not used**

#### 17.6 **Not Used**

#### 17.7. **Service Performance Requirements.**

The Contractor shall mobilize competent personnel to rectify stoppages at any time during the day or night when being called on by the Employer's representatives within a time of thirty Minutes. Repairs shall be carried out on a 24 hours per day, 7 days per week basis until the faulty unit / elevator is put back in service. The contractor shall ensure to achieve following Service Performance during DLP: -

S.N.	Service Performance Requirements during DLP	
1	Reliability (MTBF) Mean Time between Failure	≥ 7 days
2	Availability	≥ 99.9%

3	Maintainability (MTTR: Mean Time to Repair)	≤ 4 hrs
4	Call out Ratio (per Elevator per Year)	≤ 2 calls
5	Response Time	≤ 30 Minutes

### 1. Reliability:

Reliability measure for the Elevators is Mean Time Between Maintenance Action (MTBMA). MTBMA shall be calculated for each calendar month separately and MTBMA calculation shall be done based on the total number of Elevators operational on 01st day of that applicable month. The Preventive Maintenance Action is also included in this for Calculation of MTBMA. If contractor fails to comply above conditions of MTBMA (i.e. MTBMA less than 7days) then Penalty of INR 15,000/- shall be imposed.

**2. Availability:** Availability will be calculated as under: -

$$= \frac{(Availability Hour - unavailability Hours)}{(Availability Hours)}$$

$$Availability = \frac{\{(365 \times 20 \text{ hrs.}) \times \text{No of lift population in section}\} - \{\text{Total Unavailability hrs. in one year}\}}{\{(365 \times 20 \text{ hrs.}) \times \text{No of lift population in section}\}}$$

If contractor fails to comply above conditions of Availability (i.e. Availability less than 99.8%) then Penalty of INR 15,000/- shall be imposed. For the purposes of calculation of "Availability Hours", the Contractor shall assume that the service operating hours are 20 hours per day (06:00 hours of morning to 23:00 hours of midnight or as decided by Employer). For the purposes of calculation of "Unavailability Hours", breakdown time in above said service operating 20 hours shall be considered. For Example, if Elevator gets breakdown (not available for operation) at 18:00 Hr (in the evening) and Contractor put back in operation in next morning at 06:00 Hr then only 5 hours (23:00 Hr -18:00\_Hrs) will be considered as unavailable Hours, Means non-operation time will not be considered as unavailable hours for calculation.

### 3. Mean Time To Repair (MTTR)

MTTR time measurement shall include response time, on site diagnostics and rectification of the failure up to point that the system is restored to full functionality. In the event that the failure cannot be rectified, the measurement shall include the time necessary to remove the failed piece of equipment from the system and replaced it with a functioning module. The maintainability shall measure by fault rectification time, which should not exceed 4 hours since its reporting to contractor's call center and/or to his authorized person by NCRTC or/and its representative(s). If contractor fails to comply above conditions of MTTR (i.e. MTTR more than 4 hours) then Penalty of INR 15,000/- shall be imposed.

### 4. Call Out Ratio:

There should not be more than 02 (two) service engineer visits per year for any particular elevator. The period of one year will commence from date of Revenue Operation / Taking over whichever is later. If the visit of service engineer for break-down maintenance exceeds 2 per Elevators per year, then a penalty of Rs. 15,000/- (Rs Fifteen Thousand Only) shall be imposed for each-such visit which is as per Jurisdiction of Employer.

**Note: The Contractor shall submit a Quarterly Performance Report along with the Payment Invoice, giving the details actual performance achieved on monthly basis in an approved format with specific reasons if any of above mentioned target does not met, duly signed by Employer representative(s). If contractor fails to comply with anyone above performance targets of Reliability, Availability, MTTR and Call out Ratio, then penalty of Rs 15,000/- for each non-compliance target Per month shall be imposed.**

In addition to above, If anyone of Elevator is kept out of service for more than 24 hrs due to non – availability of spares or due to lack of proper attention, then Employer shall impose an additional penalty of INR. 15,000/- (INR. Fifteen Thousand Only) per day, for each such case.

The Employer will assess the reasons for the equipment not being in service, accordingly, the penalty will be imposed. The Employer decision is final. Please note that for a period of First Three months from date of Revenue Operation, the values of Reliability, availability, Maintainability, call out Ratio will be calculated and monitored, but No Penalty will not be admissible. After, Three months from the date of Revenue Operation, Penalties as specified above in the respective paras above will be applicable.

END OF CHAPTER

# CHAPTER 18

## SPARES, SPECIAL TOOLS AND TEST EQUIPMENT

## **18. SPARES, SPECIAL TOOLS AND TEST EQUIPMENT**

### **18.1 General**

18.1.1 The Contractor shall note the requirements stipulated in the General Specification and Spare Policy as provided at Appendix-E of this PS.

18.1.2 The Contractor shall supply all spares, special tools and test equipment to facilitate the maintenance, repair and overhaul of the elevators effectively and efficiently while ensuring their performance to a high standard of safety and reliability consistent with the requirements as detailed in this Specification. The details and policy for various spares, tools and test equipment required has been provided in Appendix – E. Any additional spares, tools and test equipment are required the same may be indicated by the Firm in their Technical Offer.

18.1.3 All spare parts shall be identical to the equivalent installed items and strictly interchangeable, be suitable for use in place of the original parts fitted and comply with this Particular Specification and the tests specified therein.

18.1.4 They shall be suitably marked and numbered for easy identification and shall be packed for long storage in wooden boxes in suitable groups for easy maintenance. While necessary parts shall be coated in protective material to prevent deterioration.

18.1.5 In the event that rectification and/or modifications are introduced to any part of the equipment which are deemed necessary by the “Engineer” in order to comply with the Specification requirement, the Contractor shall modify and replace all spare parts and/or special tools whether delivered or otherwise.

18.1.6 The Contractor shall guarantee that the test equipment supplied shall be well calibrated in accordance with manufacturer's instruction. Appropriate calibration certificates shall be required by the “Engineer” for checking prior to carry out testing and commissioning.

### **18.2.1 DLP Spares**

The Contractor shall recommend and provide a list of commissioning and DLP spares with sufficient quantities to ensure the successful completion of the testing and commissioning activities and covering of DLP. Details are provided in Spare Policy at Appendix-E of this PS.

**18.2.2 Unit exchange**

Details are provided in Spare Policy at Appendix-E of this PS.

**18.3 Test Equipment**

18.3.1 Not Used.

**18.3.2 Portable Test Equipment**

Portable laptops computer shall be provided to allow rapid verification of satisfactory operation of a sub-system, assist in trouble shooting and isolating sub-system failures. Portable laptops computer shall not require any mechanical or electrical disconnection to or within the sub-system under tests. Two set of laptops computer with desired software (software of downloading the reading of EVA meter also) for the Lift contract specified at clauses 18.3.2 shall be provided by the Contractor. The detailed specifications for Laptop or palmtop to be got approved from the "Engineer". Latest Specification of Laptop shall be as per Employer requirement compatible to the downloading facilities of Fault codes from the Elevators Control Panel with necessary software including of Software of EVA Meter.

**18.4 Special Tools (EVA meter and others)**

18.4.1 The Contractor shall supply all necessary tools for normal as well as emergency rescue operation and for maintenance purpose including tools such as EVA meter (1 unit), brake releasing devices and hand winding devices, all other keys for the key operated switches such as the key to open the Auxiliary Switch Cabinet, 3 set of keys for each elevator shall be provided by the Contractor at the time of handing over to Employer for trial Operations.

18.4.2 The Provision of the special tools used during erection testing and commissioning under this part of the Particular Specification shall be deemed to have been included in the Contract and shall be handed over to the Engineer when the Elevators installations are completed.

18.4.3 Certain items of these special tools shall be fixed on to a shadow board or



housed in a container mounted at an approved location. Details of the arrangement will be given to the Contractor by the Engineer during the installation stage.

- 18.4.4 The Contractor shall supply one complete set of any special tools not covered under annexure-7 of appendix E for each type of elevators per station that are necessary for routine maintenance to be carried out. These tools shall be supplied in a suitable hard wood or steel toolbox. Tools shall be of Latest Model, its specification shall be submitted for approval by Engineer/ Employer.

## **18.5 Availability of Consumable Spares during Defect Liability Period**

- 18.5.1 Consumable Spares shall be provided as per Spare Policy given at Appendix-E of this PS.

- 18.5.2 Deleted

## **18.6 Not used**

## **18.7 Second Sourcing for Non-Proprietary Items**

- 18.7.1 The Contractor shall identify principal source suppliers that can supply the Mandatory Spares. For non-proprietary items the contractor shall submit the list of alternate / second source of suppliers.

- 18.7.2 The Contractor shall ensure that second-source supplier information is maintained up to date up to a period of 10 years after taking over of whole works. The Contractor will provide support to the Employer to a reasonable extent regarding the second-source supplier information throughout the service life of the system.

- 18.7.3 The Contractor shall make the second-source supplier information available to the "Engineer" at the time of submission of the final design and taking over of the works.

## **18.8 Long Lead Times**

- 18.8.1 The Contractor shall identify the lead times for all spare parts. Parts with long lead times shall be identified in the spares list.

**18.9 Routine Change**

- 18.9.1 In the event that any item of the supply requires to be routinely changed or calibrated, regardless of whether it appears in the spares list or not, it shall be identified to the "Engineer" together with the routine change interval.

**18.10 Shelf Life**

- 18.10.1 In the event that any of the spares identified have a particular life or storage requirement, this shall be made known to the "Engineer" with the submission of the spares list, including the necessary action for disposal or storage.

**18.11 Price of AMC Charges**

The Contractor shall furnish price for 1 (One) years AMC rates beyond the DLP. The details shall be provided in statement 8 of BOQ (Pricing Document –vol-7). For This AMC period, the contractor shall furnish a separate performance Bank Guarantee from a scheduled commercial Bank in India for a value of 5% of total contract value (Including one year AMC cost), in the format of Performance BG, Schedule-2 of SCC). The Bank guarantee shall be submitted one month before completion of DLP and valid upto 28 days beyond completion of one year AMC period.

**18.12 Vendor Approval Policy**

Refer Appendix-F of this PS for vendor approval Policy.

**END OF CHAPTER**

## CHAPTER 19

### TRAINING AND TRASFER OF TECHNOLOGY

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**19 TRAINING****19.1 General Requirements**

19.1 This section of the specification covers the requirements for a Training Program to train the Employer's maintenance, operations and training personnel. The training Program shall enable the staff to operate, service, enhance, maintain, and interact with, the hardware, software, and firmware, such that the elevator systems and associated equipment will perform in accordance with the specifications of this contract.

The Contractor shall provide comprehensive training to the Employer's staff, including Employer's training Instructors. The Contractor shall provide competent training instructors, training manuals, all necessary aids and materials in support of all training courses. The training manuals shall be submitted in original plus five hard copies and in electronic format.

The training instructors shall be qualified, competent, with sufficient years of practical experience in the relevant fields and possesses good communication skills.

The training instructors shall be competent staff of the Contractor, or the subcontractors or the equipment manufacturers.

19.1.2 The training shall be carried out at such locations where the greatest benefit for trainees may be gained. This may be in India, abroad, at place of manufacture, assembly or testing, or at such other locations as may be necessary. All places of training shall be subject to review by "Engineer".

19.1.3 The training courses and/or sessions shall include system performance requirements and all major equipment and works designed, by the Contractor.

19.1.4 The Contractor shall provide full-time on-Site management and co-ordination of the entire training programme to ensure the continuity of classes, and proper distribution of training materials, and be responsible for interfacing with the instructors.

19.1.5 The training courses shall be delivered to all relevant Employer's staff, including instructors, operation and maintenance engineering staff.

**19.2 Scope of Training**

The training shall be provided by the Contractor to the Employer's personnel in design Operation and Maintenance, manufacturing, testing, system architecture and installation practices related to elevators. This will cover training in India and abroad including training at manufacturing facilities.

### 19.3 Training Programme

Contractor shall submit a training programme for imparting training to UPMRC employees with batches of approximately 20 trainees for Elevator systems in following areas:

S. No	Description	Total Period (Trainer working days)	Remarks
1	Design of Elevator	05	During the Design Stage
2	Manufacturing facilities, Testing methods and procedures, Working MRTS installations. Short Module course on System description, architecture etc., for Elevators.	10	During manufacturing at factory premises and other locations.
3	Installation and site testing practices for Elevators	20	During installation & commissioning phase
4	Elevator control & monitoring system, troubleshooting, fault diagnosis, emergency handling, etc.	15	At existing installation in other MRTS or similar sites.
5	Operation and maintenance practices for Elevators including trouble shooting, fault diagnosis and emergency handling.	20	At suitable locations

### 19.4 Training Plan

The Training Program shall be prepared and submitted by the Contractor as per requirements of GS.

### 19.5 Training Courses

19.5.1. The Contractor shall provide Training Courses on all facilities, systems, equipment, hardware, and firmware, software. Each Course shall be specific, and shall consist of classroom, hands-on, or field training as necessary to accomplish the Course Objectives specified in the Training Program Plan.

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- 19.5.2. All station operation & security staff needs to be trained in emergency handling.
- 19.5.3. All training aids shall be used during training followed by practical & demonstrations.
- 19.5.4. Trainer's kit may be used for imparting training in trouble shooting.
- 19.5.5 The Contractor shall provide training courses for each of the sub-systems, including, but not be limited to:
- (i) Elevator Control and Function system
  - (ii) Elevator drive system
  - (iii) Elevator Control & monitoring system

Different types of training courses of each subsystem shall be provided for staff from different disciplines. Operations training courses shall be provided for the operations staff. Maintenance courses shall be provided for maintenance staff. Hands on training shall be provided to maintenance staff by simulating different problems & their troubleshooting. The Employer's Training Instructors shall attend all types of training courses such that the Employer's Training Instructors shall be able to subsequently train the Employer's additional staff in future in all aspects of operation and maintenance of the System.

## 19.6 Training Materials

The Contractor shall provide all Training Aids, Interactive Training Video Pen Drive, Training Materials, Training Devices, Special Tools, fixtures ,models, or other equipment required to train Course participants.

Contractor shall provide Simulator as per specifications given in Chapter-6 of this PS.

Training Manuals are a convenient source document for use in the field.

For every lecture hand – outs with Interactive Training Video in Pen Drive should also be given. The Contractor may prepare Training Manuals bi-lingual (i.e. in Hindi and English both) as per requirement of the project.

Training Manuals shall be separate from Operation and Maintenance Manuals.

The Contractor shall prepare Training Manuals, and submit them to the Employer for review and approval at least 60 days prior to the start of the Training Demonstration.

Throughout the Contract and DLP, it shall be the responsibility of the Contractor to supply the Employer with all changes and revisions to the Training Manuals.

Training Manuals shall become the property of the Employer.

The Contractor shall provide the master and five hard copies of the Training Manual as directed by "Engineer" for each course/subject.

The Employer reserves the right to copy all Training Manuals for use in Training Courses.

The contractor shall give complete training plan for each category of O&M staff well in advance before commencement of training which shall contain training details, training methods, training aids, profile of instructors etc. At least one copy of the training manual shall be submitted 3 months before the commencement of the training.

The Contractor shall, for each course, distribute one set of training handout for each trainee, one sets of trainer's guide and three additional sets of training handout to the Employer before the commencement of the training course.

All the training materials shall be accurate and match with the actual design of the System. All types of audio/visual aids shall be used during the training. The O&M staff shall be trained to cater all types of emergency situations.

#### **19.7 Transfer of Technology (TOT)**

Tenderer shall submit the detailed plan of transfer of technology along with MOU with suitable Indian companies or company having proven track record and are working in related areas for all major systems/subsystems. TOT shall be essential and shall include system assembly, installation, maintenance and software modification/customization and training of Indian Company's personnel to cover; All configuration/application programmes for Elevator system for:

Engineering of extensions and upgradations of stations.

Re-engineering to suit changed application conditions.

Incorporation of additional features.

Incorporation of optional facilities.

Addition /Modifications to equipment and components

Maintenance of Elevators.

Change in parameters of any of the Elevator equipment in stations.

The Transfer of Technology may require involvement of Indian Company's personnel in design, manufacturing, testing and installation of Elevator Sub-Systems during the Contract period. The Contractor shall undertake to supply

or make arrangement with the original manufacturer to supply additional equipment required for replacement or upgradation of the Elevator systems in future. The Contractor shall undertake to provide to the above Indian Company, during the life of the equipment ordered technical assistance in the form of additional drawings, maintenance practices and technical advice.

END OF CHAPTER

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# CHAPTER 20

## OPERATION AND MAINTENANCE DOCUMENTATION

## **20 OPERATION AND MAINTENANCE DOCUMENTATION**

### **20.1 General**

20.1.1 The Contractor shall provide Operation and Maintenance manuals bi-lingual (i.e. in Hindi and English both), Interactive Training Video in Pen Drive As built drawings for use by supervisory, operating and technical staff of Employer.

20.1.2 Requirements of submission have been furnished in Chapter 11 of GS.

#### Requirements of Interactive Manual

The contractor shall submit in English language Interactive Electronic Technical Manuals (IETMs) to manage technical documentation. IETMs shall compress volumes of text into Hard-disks which may include sound and video and shall allow readers to locate needed information rapidly than in paper manuals.

This IETM shall follow the structure and format of a printed book, with indexes and table of contents that are hyperlinked into the content of the document. All figures, tables and section references shall be linked.

The data to be stored in a relational database, obtaining benefits of data integrity and removal of data redundancy. Relationships in the content that are presented as hyperlinks, are mapped directly to relations in the database scheme. The IETM shall be able to change the content dynamically based on users navigation and input through the content; the content may now be user specific.

20.1.3 Each and every manual shall be divided into indexed sections explaining the subject matter in logical steps. Most manuals shall consist of A4-size printed sheets bound in stiff-cover wear-resistant binders clearly and uniformly marked with the subject matter and reference number. Where alternative sizes are proposed, (e.g. A5/A6 pocket books of schematic wiring diagrams) these shall be submitted for review of Employer' Representative. The binding shall allow for all subsequent changes and additions to be readily effected.

20.1.4 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.

20.1.5 The Contractor shall provide clarifications and amendments to the Operation and Maintenance manuals as necessary during the Defects Liability Period or in AMC period(if applicable). Updates shall be provided for the originals and all copies.

20.1.6 The first draft of operation & maintenance manuals are to be provided at least 60 days before the installation commences. These should be corrected as per employer's comments and finally be submitted during installation and commissioning.

20.1.7 Hard copy as well as electronic copy should incorporate colour photos, colour sketches and drawings in pictorial form wherever possible.

## **20.2 Operation Manuals**

20.2.1 The Contractor shall provide operation manuals explaining the purpose and operation of the complete system together with its component subsidiary systems and individual item of equipment. The characteristics, ratings and any necessary operating limits of the Equipment and Sub-systems shall be provided. The Operation Manuals shall focus on operation aspects under normal and emergency conditions. The operation manual shall be supplied at the same time when training manuals are supplied.

## **20.3 Maintenance Manuals**

20.3.1 The Contractor shall provide 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.

20.3.2 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 by the "Engineer".

20.3.3 The maintenance manual shall also include an illustrated parts catalogue of all plant supplied and shall contain sufficient information to identify and requisition the appropriate part by maintenance staff. The catalogue shall comprise 2 sub-sections.

20.3.4 The first shall be an alphanumeric parts list, which shall include the following information:

- (i) Part number
- (ii) Description
- (iii) Name of manufacturer
- (iv) Quantity and Unit
- (v) Part number of next higher assembly (usually a line replaceable unit).

- 
- (vi) Cross-reference to figure number.
  - (vii) Category: e.g. consumable, line replaceable unit, repairable.
  - (viii) Life-expected life, Mean time between failure or mean distance between failure where available.
  - (ix) General or specific purpose

20.3.5 The second is 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.

20.3.6 Maintenance Manual shall include the following;

20.3.6.1 Infrastructure required for the maintenance.

20.3.6.2 Maintenance check sheets for I line, II line & III-line maintenance.

20.3.6.3 Illustration of lift's components, sub-assemblies, assemblies etc. with a sketch.

20.3.6.4 Detailed explanation of safety items.

20.3.6.5 Detailed coverage of trouble shooting.

20.3.6.6 Reliability Centre maintenance (RCM), Maintenance Requirement Analysis, condition Monitoring based Maintenance & Reliability, Availability & Maintainability datas.

20.3.6.7 Check Sheets & scope of work for comprehensive annual maintenance.

## END OF CHAPTER

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## CHAPTER 21

### PROGRAMME REQUIREMENTS

## **21 PROGRAMME REQUIREMENTS**

### **21.1 General**

In addition to the requirements specified in the General Specification, the Contractor shall programme the Works in accordance with a pre-determined sequence to meet various Key Dates and Access Dates so as to meet the Target Dates of commercial opening:

### **21.2 Key Dates**

The work includes a number of stages. These stages are inter-related and essential to the completion of the Elevator works to be achieved within the Key Dates.

The Key Dates indicated in the schedule of Key Dates are mentioned in terms of the time period reckoned from the commencement of the works, and the deliverables for each Key Date shall be achieved by the midnight of the last day of the week mentioned.

If the identified work is not achieved by the stated Key Dates, liquidated damages may become applicable as set out in the Contract.

**Each Key Date and its description is given in the Appendix "B"**

### **21.3 Access Dates**

The contractor shall require Access to information as well as to various locations at stations / depots / guide-ways etc., in stages, in order to plan his activities for time-bound completion of his obligations under the Contract.

The dates on which such Access becomes available are indicated in terms of the time period reckoned from the commencement of works, and shall mean guaranteed access by the mid-night of the last day of the week mentioned.

These sequence, timings and extent access within any location will be further refined and reflected in the Master Programme developed by the "Engineer", based on the Installation Programme from the Contractor and Project Contractors.

The exact timing to access a specific location (or any part of the location) shall then be confirmed by the "Engineer" in the weekly Works Meeting during the construction stage.

Major installation works in the stations and ancillary buildings which require coordination with the Civil Project Contractors shall be followed as per the Co-ordinated Installation Programme to be prepared by the Civil Project Contractors.

The work area access dates in connection with various stages are also given in the Appendix "B"& "C".

END OF CHAPTER



## CHAPTER 22

NOT USED

## Appendix-A

### Interface Matrix of Phase-IB Elevator Contract (LKE (02)-02)

#### Section-I (Elevated Stations)

- 1) All System Contractors to display interface issues on boards at site in suitable format, so that concerned contractor / department and inspecting officials are aware of the interface requirements.
- 2) Architect / DDC to ensure that interface requirements are met with while issuing GFC drawings. All system contractors are to ensure it & sign off. Interface with concerned contractor is the responsibility of the system contractor. Engineer will provide the contact detail of concerned contractors to system contractor to facilitate timely interface.

#### Part-I

Item No	Subject	Civil Contractor responsibilities	Electrical Contractor responsibility	Elevator Contractor responsibilities
1	Elevator	<b>Design:</b> <ul style="list-style-type: none"> <li>Establish elevator locations and requirement.</li> <li>Consider &amp; plan water drainage and protection from rain.</li> <li>Consider &amp; plan maintenance access requirements.</li> <li>Incorporate elevator monitoring panel location.</li> </ul> <b>Construction:</b> <ul style="list-style-type: none"> <li>Provide shaft structure with proper drainage &amp; access.</li> <li>Provide lifting hooks/beams at top of shafts and water proofing in pits.</li> <li>Provide the load test reports of the hooks and the bracket to hold the Guide rail as per the load requirement of elevator Contractor.</li> <li>Ramp for access to ground floor elevators.</li> <li>Sun Shade, Rain water protection &amp; prevention from water ingress for elevators</li> </ul>	<b>Design:</b> <ul style="list-style-type: none"> <li>Electrical power, Control Interfaces and system shall be developed.</li> </ul> <b>Construction:</b> <ul style="list-style-type: none"> <li>Provide three phase power with dual earth duly terminated on a suitable MCCB of the elevator as specified by lift contractor. However, MCCB and ELCB is to be provided by the elevator Contractor.</li> <li><b>The Earthing up to entry In Elevator shaft is to be provided by Electrical contractor.</b></li> <li>Provide cable tray conduit / trunking from lift controller room to SCR for data cable. Provide lift shaft with fire protection measures</li> </ul>	<b>Design:</b> <ul style="list-style-type: none"> <li>Provide Civil Contractor with detailed requirements of shaft size, size of ventilation opening, lifting beams/hooks, water proofing and protection from rain, structural provision etc.</li> <li>Provide E&amp;M contractor with all details of electrical load, shaft lighting and earthing requirements.</li> <li>Inform the size of access necessary likely along the passage for moving the elevator for installation.</li> <li>Co-ordinate fire safety requirement with firefighting systems.</li> <li>Furnish design for monitoring and control panel.</li> <li>To provide MCCB and ELCB as per requirement of</li> </ul>

		<p>to be installed in open area.</p> <ul style="list-style-type: none"> <li>• Certificate of strength.</li> <li>• Stone work around the facia elevator in all landings beyond the 300mm widths.</li> </ul>		<p>elevators outside the lift shaft.</p> <ul style="list-style-type: none"> <li>• <b>The extension of Earthing inside the entry in Elevator shaft is to be provided by Elevator contractor.</b></li> </ul> <p><b>Construction:</b></p> <ul style="list-style-type: none"> <li>• To satisfy himself with the load bearing capacity of civil structure at location of Guideway support and of the lifting Hooks beams before starting installation.</li> <li>• Provide elevator car and all mounting/ guideway support and mechanism.</li> <li>• Provide all exterior finishes and door components for landing doors.</li> <li>• Provide and install telephone equipment in car, controller and SCR.</li> <li>• Provide data cable for control from station control room including requirements of BMS and NP-SCADA contractor.</li> <li>• Provide all cabling within lift shaft.</li> <li>• Supply equipment control &amp; monitoring panel with all accessories.</li> <li>• Minor civil works like cutting of Iron bar/ Granite stone/ Concrete for mounting lift fixtures.</li> <li>• Provide shaft lighting and power sockets from separate single-phase power duly controlled by a switch</li> </ul>
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				provided outside the shaft. • Provide exterior finishes as per PS Clause 6.8.10 (a) ii.
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**Part-II**

<b>Subject</b>	<b>Architect / DDC Responsibility</b>	<b>Civil Contractor Responsibility</b>	<b>Electrical Contractor Responsibility</b>	<b>Elevator Contractor Responsibility</b>
Elevators	<b><u>Before Erection</u></b> <ul style="list-style-type: none"> <li>To identify the entrance elevator shaft with lockable arrangement.</li> <li>To issue structural drawing of elevators.</li> <li>Cable routing of Computer based RMS cable tray in drawings.</li> <li>Detailed drawing of Phone/alarm/ RMS panel in customer care/SCR</li> <li>To identify and mark on the drawing the SS Handrail along with Ramp on both side of elevator as per requirement of elevator contractor for Ground level of G to C elevator.</li> <li>Identification of location for installation of Computer based RMS in CCC / SCR.</li> </ul>	<b><u>Before Erection</u></b> <ul style="list-style-type: none"> <li>Define installation provisions for elevator assemblies, co-ordinate access and delivery space provisions.</li> <li>Adequate storage area at station / depot / storage yard including proper access to storage area from nearby road for carrying elevators by hydra cranes / trailers.</li> <li>Future elevator shafts to be protected suitably.</li> <li>Marking for finished floor level at all landings of elevator.</li> <li>Cut outs for fixing indicators and for laying of cables at all landings.</li> <li>Proper connectivity of drainage hole to nearest sump by suitable GI pipes, drainage pit of elevator should</li> </ul>	<b><u>Before Erection</u></b> <ul style="list-style-type: none"> <li>Provision of Pump in sump for Entrance / Ground elevators.</li> <li>Single Phase UPS for Intercom in Customer Care Centre / Station Control Room.</li> <li>Single phase power supply for Computer based RMS Panel in Customer Care Centre / Station Control Room.</li> <li>Adequate lighting fixtures above the Elevator entry point at all landings for proper illumination</li> <li>UPS supply at Elevator shaft as per requirement of Elevator contractor.</li> </ul>	<b><u>Before Erection</u></b> <ul style="list-style-type: none"> <li>Provide proper size wooden block for cutout to civil contractor.</li> <li>To furnish the design for Computer Based RMS system.</li> <li>Minor civil works like chipping up to 25 mm, plaster up to 25 mm, cutting of unwanted projection inside the lift shaft.</li> </ul> <b><u>During Erection</u></b> <ul style="list-style-type: none"> <li>Interface with Civil Contractor and Architect for location of suitable water drainage arrangements.</li> <li>Interface with Civil construction (Finishing and Structural) for level marking as per finalized Station drawings.</li> </ul>

	<p><b><u>During Erection</u></b> Signage at all landings (except in Architraves)</p>	<p>be away from the elevator pit for ease of cleaning.</p> <ul style="list-style-type: none"> <li>• Slope of finished floor at the landing of elevator should be away from elevator to prevent entry of mopping water to pit of elevators.</li> <li>• Epoxy paint in Pit floor.</li> <li>• Provision of ventilation cutout in shaft.</li> <li>• Pit Cleaning, PCC work and construction of slope in pit towards drainage hole.</li> <li>• Primary whitewash /Paint in shaft.</li> <li>• Hole in Slab / Wall for cable entry from E &amp; M shaft to Elevator.</li> <li>• Finishing of roof ceiling - painting on load hook etc. above Elevator.</li> </ul> <p><b><u>During Erection</u></b></p> <ul style="list-style-type: none"> <li>• PCC filling at entrance sill &amp; sill stone at all landings.</li> <li>• Sealing of Rain shelter for entrance elevator / Ground elevator.</li> </ul> <p><b><u>After Erection</u></b></p> <ul style="list-style-type: none"> <li>• Stone Flaming for making it rough surface.</li> <li>• Covering of Gap (b/n stone and Architrave) by stone cladding in all landings.</li> </ul>	<p><b><u>Testing</u></b></p> <ul style="list-style-type: none"> <li>• Fire detectors testing.</li> <li>• Testing of Pump in pit.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide and install elevator complete with claddings, finishes and operating mechanism</li> <li>• Provide and install Computer based Remote Monitoring System in CCC / SCR and Intercom etc. in SCR/MAP/CC.</li> <li>• Plan elevator section / sizes considering local site conditions to facilitate easy transportation to installation location.</li> <li>• The gap between ELCB Panel &amp; MAP Panel and the Architrave sheet to be filled up by the elevator contractor with flexible sealant.</li> <li>• Lift number, Job Number &amp; Station Name (in both Hindi &amp; English language), Lift capacity plate (in both Hindi &amp; English language), Emergency / Safety instruction (in both Hindi &amp; English language) License display.</li> </ul>
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		<ul style="list-style-type: none"> <li>• Filling of gap on elevator</li> <li>• Water proofing of lift's Pits</li> <li>• Louver over Ventilation Louver on Stonework of Shaft. (Note; If, Shaft is painted then Louver provided by Lift Contractor is sufficient and no further louver is required).</li> </ul> <p>shaft on all side &amp; sealing of holes with fire rated material.</p> <ul style="list-style-type: none"> <li>• Storage area for maintenance purpose.</li> <li>• SS Handrail along with Ramp on both side of elevator as per requirement of elevator contractor for Ground level of Ground to Concourse elevator.</li> <li>• Finishing of patch work with final whitewash / Paint in lift shaft.</li> </ul> <p><b><u>Testing</u></b></p> <ul style="list-style-type: none"> <li>• Drainage Hole Connectivity to Sump Checking.</li> <li>• Load testing of structure, Load hooks &amp; beams.</li> </ul>		<ul style="list-style-type: none"> <li>• Architrave / Stone work coordination.</li> <li>• Roof leakage checking/coping stone/slope of roof for Entrance / Ground elevator.</li> <li>• Lighting provision in under craft of Elevator car.</li> <li>• Alarm working at all landings.</li> </ul> <p><b><u>After Erection</u></b></p> <ul style="list-style-type: none"> <li>• Ventilation Louver over cutout whose design should be such that rain showers didn't enter lift shaft.</li> <li>• RMS Cable laying.</li> <li>• Installation of Computer based RMS Panel in CCC / SCR.</li> </ul> <p><b><u>Testing</u></b></p> <ul style="list-style-type: none"> <li>• Water sensor testing.</li> <li>• Contract load &amp; linear speed.</li> <li>• LUX level &amp; Noise level testing.</li> <li>• EVA Meter / Ride</li> <li>• Comfort testing.</li> </ul>
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**Part-III** (*Lift CCTV Centralization & Lift RMS Data Centralization (via Dark Fiber)*)

Item No.	Subject	Civil Contractor Responsibilities	Electrical Contractor Responsibilities	Elevator Contractor Responsibilities	S&T Contractor Responsibilities
1	<b>Lift CCTV – Centralized Streaming to OCC (via Dark Fiber)</b>	Provide cable containment from Lift machine area to SCR as per approved routing. Ensure access openings, sleeves, and protection in shafts for CCTV cable routing.	Provide 230V AC power supply with dual earth for CCTV equipment inside Lift shaft/machine area.	<p>Supply, install and commission Lift CCTV Camera(s), encoder (if required), and Lift CCTV network interface device. Terminate CCTV feed at SCR handover point. Ensure ONVIF-compatible stream availability.</p> <p>Configure transport network to carry Lift CCTV stream to OCC</p> <p>Provide necessary patching, IP routing/VLAN as required.</p>	Provide dedicated dark fiber path from SCR → TER → OCC.. Provide necessary ports.
2	<b>Lift RMS Data Centralization to OCC (via Dark Fiber)</b>	Provide containment from Lift controller area to SCR for RMS communication cable. Ensure environmental protection and clear routing.	Provide 230V auxiliary power for RMS PC in SCR (if required). Provide earthing up to entry in Lift shaft.	<p>Provide RMS Board in Lift Controller, RMS software, RMS PC/Interface at SCR, and all hardware required for data generation and handover at SCR Ethernet Port. Ensure compatibility with OCC RMS Server.</p> <p>Transport all RMS data from SCR → TER</p> <p>Required Bandwidth shall be informed</p>	<p>Transport all RMS from TER → OCC over Telecom dark fiber network.</p> <p>Provide required bandwidth reservation as informed by Lift Contractor during design stage.</p>

				during design stage.  Provide required configuration, IP addressing, VLAN, bandwidth reservation, and interface with OCC RMS Server. Maintain uptime of transport network and workstations.	
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**Part IV** (*Lift CCTV Centralization—& Lift RMS Data Centralization (via Dark Fiber) at Underground Stations*)

Item No.	Subject	Civil Contractor Responsibilities	Electrical Contractor Responsibilities	Elevator Contractor Responsibilities	S&T Contractor Responsibilities
1	<b>Lift CCTV – Centralised Streaming to OCC (via Dark Fiber)</b>	Provide protected cable routing through Lift shaft, equipment room, and SCR. Ensure water-ingress protection, fire-rated ducts, and necessary sealing.	Provide power supply and emergency power (if applicable) to Lift CCTV equipment. Provide earthing up to Lift shaft entry.	Supply & install Lift CCTV camera(s), encoder/interface, and terminate the CCTV network feed up to SCR. Ensure integration readiness with OCC VMS.	Provide dark fiber network connectivity from SCR → TER → OCC. Configure network for CCTV data carriage. Provide necessary switching, routing, synchronization with OCC VMS.
2	<b>Lift RMS Data Centralisation to OCC (via Dark Fiber)</b>	Provide fire-rated cable containment, risers, and shaft routing for RMS communication cable up to SCR.	Provide power (UPS-backed as applicable) for SCR RMS PC/interface.	Provide RMS Board in Lift Controller, RMS software, RMS PC/Interface at SCR, and all hardware required for data generation and handover at SCR Ethernet Port. Ensure compatibility with OCC RMS Server.  Transport all RMS data from SCR → TER	Transport all RMS from TER → OCC over Telecom dark fiber network.  Provide required bandwidth reservation as informed by Lift Contractor during design stage.



				<p>Required Bandwidth shall be informed during design stage.</p> <p>Provide required configuration, IP addressing, VLAN, bandwidth reservation, and interface with OCC RMS Server. Maintain uptime of transport network and workstations.</p>	
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## **Section-II**

### **List of interface items for lift in Underground Stations**

All System Contractor to display interface/dependency boards at site in suitable format, so as concerned contractor/department and inspecting officials are aware of the requirements. Architect/DDC to ensure that interface requirements are met with while issuing GFC drawings. All system contractors to ensure it & sign off. Interface with concerned contractor is the responsibility of contractor. Engineer will provide the contact detail of concerned contractors to system contractor to facilitate timely interface.

If they fail to timely ensure, it will be contractors responsibility to get it done. Not getting it done will attract imposition of penalty.

#### **1.BEFORE ERECTION**

1	To ensure integration of lift in station drawings	ARCHITECT/DDC
2	Shaft as per required dimension	CIVIL
3	Drainage hole in pit	CIVIL
4	Hole for power cable	CIVIL
5	Cleaning of pit before installation	CIVIL
6	Cutouts/Notches at both landing at edge of door	CIVIL
7	Lifting hooks	CIVIL
8	Hook testing	CIVIL
9	Proper access	CIVIL
10	Storage of material at station/depot	CIVIL
11	Routing of rms cable tray	ARCHITECT/DDC

12	Pump in sump	E&M CONTRACTOR
13	Fire detection	E&M CONTRACTOR
14	Cable tray/raceways from lift to SCR and CCR	E&M CONTRACTOR

## 2. DURING ERECTION

1	Rain shelter for G-C lifts	CIVIL
2	Sealing of rain shelter for G-C lifts	CIVIL
3	Ramp for G to C at G/gallery for C to P at C	CIVIL
4	Power supply	E&M CONTRACTOR
5	Earthing (dual) in up to entry of elevator shaft	E&M CONTRACTOR
6	<b>Earthing(dual) extension inside the entry of the Elevator Shaft</b>	<b>ELEVATOR CONTRACTOR</b>
7	Signage (except in Architraves)	ARCHITECT DEPARTMENT

## 3. AFTER ERECTION

1	Sealing of holes	CIVIL
2	Stone cladding on wall	CIVIL
3	Front stone	CIVIL
4	Storage for maintenance purpose	CIVIL

## 4. TESTING

1	Fire detectors testing	E&M CONTRACTOR
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**END OF APPENDIX**

## APPENDIX B

### **KEY DATES AND ACCESS DATES**

#### **1.0 Key Dates**

The following key dates have been stipulated in this Contract:

##### **1.1 Key Date 1 (KD1): Preliminary Design submission**

**Achievement** - The following activities shall have been completed prior to the Key Date:

Submission to the "Engineer" of the Preliminary Design which consists of general equipment layouts including machine room sizes, major cabling routings, proposed architectural materials for public areas, preliminary drawings, elevator equipment details and proposed arrangement, preliminary delivery routes, preliminary design and construction specifications, preliminary installation and testing procedures etc. Submission to "Engineer" of Interface Management Plan.

##### **1.2 Key Date 2 (KD2): Submission of Final Design (Definitive)**

**Achievement** - The following activities shall have been completed prior to the Key Date:

Submission to the "Engineer" of the Definitive Design in respect of the whole of the works, the same being in the opinion of the "Engineer", a complete and comprehensive submission or submissions which complies with the Employer's Requirements.

##### **1.3 Key Date 3 (KD3): Delivery to Site of major Elevator components**

**Achievement** - The following work shall have been executed prior to the Key Date:

Manufacture, acceptance of factory testing, shipping and delivery to site of all major equipment and components of proposed Elevators. The delivered equipment shall be unloaded and stored at storage area, which will be subject to agreement by the "Engineer".

##### **1.4 Key Date 4 (KD4): Installation at Site, Testing and Commissioning of Elevator Systems.**

**Achievement** - The following work shall have been executed prior to the Key Date:

Completion of all installation processes at site for elevators systems. The completion of all testing at site, completion and testing of all remote monitoring and control system, obtaining all licenses and clearances from local authorities and commissioning of elevator systems.

##### **1.5 Key Date 5 (KD5): Completion of whole of the Works and taking over by the Employer.**

**Achievement** - The following work shall have been executed prior to the Key Date:

Completion of whole of the works to facilitate taking over of elevator system by the Employer. Completion of all training related activities for the Employer's Staff. Submission of all necessary documents including operation and maintenance manuals etc. Supply and handing over of all mandatory spares as required under the Contract.

### **SCHEDULE OF KEY DATES: CONTRACT LKE (02)-02**

**Kindly refer Appendix 2B (LKE (02)-02) of General Specification**

END OF APPENDIX

## APPENDIX C

### WORKS AREA ACCESS DATES

#### 1. WORKS AREAS

The Site is divided into a series of Works Areas, which are divided into Construction Depot and Work Sites, that will be made available to the Contractor at different times and for various duration as shown on the Schedule of Works Area availability overleaf.

The descriptions of the Works Areas given below are indicative and the Contractor shall satisfy as to the exact nature of the various Works Areas and the extent of works to be carried out prior to the making use of the area as working space and/or for temporary site facilities.

- (a) The Contractor shall submit to the "Engineer" proposals for the use and occupation of these Works Areas, such submissions being at least sixty (60) days prior to the programmed use of the specific Works Area.
- (b) Prior to the returning of any Works Area, the Contractor shall carry out the following works:
  - (i) reinstate the area to the condition as close as possible to its condition when it was taken over, except where the contract requires construction of Permanent Works,
  - (ii) Propose final modifications / changes to the area, at locations where it is not possible or desirable to reinstate the area to its original condition, to the "Engineer" for approval and form the area to the approved lines and levels and carry out such other works as may be required by the "Engineer",
  - (iii) Remove all rubbish, debris and other materials.

#### SCHEDULE OF WORKS AREA ACCESS DATES: LKE (02)-02

Sl.No.	Description	Period From Date Of Commencement Of The Works (Weeks)	Interfacing Contractor
Contractor has to interface with designated Civil Contractor			

**Notes: -**

1. The Contractor is obliged to co-ordinate with the Designated Contractors for the location of area available and provide storage, staging and unloading areas.

END OF APPENDIX

## APPENDIX D

### LIST OF ABBREVIATIONS

The abbreviations used in this Specification are as follows: -

AC	Alternating Current
ASTM	American Society for Testing and Materials
BCC	Back-up Control Centre
BIS	Bureau of Indian Standards
BS	British Standards
CPWD	Central Public Works Department
DC	Direct Current
DDC	Detail Design Consultants
DFT	Dry Film Thickness
DLP	Defects Liability Period
E & M	Electrical and Mechanical
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EMU	Electrical Multiple Unit
EMR	Elevator machine room
EN	European Standard
g	Gravitational acceleration
GCC	General Conditions of Contract
GS	General Specification
IEC	International Electro Technical Commission
IEEE	Institute of Electrical and Electronic "Engineer"
IMP	Interface Management Plan
IS	Indian Standards
ITB	Interface Terminal Board
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LT	Low tension
LMR	Lift machine room
m	meter
mm	millimeter

	MCB	Miniature Circuit Breaker
	MCCB	Moulded Case Circuit Breaker
	MMS	Maintenance Management System
	MRT	Mass Rapid Transit
	N	Newton
	NFPA	National Fire Protection Association, USA
	N/m <sup>2</sup>	Newton per square meter
	N/C	Contactor or relays with normally close contacts
	N/O	Contactor or relays with normally open contacts
	OCC	Operations Control Centre
	PS	Particular Specification
	RAM	Reliability, Availability and Maintainability
	SCC	Special Conditions of Contract
	SCADA	Supervisory Control and Data Acquisition
	SCR	Station Control Room
	UPS	Un-Interruptible Power Supply
UPMRC		Uttar Pradesh Metro Rail Corporation
VVVF		Variable Voltage Variable Frequency

END OF APPENDIX

## **APPENDIX "E"**

### **Spare Policy for Electrical Contracts**

#### **1.1 General**

1.1.1 The Contractor shall supply the following spares:-

##### **I. Consumable Spares**

- (i) The 'consumable spares' shall include items such as lubricants, oils, greases, sealants, filter Medias, gaskets, lamps and wearable parts etc. whose declared life is less than one year. This will not include the consumables like Diesel Salt etc. required for operation of the equipment.
- (ii) The Tenderer shall provide a recommended unpriced list of 'consumable' spares in Annexure-1 as noted above for maintenance and repairs of equipment in technical package. Any consumable item if required but not included in the above recommended list by the tenderer will be deemed to have been included and shall be supplied as per the provisions of this contract without any extra financial implication to the Employer. Contractor will be required to supply the requisite quantity of spares, as required irrespective of the quantities indicated by the contractor in the recommended list. Employer's decision in determining any particular item(s) as consumable in line with above guideline will be final and binding. In case any changes are required in the supply of consumables on account of changes at design stage, the contractor shall have to supply the required consumables also.
- (iii) The price of these spares will be part of tender evaluation while assessing the inter-se position of the bidders.
- (iv) The consumable spares shall be handed over by the contractor 3 months prior to ROD or Handing Over (whichever is earlier) to O&M Department. All the Spares shall be stored in the custody of O&M department at a location approved by Engineer-in-charge. However, the delivery of Consumable Spares that have shelf life of less than 2 years shall be regulated as per the requirement at site and approval of Engineer-in-Charge.
- (v) List of consumable spares furnished in the technical package shall be updated during the execution of Contract and following information as minimum shall be provided.
  - (a) Names, addresses, telephone numbers and other particulars of manufacturers and their local representatives;
  - (b) Models and part numbers,
  - (c) Full description of spares including a note whether it is sealed unit or an assembly or sub-assembly which can be broken down into component parts;
  - (d) Quantity installed in the system;
  - (e) Expected consumption rates;
  - (f) Overall dimensions and weight including minimum packing (if any) for shelf space purposes;

- (g) Inter-changeability or otherwise with similar parts; (h) Normal manufacturing and shipment lead times; and (i) Shelf life.
- (vi) It shall be the responsibility of the contractor to maintain sufficient stock of consumable spares till the end of DLP. These spares will be utilized by the Contractor during the maintenance etc. and the same would be issued by Operation & Maintenance wing of UPMRC on request of contractor. The old, replaced parts shall be disposed off/destroyed by contractor. Unused consumable spares, if any, at the end of DLP shall become property of the Employer.
- (vii) There will be joint quarterly audit of available consumable spares by nominated representatives of engineer and contractor and forecast of proportionate balance requirement of consumable spares till the end of DLP will be generated which will be binding on the tenderer to arrange within 3 months of finalization.
- (viii) If due to any Design change, some type of Consumable Spares defined in the list are not required, the same shall be deleted from the scope of contractor by the way of Negative Variation.
- (ix) If during the course of Execution of the project certain Non-Schedule Items are approved, then the list, quantity and cost of Consumable spares (if any) related to these non-Schedule items shall be approved along with the approval of that item, as per the discretion and approval of Engineer-in-charge.
- (x) Recommended list shall be furnished by the contractor as part of design submission / vendor approval for respective systems and subsystems. (The price of these spares will be part of tender evaluation while assessing the L-1 bidders).
- (xi) In case of award of Quantity Variation (Positive or Negative) during the execution of the contract, there shall be no variation in the value of Spares till such time the value of variation is within 25% (Positive or Negative) of the Original Contract Value regardless of any variation in Individual item. However, in case of Variation beyond 25% (Positive or Negative) of Original Contract Value, proportionate variation in Consumable Spares rounded to the next higher digit shall be awarded to the contractor.
- (xii) Payment for spares shall be made on delivery and handing over of Spares to UPMRC O&M Department.

## II. Unit Exchange Spares

The Contractor shall supply the Unit Exchange Spares as listed in the Annexure-2 of this Chapter on Employer's Requirements. The Unit Exchange Spares shall be supplied in the Store nominated by the Engineer. The delivery requirements of different lots are mentioned in the Annexure-2. These shall be delivered as per the key dates defined (**key dates will be informed to the contractor within sixty {60} days of issuing of LOA/NTP**). Any delay in this regard will make the Contractor liable for liquidated damages as per tender conditions. **This will be part of tender evaluation while assessing the L-1 bidder.**

## III. DLP Spares

- (i) The Contractor shall submit to the Engineer for review a list of minimum spare parts that he intends to make available during the installation, erection, commissioning and defect liability periods. **A list of minimum Spares is provided at Annexure-3.**
- (ii) The Contractor shall keep on Site, at his own cost, throughout the installation, erection, commissioning and defect liability periods, stocks of spare parts, as per



the list to enable rapid replacement of any item found to be defective or in any way in non-conformance with the Specification.

- (iii) The Contractor shall generally not be entitled to use any of the Employer's spare parts during the installation, erection and commissioning periods or during the Defects Liability Period.
- (iv) Contractor shall not be permitted to remove any working/healthy equipment / components / sub-systems / systems for any reason whatsoever without specific approval in writing from Employer's Engineer or Engineer's authorized representative.
- (v) Spares as per the agreed list shall be supplied at least three months before ROD. Stocks of such spares as available in Contractor stores will be jointly checked with Engineer every three months. Certificate by Engineer confirming availability of the spares in contractor stores / in Depots as per agreed list will be a pre-requisite for release of interim payments of the Contractor. However, this condition will not be applicable for six months before the expected expiry of the DLP period.
- (vi) The Contractor shall include the price of this item in cost of DLP in their Financial bid. This will be part of tender evaluation while assessing the L-1 bidder.

#### **IV. Recommended Spares for 1 year beyond DLP**

- (i) The Tenderer shall furnish priced list of the 'recommended spares' not covered under 'Unit Exchange Spares', 'consumables' and 'DLP' spares but the Contractor expects them to be required during three years after expiry of defect liability period, along with the bid as per format enclosed in Annexure-5 of this Chapter of Employer's Requirements. The prices should be proportionate and reasonable. Employer may decide to procure any number of these spares at quoted / negotiated rates before the end of DLP. The Spares shall be supplied at a location nominated by the Engineer.
- (ii) Contractor shall supply all the spares recommended by equipment/sub-system manufacturers within the quoted cost for recommended spares. Contractor shall update list of spares recommended by equipment/sub-system manufacturers at design submission stage.
- (iii) This will not be part of tender evaluation while assessing the L-1 bidder.

### **1.2 Manufacture, Delivery and Warranty**

- (i) The major spare parts ordered under the Contract shall be manufactured, tested and inspected in accordance with the relevant quality system, suitably packed and labelled. All spares shall be subject to inspection by the Engineer. In the event that any item is known to be going out of production, then the Contractor shall give advance notice to the Engineer.
- (ii) The warranty period of 'unit exchange' and 'mandatory spares', delivered shall be:
  - (a) Either 24 months from the date of acceptance or
  - (b) Upto expiry of the defect liability period, whichever is later.

**1.3 Purchase of Spares from Vendors**

- (i) The Contractor shall furnish an undertaking that he has no objection whatsoever to and shall not in any way deter or obstruct the Employer, its licensee or its representative from dealing directly with the Contractor's Vendors for the purchase of the spares during the Contract period. The spares purchased shall be subject to inspection by the Engineer.
  - (ii) Contractor shall obtain an undertaking from vendors, OEMs etc. at detailed design submission stage that they will deal directly with Employer for supply of spares, equipments and/or sub-systems.
- 1.4** The relevant list of the spares mentioned above shall be submitted in the technical bids after blanking the prices, where applicable. The financial bid shall have the price details.
- 1.5** Contractor shall submit technical specifications of the items used in this project for the purpose of purchasing. Engineer's views, if any, shall be suitably incorporated.

**Annexure-1**

The indicative list of recommended & consumable Spares in Lucknow MRTS Project is given in following table.

**List of Recommended & Consumable Spares**

Refer Statement of Price-4A

**Annexure-2**

The indicative list of Unit Exchange Spares in Lucknow MRTS Project is given in following table.

**Unit Exchange  
Spares**

Refer Statement of Price-4B

**Annexure-3**

**The indicative list of DLP Spares in Lucknow MRTS project is mentioned in following table.**

**List of DLP Spares in Lucknow MRTS**

Refer Statement of Price-5B

**Annexure-4**

**The indicative list of Mandatory Spares in Lucknow MRTS project is mentioned in following table.**

**List of Mandatory Spares in Lucknow MRTS**

Deleted

**List of the Tools**

Refer Statement of Price-5A

**Annexure-5**

**Deleted**

**Annexure-6**

**Deleted**

**Annexure-7**

**The indicative list of required tools in Lucknow MRTS project is mentioned in following table.**

**List of the Tools for Lucknow MRTS Project**

Refer Statement of Price- 5A

## **Appendix-F**

### **Vendor Approval**

It shall be obligatory for the Contractor to obtain Notice of 'No Objection' from the Engineer for the selection of the vendors for all items of work, even if the name of the vendor is specified in the Contractor's Technical Submission and the works to be done including purchase of materials and equipment is in accordance with the Standards specified in the Contract.

Vendor to be selected who are capable to provide good after sales services available in Lucknow MRTS during DLP and thereafter.

#### **Vendor Approval and Selection Procedure**

- (1) The contractor can send a proposal for the vendor after ensuring that what he proposes at least meets the specifications both, the quality and safety standard of the stipulated makes, the proposed product should be a proven one. He shall also stand full guarantee to his proposal and if at any stage it is found that the material is not suitable or meeting the tender requirement, the contractor shall replace the material and provide the material from the alternate vendor after approval from UPMRC without any additional cost to UPMRC. The alternate makes can be used only after an approval accorded by the Employer, whose decision will be final in the matter.
- (2) The approval of any equipment or product to be used shall be done in two stages: -
  - (a) **Stage-I**
    - Assessment of capability of proposed Vendor to supply a particular equipment or product, with quality and performance requirements, as required by Specifications as well as other contract conditions. The proposed product should be a proven product in service for at least 3 years.
    - Assessment of the financial and functional strength of the Vendor to supply the requisite quantity of equipment and product as per delivery schedule acceptable to contractor and engineer to deliver the project in time.
  - (b) **Stage-II**

Stage-II called as Technical Submission Approval Stage, selection of Equipment or product from the equipment / products manufactured / supplied by the approved

vendor will be done. This stage includes thorough technical assessments about the conformance of the offered equipment / product to the Specifications and other requirements.

- (c)** To obtain Vendor Approval the Contractor must apply with the four sets of the following documents to the Engineer
- (i) Company Profile and Experience of the Vendor
  - (ii) Clause wise compliance of the relevant Clauses of Specifications.
  - (iii) Details of supplies / orders executed in last ten years for the type of equipment / product offered. Supplies / orders executed for Underground Metro Systems shall be specifically mentioned
  - (iv) Details of the facilities available at the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured.
  - (v) ISO 9000 Certification for the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured (The Works / Manufacturing Unit where the proposed equipment / product shall be manufactured must have ISO 9000 Certification)
  - (vi) Proof regarding compliance to Manufacturer's Qualifications. The offered products must be proven in service.
  - (vii) Audited Financial Statements of the Vendor for the last three years.
  - (viii) Type test certificates/ Performance certificate from accredited laboratories for the proposed type of equipment / products to establish the technical capability of the vendor (In case, specific requirements are mentioned in the relevant sections of Specifications with regard to type testing, same shall also be complied additionally).
  - (ix) The vendor shall not have been blacklisted by any Govt. Agency in India.
  - (x) Any other item as required by Employer / Employer's Representative.
- (d)** Contractor must certify the check list provided that vendor Proposal is complete and all the above documents are available in the Vendor Proposal. In addition, the Contractor must check / certify compliance to the Specifications before forwarding the same.
- (e)** Incomplete Vendor Proposal will not be treated as a submission and will be returned.
- (f)** Engineer will give Approval to the Vendor Proposal (received complete with all the documents mentioned above) expeditiously.

- (g) Technical submission shall be accompanied with the calculations / other technical documents to justify the selection of any particular model of equipment / product, detailed technical features / parameters of the selected product, type test certificates from the accredited laboratories for the offered products, any other document required by the Engineer.
  - (h) Engineer will give Approval to the Technical Proposal (received complete with all the documents mentioned above) expeditiously.
- (3) It may be noted that Approval of Vendors as per Point (3) above shall only be done by Employer / Engineer after the award of the work. Vendor submissions shall not be evaluated during the tender evaluation. Conditional Tender offers received from Tenderers with particular Vendors for supply of equipment/ products will not be evaluated during evaluation and will be dealt with after award of the work.
- (4) It may further be noted that Employer / Engineer shall be under no obligation to accept equipment / products manufactured by the successful Tenderer, unless it meets the entire criterion mentioned above.

#### **For Design and Build Contracts**

**In addition to above, in Design and Build Contracts the following shall also be ensured for the Vendor Approval and Selection: -**

#### **1. Proven Design**

The Contractor shall develop the design based on this specification and on sound proven and reliable engineering practices. The broad design details shall be submitted with technical support data in the technical bid. Detailed calculations shall be submitted to the Engineer during the design process stage for review and approval.

#### **1.1 Systems and Sub-Systems**

Manufacturer shall have at least 5 years experience of design and manufacturing of similar system. Proposed systems from the proposed manufacturing unit shall have been in use and have established their satisfactory performance and reliability for 3 years in minimum.

All sub-systems, equipments and major components etc. (hereinafter referred as 'subsystems') shall be state-of-art and of proven design.

Proposed Systems/ sub-systems shall have been in use and have established their satisfactory performance and reliability on at least Two mass rapid transit systems (including Railway or Airports) in revenue service over a period of three years or more either outside the country of origin at an average in two different countries or in UPMRC. Systems/ Subsystems/ components used in UPMRC do not get automatically qualified for use unless

specifically approved by the Engineer for this project. If required by the Engineer, Contractor shall provide certificate of satisfactory performance for a period of five years or more from the Metro operators. Where similar System/ Sub-systems of a different rating are already proven in service as per the above criteria then the supply shall be based on such sub-systems.

All 'sub systems' shall be procured from the approved vendors and sourced from only such manufacturing units that have supplied the sub-systems that fulfill the proven design requirements as above.

In case the contractor proposes to use systems or sub-system(s) that do not fulfill the above said criteria then the contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered systems and sub-system(s) for review of the Engineer.

The Engineer's decision on contractor's proposal shall be final and binding.

**For sourcing the equipment from indigenous manufacturing facilities, following conditions shall be complied:-**

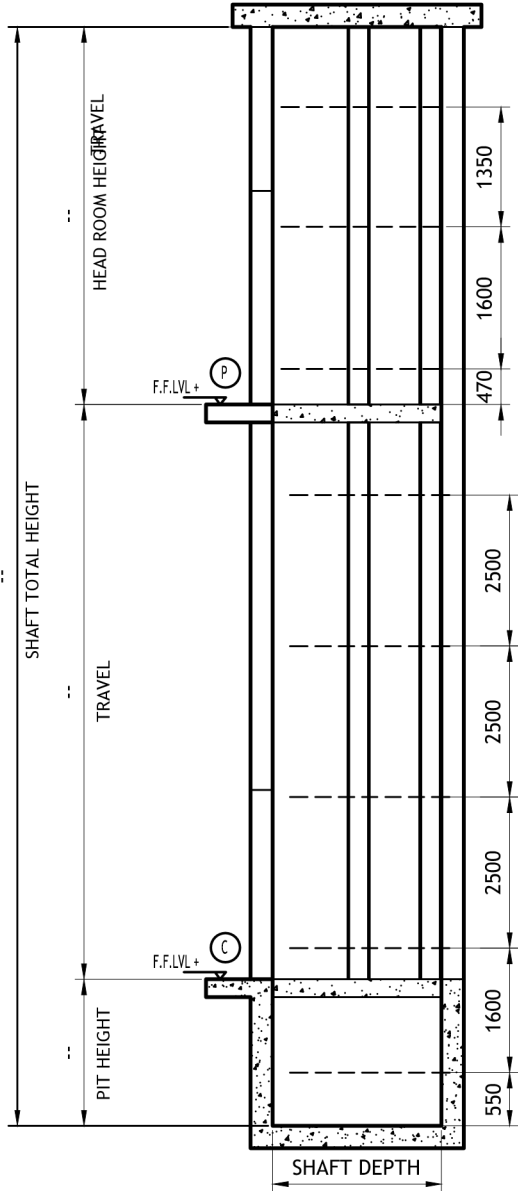
- (i) In case the vendor uses his own facilities for indigenization after part supply of equipment from the approved manufacturing unit, no change in design, component type/make, quality standards, manufacture procedure, etc. shall be made without specific approval of the Engineer.
- (ii) In case OEM wants to use manufacturing facilities in India (other than his own) for items for which the OEM has been approved, it shall enter into an agreement with such selected Indian equipment manufacturer and obtain prior approval from UPMRC. No change in composition, rating, type, model no., manufacturing process, quality standards, design, etc. and make of the components used in assemblies/sub-assemblies of such equipment as manufactured by the approved parent vendor shall be made without specific approval of the Engineer.
- (iii) In case OEM wishes to change/make/type specifications, etc. of any sub-components for supplies to be sourced from Indian facility, specific prior approval of the Engineer shall be obtained for changes made, model, specification, etc. Responsibility for obtaining such prior approval shall rest solely with the contractor.

Format for submitting the vendor approval request shall be given to the contractor during initial stages and approved format shall be followed throughout the contract.

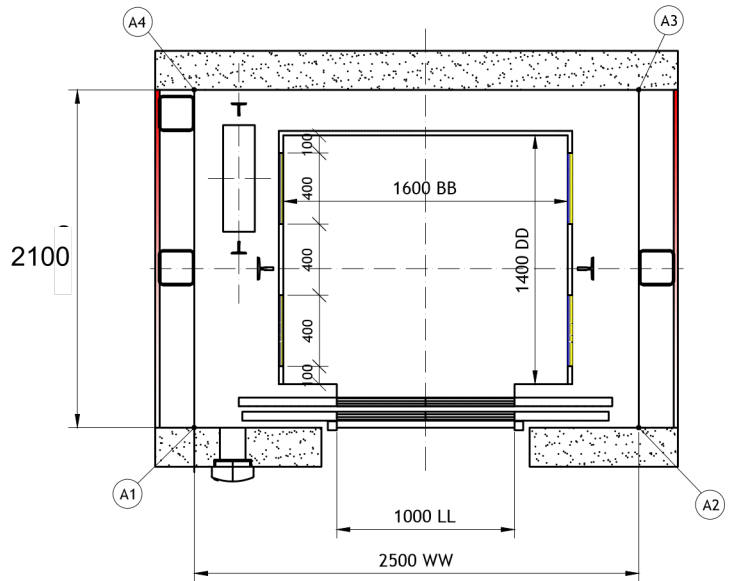
**END OF APPENDIX**



APPENDIX G



TYPICAL ELEVATION LAYOUT



CAR & SHAFT PLAN



183R



## APPENDIX -H

### MAINTENANCE REQUIREMENTS

To be Read in conjunction with the chapter -17 Maintenance Requirement of PS

#### 1.0 Maintenance

- 1.1 The Contractor shall provide maintenance services throughout the 2 Years Defects Liability Period (DLP) under the Main Contract and also under the ~~Supplementary~~ Comprehensive Annual Maintenance Contract for the Elevators supplied under the Contract.
- 1.2 The Maintenance work shall include attendance to all service calls, work described in approved Maintenance Schedule, and the followings:-
  - 1.2.1 Service shall include all work necessary to maintain entire Elevator system in good working order at all times through Preventive / Scheduled Maintenance (PM) & Corrective Maintenance (CM). Preventive Maintenance can be carried out only during Non – Revenue Hours. (likely to be 00.00 hrs (Midnight) to 04.00 hrs.)
  - 1.2.2 The Contractor shall dispatch competent personnel to rectify stoppages at any time during the day or night when being called on by the Employer within a time of Four hours (maximum).
  - 1.2.3 The Contractor shall maintain adequate quantity of consumable and contingent spare parts as per agreed list at mutually agreed location in order to minimize the shut down time due to repairs and maintenance.
  - 1.2.4 The DLP and Comprehensive AMC includes all spare parts of Elevators including consumables i.e. Car door Enclosure, door panels, ceilings, Car gates, Light diffusers, Light Bulb, Fluorescent Tubes, Hand Rails, Starters, Chokes, Floor covering Carpets, other lift architectural features, Hoist way enclosures, Hoist way Gates, Door frames, Door Sills, Batteries, Security Systems, external wiring to elevators & hoist way/Machine Room, Imported components like LED, Plasma display, EVIAS etc., Security systems, external wiring to elevator & hoist way/ machine room, imported components like LED, Plasma display
  - 1.2.5 Contractor shall carry out periodic testing and examination of Elevators safety devices as required by the provisions of any enactment in force relating thereto or of any enactment, regulations or by-laws of any local or other duly constituted authority which may be applicable to such tests and to provide such copies of the test certificates, duly signed by a competent "Engineer."
  - 1.2.6 Contractor shall be fully responsible for obtain & ensure timely renewal of relevant safety certificate (s) or license(s) or any other documents required from statutory authorities for operation & maintenance of Elevators, during 2 Years Defects Liability Period (DLP) and also during the Comprehensive Annual Maintenance Contract. **Nothing extra shall be payable.**

- 1.2.7 Annual Independent Third Party Safety Check including loading test for each Elevator and corrective adjustment (if necessary) shall be done by the Contractor. The report format shall be approved by Employer.

### **1.2.8 Reports**

- 1.2.8.1 The Contractor shall provide monthly, quarterly, half-yearly and yearly reports on the condition of the equipment in a format approved by the Employer.
- 1.2.8.2 A report in duplicate shall be sent to the Employer immediately following every call out, indicating the time of call out visit, cause, remedial action taken and the time that the service was restored. The monthly summary of failure report along with the analysis giving details of nature of fault, remedial action taken etc in the approved format shall be provided.
- 1.2.8.3 Reports on routine visits are not required except where necessary to draw attention to defects of a minor nature, which could not be rectified during the routine visit. Records of each routine visit and call-out visit, together with details of the work done or action taken, shall be entered on a log book which shall be provided by the Contractor and retained in the location as decided by the "Engineer".

### **1.2.9 Maintenance Service Plan**

- 1.2.9.1 The Contractor shall provide the employer with a maintenance service plan and a Predictive Replacement Plan for the components which are likely to result in failure of Elevators. Reference Plan shall be finalized during design approval stage.
- 1.2.9.2 Maintenance service plan shall include all Preventive / Scheduled & Corrective Maintenance, and must be submitted for Approval, 3 months before the commencement of the DLP.
- 1.2.9.3 The Employer shall reserve the right to review the "Predictive Replacement Plan" based on actual performance of equipment during 2 Years Defects Liability Period (DLP) and also during the Comprehensive Annual Maintenance Contract. **Nothing extra shall be payable.**

### **1.2.10 Failure Investigations**

The Contractor shall conduct failure investigations. The Contractor shall make available to the Employer / Owner all test and failure data as required. Disputes (if any) will be resolved by "Engineer".

- 1.2.11 Contractor shall provide Operation and Maintenance Manuals (in Hindi & English).
- 1.2.12 Contractor shall provide training to UPMRC personnel (a batch of 20 person) in operation & maintenance related to Elevators for 15 trainer working days (from 10:00 hrs to 17:30 hrs ).

## **2.0 Maintenance Performance Requirements.**

2.1 The Contractor shall dispatch competent personnel to rectify stoppages at any time during the day or night when being called on by the Employer within a time of **Four hours (maximum)**. Repairs shall be carried out on a 24 hours per day, 7 days per week basis until the faulty unit / elevator is put back in service.

2.2 If contractor fails to comply above conditions the penalty of **Rs. 1,000/- Per hour if response time is more than Four hour and Rs. 15,000/- per day if repair is not carried out on a 24 hours, 7 days per week basis**, until the faulty unit is put back in service shall be imposed.

### 2.3 Not Used.

2.4 The contractor shall ensure that the Maintenance Performance requirements as mentioned below are achieved:-

S.No	Maintenance Performance Requirement.	
1	Availability	≥ 99.9 %
2	Maintainability (based on Mean Time To Repair)	≤ 4 hrs.
3	Call out Ratio (per Elevator per Year)	≤ 2

**Availability** will be calculated as under:-

Availability =  $\frac{\{(365 \times 20 \text{ hrs.}) \times \text{No. of Elevators in a Section}\} - \{\text{Total Unavailability hrs in one year}\}}{\{(365 \times 20 \text{ hrs.}) \times \text{No. of Elevators in a Section}\}}$

$\{(365 \times 20 \text{ hrs.}) \times \text{No. of Elevators in a Section}\}$ .

### Mean Time To Repair (MTTR).

The MTTR time measurement shall include On site diagnostics and rectification of the failure up to point that the system is restored to full functionality. In the event that the failure cannot be rectified, the measurement shall include the time necessary to remove the failed piece of equipment from the system and replaced it with a functioning module.

**LKE (02)-02 Employer's Requirements: Particular Specification**

The maintainability shall measure by fault rectification time, which should not exceed 4 hours since its reporting to contractor's call centre or his representative by UPMRC.

- 2.5 The Contractor shall submit a Quarterly Maintenance Performance Report along with the Payment Invoice, giving the details actual performance achieved on monthly basis in an approved format with specific reasons if any target is not met.
- 2.6 If contractor fails to comply any one of above performance targets, the penalty of Rs 15,000/- Per month shall be imposed for each Elevator under the Section. Indicative List of Spares and tools are provided at Annexure-1 to Annexure-6 of Appendix- E of Particular Specifications.

**List-A**

**Predictive Replacement Plan**

Major Area	Item Description	Replacement Interval in Years				
		2	4	6	8	10
Car	Car Ligthing	X				
	Emergency Batteries(UPS,EBD,CCB,BDT)	X				
Door	Car Door Contacts			X		
	Car Door Hanger Rollers			X		
	Car Door Guide Shoes	X				
	Landing Door Lock Rollers		X			
	Landing Door Closing Weight Rope		X			
	Landing Door Closing Weight Pulley		X			
	Landing Door Contacts				X	
	Landing Door Hanger Rollers				X	
	Landing Door Guide Shoes		X			
	Door Operator Belts		X			
	Synchronization Rope		X			
	Synchronization Pulley		X			
	Door End/Close Buffers		X			
Others	Drive Replacement			X		



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**LKE (02)-02 Employer's Requirements: Particular Specification**

	Tachometer/Encoder	X				
	Encoder		X			
	PCB LCECCB		X			
	PCB LCEADO		X			
	PCB LOB 230 fuses		X			
	Car & CWT sliding Guide shoes	X				

**Note:**

- 1.The above list is considering usage of lift as 5 lakh operation/Year.
2. It can be modified only after approval of Employer.

## **Annexure-1 of Appendix H**

### **PRICE VARIATION CLAUSE FOR COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT FOR ELEVATORS**

The price of comprehensive maintenance contracts, if any awarded after completion of 2 years DLP and 1 years AMC for elevators/escalators, it is to be Revised at the end of one year period on the basis of the following variation formula:

$$P = P0/100 \{15+50(W/W0) +25(MP/MP0) +10(FP/FP0)\}$$

Wherein,

P = Revised price payable in accordance with the above formula. P0 = Previous year's confirmed price for the maintenance contract.

W0 = All India average consumer price index number for industrial workers, as published  
by the Labour Bureau, Ministry of Labour, Govt. Of India (Base 1982 = 100).

This index number is as applicable for the month six months prior to date of commencement of previous year contract.

MP = The final wholesale price index number for metal products as published by the office  
of the of the economic advisor, Ministry of Industry, Government of India (refer notes).

FP0 = The final wholesale price index number for fuel, power, light and lubricants as  
published by the office of the economic advisor, Ministry of industry, Government of India (refer notes).

This index number is applicable on the 1st Saturday of the month, six months prior to the date of commencement of previous year's contract.

For example: For the contract period 1st January 2002 to 1st December 2002, the applicable (P0) should be the contract price for the period 1st January 2001 to 31st December 2001 (W0) should be for the month of July 2000, (MP0) and (FP0) both should be as on 1st Saturday of the month of July 2000 would appear in the circular issued for the month of October 2000.

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***LKE (02)-02 Employer's Requirements: Particular Specification***

The above published by IEEMA vide circular reference number IEEMA(PVC)/LLES prevailing as on day of the month.....i.e. one month prior to the date of commencement of previous year's contract.

W = All India average consumer price index number for industrial workers. (base 1982=100) is as published by labour bureau, Ministry of labour, Govt. of India.

This index number is as applicable for the month, six months prior to the date of commencement of the revised contract.

MP = The final wholesale price index number for metal products as published by the office of the economic advisor, Ministry of Industry, Government of India (refer note).

This index number is as applicable on the 1st Saturday of the month, six months prior to the date of commencement of the revised contract.

FP = The final wholesale price index number for fuel, power, light and lubricants are published by the office of the economic advisor, Ministry of Industry, Government of India (refer notes).

This index number is as applicable on the 1st Saturday of the month, six months prior to the date of commencement of the revised contract.

For example: For the contract period from 1st January 2002 to 31st December 2002, the applicable index numbers (W) should be for the month of July 2001 and applicable wholesale price index number (MP) and (FP) both should be for the week ending 1st Saturday of July 2001, which would appear in the circular issued for the month of October 2001. Notes:

- a. Wholesale price index number for metal products and for fuel, power, light and lubricant are as published by the office of economic adviser, Ministry of Industry, Govt. Of India with base 1993-94=100. These wholesale price index numbers are being published weekly, on provisional basis. However the same gets finalised after 8 weeks and are normally available after two/three months. (Therefore we are considering in our circular only this final index published by the economic adviser for the 1st Saturday of the month.).
- b. The sole purpose of the above stipulation is to arrive at the amount of the entire contract under the various situations. The above stipulations do not indicate any intentions to sale material under this contract as movables.
- c. The indices MP, FP and W are regularly published by IEEMA in monthly basic price circulars based on information bulletins from the authorities mentioned.  
For Indian Electrical & Electronics Manufacturers' Association

Authorised Signatory

## **APPENDIX -I**

### **PROVISION FOR REMOTE MONITORING SYSTEM (RMS)**

1. The Contractor shall provide a PC based Remote Monitoring and Control System (RMS) to be run on the computer in the Station Control Room and Operation Control Centre. The RMS shall provide continuous monitoring and controlling of the lifts and escalators. In addition to above, the tentatively following data of elevators are to be integrated into BMS system at Station Control Room in elevated and underground stations (if required by the engineer). The BMS will be provided by the respective E&M Contractor. The elevator contractor shall provide / receive the following status monitoring points and control points to the RMS in the form of voltage free contacts: -
  - a. Maintenance mode status- Monitoring
  - b. Run/Stop status- Monitoring
  - c. Power available status- Monitoring
  - d. Emergency Alarm status- Monitoring
  - e. Lift parking status- Monitoring
  - f. Fault status- Monitoring
  - g. Homing command (Parking/un-parking)- Control
2. The contractor shall deliver an Integrated Remote Monitoring System.
3. The elevator fault / trip signal shall be activated whenever there is a fault in the elevator system, which causes a breakdown. The signal shall be latched on for at least 10 seconds. It shall only be reset after the fault is cleared.
4. The alarm signal shall be activated whenever the alarm inside the elevator car is pressed.
5. A by – pass switch with illuminated indication, which shall de-activate the fault / trip signal to RMS when switched “ON” and give a “Under Maintenance” signal to RMS is SCR shall be provided in the controller for maintenance purpose. The switch shall be labeled Hindi and English and shall be subjected to the acceptance by Employer’s Representative’s.
6. Upon actuation by remote switch from the RMS for parking on, the elevator shall complete the last landing or car call, if any, and return to the designated landing and stop there with both the car and landing doors open for 15 – 20 seconds and then close. The “Not in service” indicator shall be illuminated on the landing indicator automatically for a pre-determined time and then extinguished. The car light and ventilation fan shall be switched off automatically at the same time. The essential buttons e.g. door open, intercom and alarm bell etc. on the car operating panels shall be remained functional and illuminated when the elevators have been parked and locked out.
7. Upon actuation by remote switch from the RMS for non-parking, the elevator shall be switched back to normal operation, and both the car light and ventilation fan shall be switched on automatically.
8. The contractor shall connect the contacts with screen wires and terminate at the terminals in the ITB to be located in SCR whereas the conduits from the Elevator shaft to the SCR will be provided by E&M contractor. The Contractor shall coordinate and interface with E&M contractor and / or his sub – contractor in association with conduits routing and sizing requirement. The connection from ITB to the RMS will be provided by the contractor.
9. Contractor shall also provide LED Based Remote Monitoring System Panels (Audio Visual; Indication Panel) in Station Control / Customer Care Room for the Remote Monitoring System (RMS). Detailed Requirement for the same is enclosed at Clause 6.20 and Clause 6.22 of this Particular Specification.
10. The contractor shall also interface with the E&M Contractor for the requirements pertaining to emergency evacuation push button in Ventilation Control Panel (VCP) at underground stations and in BMS at elevated stations.
11. Contractor shall also make necessary arrangements for time synchronization of all Systems with UPMRC’s System Clock.

## APPENDIX-J

### CCTV CAMERA TO BE INSTALLED IN LIFT CAR

#### Specifications (Minimum) of Lift Camera

S. No.	Parameter	Specifications
1	Image Sensor	1/2.8" or bigger, CMOS progressive scan image sensor, P-Iris sensor
2	Pixel Resolution	Full HD (1920 × 1080) or better (16:9 aspect ratio)
3	Data Rate	with latest compression technology  Configurable between 64 Kbps (min.) to 4 Mbps (max.). Max data rate of 4 Mbps per stream shall support Full HD without degradation
4	Compression Method	H.265 and H.264 or better
5	Video Streaming	Minimum two video streams with H.265 or better compression; 25/30 FPS; intelligent streaming; both streams configurable as unicast or multicast; both streams independently configurable from SD to Full HD
6	Sensitivity @ 30 IRE F1.4 (AGC off)	(a) Colour Mode: 0.10 Lux (b) Monochrome Mode: 0.05 Lux
7	Shutter Speed	1 to 1/8000 sec or better
8	Wide Dynamic Range (WDR)	≥ 65 dB
9	Angle of View	115° × 85° (minimum)
10	Lens Type	Fixed 2.4 mm or better
11	Housing & Mounting Arrangement	a) Housing arrangement shall be in accordance with lift car.  b) Housing shall be elegant & compact in design with brushed steel or white finish.  c) Housing & mounting arrangement shall be provided by camera manufacturer.
12	Edge Analytics	Camera shall be equipped with following in-built /integrated edge video analytics as a min.:  a) Left Object detection  b) Camera Tampering
13	Protection Rating with Housing	IP65, IK10 or better
14	Signal to Noise Ratio	≥ 50 dB when AGC off
15	Day/Night	Auto day/night configuration
16	Camera Stamping	Logo, name, date & time (on/off)
17	Edge Storage	Edge storage with built In slot compatible for SD/SDHC/SDXC memory card of 128 GB or higher (128 GB memory card is to be supplied) or suitable for recording of minimum 72 hrs., whichever is higher.
18	IR Filter	Auto, remote
19	Infrared	Built-in IR illuminator with range ≥ 9 m
20	Network Interface	Ethernet (RJ45), 100 Base-T auto sensing
21	Camera Discovery in local network	OEM application- for automatic discovery/detection of all cameras in local network and to configure network setting.
22	Supported Protocols	TCP, UDP, HTTP, HTTPS, IGMP, IPv4, IPv6, SNMP, DNS, NTP, DHCP, ARP, ONVIF etc. Or as required to fulfill the functional requirement of the project.
23	Web Server	Internal web server required with embedded OS
24	Auto Gain Control	ON / OFF / Auto

25	Backlight Compensation/Anti Blooming	ON / OFF
26	White Balance	Auto / Manual
27	Alarm Input/Outputs	1 input & 1 output; compatible for interface with lift telephone; Camera shall have inbuilt provision to receive input from Normal Open /Normal Close potential free Contact.
28	Power Options	PoE/PoE+ (IEEE 802.3af/at) and 220VAC / 24VAC / 12VDC (Reliable option to be implemented)
29	Operating Temperature	0°C to +60°C (minimum)
30	Storage Temperature	0°C to +70°C (minimum)
31	Humidity	Up to 90% RH non-condensing
32	Time Synchronization	Embedded Real Time Clock, NTP client
33	Flicker Control	50 Hz, 60 Hz
34	MAC Address	The MAC address of the IP Cameras must be registered in the name of OEM supplying the camera
35	ONVIF (Open Network Video Interface forum) Compliance	The camera shall comply to ONVIF standards with Profile 'S', 'G' and 'T'. The quoted models should appear on the ONVIF website and a confirmation certificate for the offered models should be available at the time of supply.
36	Firmware Upgrade	It shall be possible to remotely upgrade the firmware of the camera.
37	GBT Standard	The Camera to be provided by the bidder should not be complying to GB28181, GB/T28181-2011 standards and there should be no option to activate or deactivate GB/T 28181 Standards in the camera web page/settings.
38	Regulatory Certifications	UL/EN certification for safety. and FCC Certifications for EMC & Immunity. Note: The Regulatory Approvals/Certifications are to be provided from NABL/NABCB accredited Labs or internationally reputed and accredited Labs/Agencies
39	Approved Makes	Pelco, Axis, Avigilon, GE, Indigo vision, Panasonic, Bosch, Sony, Honeywell, Siemens, Dvtel or equivalent subject to meeting the above specs. Printed data sheet of manufacturer shall be attached with the bid proposal, clearly identifying clause by clause compliance.
40	Statutory Compliance	CCTV camera and other networking devices should be STQC certified and shall follow all statutory requirements and guidelines issued by Govt. of India time to time.



## **TENDER DOCUMENTS FOR**

**Design, Manufacturing, Supply, Installation, Testing and Commissioning of Heavy Duty Machine Room Less Escalators and Heavy Duty Escalators including Maintenance during 02 (two) Years Defect Liability Period (DLP) and 01 (one) year comprehensive Annual Maintenance beyond DLP Period for Lucknow, Kanpur & Agra Mass Rapid Transit System Project under the Contract LKE(02)-02.**

## **TENDER DOCUMENTS**

**Contract LKE-(02)-02**

**VOLUME 3**

**Part-B (Escalator)**

**EMPLOYER'S REQUIREMENTS - PARTICULAR SPECIFICATION**

**Uttar Pradesh Metro Rail Corporation Ltd.  
Administrative Building, Vipin Khand, Gomti Nagar,  
Lucknow – 226010, Uttar Pradesh, India  
Website: [www.upmetrorail.com](http://www.upmetrorail.com)**



**CONTRACT LKE (02)- 02****EMPLOYER'S REQUIREMENTS - PARTICULAR SPECIFICATION****TABLE OF CONTENTS**

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# CHAPTER 1

## INTRODUCTION

# 1 INTRODUCTION

## 1.1 Scope and Purpose

1.1.1 This specification defines the objectives, guidelines and requirements for the contractor's design, manufacture, supply, installation, testing and commissioning of the Escalators at Stations of UPMRC (Uttar Pradesh Metro Rail Corporation) network in Lucknow.

1.1.2 The works to be executed under the Contract include the design, manufacture, verification, delivery, installation, testing, including integrated testing and commissioning, technical support, maintenance, training of Employer's staff and documentation for a complete System necessary to deliver the requirements of this Specification.

## 1.2 Relevant Documents

1.2.1 This Specification should be read in conjunction with the General Conditions of Contract (GCC), Special Conditions of Contract (SCC), the General Specification (GS), Safety Health and Environment Manual (SHE) and any other document forming part of the Contract.

1.2.2 In the event of a conflict between the GS and this Specification, this Specification shall prevail.

1.2.3 In the event of a conflict between this Specification and any other standards or specification quoted herein, the requirements of this Specification shall prevail.

1.2.4 The order of precedence, with item 1 having the highest priority, is:

- 1 Particular Specification
- 2 General Specification
- 3 Indian Standards
- 4 International Standards referenced herein.
- 5 Other International Standards
- 6 Other National Standards.

1.2.5 Notwithstanding the precedence specified in clauses above the Contractor shall always immediately seek advice from the Employer in the event of conflicts between Specifications.

## 1.3 Design Service of the Works

1.3.1 The Contractor shall be responsible for the design service of the Works and shall satisfy himself that the sizes, ratings and quantities of equipment as specified herein meet the functional and operational requirements of the UPMRC Metro Station at Lucknow. ~~elevated and at grade stations.~~

1.3.2 The contract price shall be deemed to include any additional equipment, accessories, assemblies, sub-assemblies, equipment of higher capacities or higher ratings for the systems and sub-systems necessary for the complete, safe, reliable and operable system.

- 1.3.3 The proposed capacities, sizes, ratings of equipment in escalator system, as a result of the design development shall be demonstrated by a proper design and simulation study and subject to review by the “Engineer”.

**END OF CHAPTER**





CONTRACT LKE (02)-02  
EMPLOYER'S REQUIREMENTS  
PARTICULAR SPECIFICATION

CHAPTER 2

OVERVIEW OF THE PROJECT

## 2 OVERVIEW OF THE PROJECT

### 2.1 General

This Chapter gives an overview of the Project and the information provided in this Chapter is for reference only.

### 2.2 UPMRC MRTS Projects

#### 2.2.1 The Phase – 1B of Lucknow MRTS Project is expected to have following Corridors:

Sl.	Corridor/Sections	Expected date of commissioning
(a)	Thakurganj- Vasant Kunj (Elevated Section of Corridor-1B)	As per appendix 2B of GS
(b)	Charbagh – Chowk (UG Section of Corridor-1B)	As per appendix 2B of GS

#### 2.1.1.1 Agra & Kanpur MRTS Project

The Corridors details of Agra & Kanpur MRTS Project is as following:

Sl.	Corridor	Expected date of commissioning
(a)	Agra Corridor 1 & 2	As per appendix 2B of GS
(b)	Kanpur Corridor-2	As per appendix 2B of GS

### 2.3 Key Challenges

#### 2.3.1 The following are the Key Challenges presented to the Contractor.

- The escalators installed under the contract shall be highly reliable and shall provide the level of service required for Mass transit application.
- The specified level of reliability, availability, maintainability and safety requirements of these systems shall be achieved and verified by the Contractor by analysis, simulation, testing and commissioning, and system demonstrations as required in this Specification.

- c) The Contractor shall carefully study the space layouts allocated for the installation of escalators and plan for transportation, unloading, assembly and installation of escalators taking all the constraints into account and to ensure that all relevant safety clearances and rules are complied with and performance requirements are fully met.
- d) The space requirement given in the tentative layouts of various stations shall be critically reviewed by the Contractor to economise on space and also to provide a layout amenable to good maintenance and operation practices, to achieve an overall economic design.
- e) Various interfacing issues with other designated Contractors are required to be resolved to ensure timely completion of the Works. Whilst some of the interface issues have already been addressed, some of them are yet to be identified or finalised. It is the Contractor's responsibility to ensure that all interfacing issues are clearly defined and agreements sought from all other Contractors as well as from the local authorities in accordance with the GS and the interface requirements.
- f) The System Design shall meet the specified performance and operational requirements stipulated in this Particular Specification. The Contractor shall conduct Simulation Studies in early design stage, to ensure that the system capacity and equipment design meet the Employer's Requirements.
- g) The entire Scope of Works shall generally meet design requirements of fire safety in accordance with *NFPA –130 Standards* for Fixed Guide-Way Transit System, and *NBC* with latest versions / amendments, except where amended by this PS.
- h) The entire installation shall meet the protective provisions relating to electrical safety and life safety described under various standards.

**END OF CHAPTER**



# CHAPTER 3

## SCOPE OF WORKS

### 3 SCOPE OF WORKS

#### 3.1 General

This Specification establishes requirements for the design, manufacture, delivery at Site, installation, testing and commissioning, operating and maintenance manual preparation and training of maintenance/operation personnel of the Escalator system at stations of Uttar Pradesh Metro Network in Lucknow, Kanpur and Agra.

The Contractor shall be required to interface closely with the Detail Design Consultants appointed by the Employer and Designated Contractors working on Corridors. The Contractor shall also be responsible for obtaining clearances from statutory authorities, as per UP Lift & Escalators Act 2024 and future amendments, whenever required.

#### 3.2 Scope

The Contract shall include but not be limited to the following Works: -

- a) Provision of escalators in stations for passenger movements.
- b) Remote Monitoring System for Escalators and Elevator at Stations and OCC.
- c) Interface with civil contractor at site.
- d) All minor civil works or modifications required for installation of the equipment and restoring to final finishes.
- e) Transportation of materials and equipment for installation purposes.
- f) Spare parts, special tools, testing and diagnostic equipment and measuring instruments.
- g) Training and Transfer of Technology.
- h) Documentation.
- i) Control and monitoring system for Escalators.
- j) Maintenance for specified period.
- k) Services.
- l) Obtaining approvals / licence (if required) from the statutory authorities
- m) Interface and coordination for Computerized Maintenance Management System (CMMS) as per the requirements
- n) Any other documents as required by the Employer

The details of the above works are given in the relevant Chapters of this Specification.

#### 3.3 Services

The Services to be performed by the Contractor shall include, but not be limited to, the following:

- a) Design, manufacture, supply, system quality management, installation, testing including integrated testing and commissioning of the complete system as brought out above;
- b) Presentations, reviews and audit support as specified in this Specification;
- c) Interface management as specified in this Specification;
- d) System operations and maintenance support services;

- e) Training for Employer's staff and Transfer of Technology;
- f) Decommissioning, removal and/or disposal of temporary works;
- g) Prototyping;
- h) Defects liability of Permanent Works after commissioning as stipulated in the General Conditions (GCC) and Particular Conditions (PC); and
- i) Obtaining statutory clearances / licence (if required) for the commissioning of escalators from relevant authorities if necessary.
- j) Any other documents as required by the Employer

### **3.4 Documentation**

The documentation to be delivered by the Contractor shall include, but not be limited to, the following items:

#### **3.4.1 Design Stage**

- a) Description of general design philosophy;
- b) System reliability, availability, maintainability and safety evaluation reports;
- c) Automatic fault identification and isolation arrangement;
- d) Determination of equipment ratings;
- e) Determination of space requirement;
- f) Design and proving protection devices/ systems and its validation,
- g) Type test reports for equipment selected;
- h) Detailed design drawings and reports;
- i) Detailed interface reports and interfacing design drawings;
- j) Hazard identification and control documentation.
- k) Any other documents as required by the Employer

#### **3.4.2 Construction Stage**

- Construction and Installation Plan including site safety plan;
- Factory Acceptance Test Plan for equipment;
- Quality Plans and RAMS Plans;
- Installation, operation and maintenance instruction of all equipment;
- Operation and Maintenance Manuals;
- Records and drawings of equipment installed;
- All other records of construction, including hidden parts;
- Site test report of equipment;
- As built drawings including interface drawings; and
- Other documentation as required, by the Employer.

### **3.5 Other statutory requirements**

- 3.5.1 The Contractor shall be fully responsible for obtaining relevant safety certificate or license or Registration or any other document required from statutory authorities for commissioning the regular operation of Escalators. The renewal of the license/safety certificate or any other statutory renewal during DLP and CAMC will also be the responsibility of the contractor. Fee, if any for obtaining such license/certificate/registration shall be borne by the contractor.
- 3.5.2 The Contractor shall submit the relevant safety and clearance certificates obtained for each equipment from the statutory authorities to the “Engineer”.
- 3.5.3 The Contractor shall provide adequate signage and graphics as being statutory requirements, for the safe and proper utilisation of each equipment, in adequate number exhibited at required locations.

### **3.6 Key Dates and Access Dates**

The 'Key Dates' and 'Access Dates' applicable to this Particular Specification are given in Chapter 21 of this Specification.

### **3.7 Provision of Works Areas**

The Designated Contractor shall provide the Contractor specified Works Areas at designated locations during construction period. The Contractor shall hand over back the Works area to the designated Contractor after the expiry of specified period, reinstatement.

### **3.8 Items of Work Excluded from Contract**

The following items of work associated with the System will be provided by other Contractors and are excluded from the Contract. However, the Contractor shall provide timely inputs such as necessary drawings, instructions, hardware and materials to the relevant other contractors and co-ordinate fully with them in all matters pertaining to present contract as and when required under intimation to the Employer.

- 3.8.1 The relevant Civil Contractors will provide Major Civil Works including access roads, escalator pits and notches, escalator controller room, fences and building services.
- 3.8.2 Earth mats and earth electrodes will be supplied and installed by the respective Electrical Contractors.
- 3.8.3 The incoming LT cable from LT switchboard up to the Escalator controller room / Enclosure shall be provided by the respective Electrical Contractors. From there it's extension to escalator will be in the scope of escalator contractor, however, the required cable trays/race ways/conduits will be provided by the electrical contractor. The lighting as well as ventilation requirements in the escalator Controller/enclosure and fixing of the Control Panel of escalators are in scope of the Escalator Contractor. The fixtures and cables will be got approved from the Employer.

**END OF CHAPTER**



## CHAPTER 4

# DESIGN AND PERFORMANCE REQUIREMENT

## 4 DESIGN AND PERFORMANCE REQUIREMENTS

### 4.1 General

- 4.1.1 The design, manufacture, supply, installation, testing and commissioning of the Escalators shall meet the design and performance requirements within the design environments specified in this PS.

### 4.2 Design Environment

- 4.2.1 Climate Conditions/Operating Environment stipulated in clause 1.12 of General Specification shall apply.
- 4.2.2 Isokeraunic level: Average 30 thunderstorm days per year as per latest edition of IS 2309:1989
- 4.2.3 The stations are exposed to extreme weather conditions such as heat, dust and high humidity and occasional seepage. The system design shall, take into consideration these conditions and ensure that performance of the system remains unaffected due to such conditions.

#### 4.2.4. Environment and Climate Condition

- (i) Relays, cards and all equipment must be suitable to withstand very heavy pollution level as per IEC 60815.
- (ii) All applicable electronic cards / items should have conformal coating complying to environmental parameters prescribed in IEC 60721-3-3 for minimum 3C2 class. Test certificate as per test method specified in IEC 60068-2-60 needs to be submitted before delivery of the material.
- (iii) However, to withstand very high polluted area conditions, the conformal coating should meet 3C3 class requirement as specified in IEC 60721-3-3. It should be tested for values of mixed gases (H<sub>2</sub>S, SO<sub>2</sub>, CL<sub>2</sub> and Nitrogen oxides as per concentration given in 3C3) in accordance with IEC 60068-2 60 standard for a minimum duration of 10 days. Test certificate to this effect, shall be submitted by the successful tenderer before delivery of the material.
- (iv) All electronic cards, assemblies, sub-assemblies and components thereof used in equipment, relays, IED, PLC, AVR etc. supplied under the contract shall be of Industrial grade only as per relevant standards and shall be suitable for the ambient temperature range between - 0.6°C to 50°C. However, temperature inside the metal enclosed equipment placed in open sun may go up to 70°C (inside enclosure /surface).
- (v) All applicable cards must also be tested for Environmental test as per IEC 60571 and shall be done in accordance to IEC 60068. Details of tests are mentioned below: -
  - (a) Dry Heat Test for Class T3
  - (b) Low Temperature Test (Applicable for Lucknow region ambient temperature range).
  - (c) Change of Temperature Test.
  - (d) Cyclic Humidity Test.
  - (e) Driving Rain Test.
  - (f) Dust and Sand Test & Mould growth Test.
- (vi) Prior approval for specifications and makes of all components and sub components proposed to be used for electronic cards, for the respective equipment, shall be obtained from the Employer.

- (vii) The contractor shall submit details of components' configuration in the card, block diagram of the card and waveform signature at the beginning and end of each such block for each electronic card used in the equipment along with O&M documentation.
- (viii) All Electrical / Electronic Cards' enclosures shall be suitably IP rated as per relevant application and shall be dust, moisture, and vermin proof.

### 4.3 Basic Design Philosophy and Requirements

#### 4.3.1 Proven Design

- The Contractor shall develop the design based on this specification and on proven and reliable Engineering Practices. The design details shall be submitted with technical data and calculations to the “Engineer /Employer” for review and approval.
- The System, including all Sub-systems and Equipment shall be of proven design.
- The Escalator Sub-systems and Equipment proposed by the Contractor shall have been in use on at least two Projects of Mass Rapid Transit Systems/ Railway Station(s) / Airport(s) / Sub – Urban Railway(s) in Revenue Service over a period of at least two years during past ten years. The performance certificate from the client/ User of the system is to be submitted.
- Where similar equipment or Sub-systems of a different rating are already proven in service, then the design shall be based on such equipment. In case these stipulations are not fulfilled, the Contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered Sub-system.

The design philosophy should meet the following criteria:

- a) Application of state-of-the-art Technology,
- b) Service proven design,
- c) Design life 30 years,
- d) Minimum life cycle cost,
- e) Low maintenance cost,
- f) Use of interchangeable, modular components,
- g) Extensive and prominent labelling of parts, cables and wires,
- h) Use of unique serial numbers for traceability of components,
- i) High reliability,
- j) Low energy consumption,
- k) System safety,
- l) Adequate redundancy and factor of safety,
- m) Fire and smoke protection,
- n) Use of fire retardant materials,
- o) Environment friendly,
- p) Adherence to operational performance requirements,
- q) Maximum utilisation of indigenous materials and skills, subject to quality conformity.
- r) Specified values for Reliability, Availability and Maintainability (RAM) for equipment / components in escalator.

- 4.3.2 Adequate margin shall be built into the design particularly to take care of the higher ambient temperatures, dusty conditions, and high seasonal and general humidity, etc.

#### **4.4 Design Management and Control**

- 4.4.1 In order to ensure that the requirements of this Particular Specification are met, the Contractor shall establish and maintain documented procedures using ISO 9001 to control and verify the design of the System and all its equipment. These procedures shall be subject to review by the “Engineer /Employer”.
- 4.4.2 The Contractor shall establish and maintain a systematic, documented, comprehensive, and verifiable system integration process throughout the execution of the Contract.
- 4.4.3 This process shall ensure that interfaces and interaction between System, infrastructure, sub-systems, software, and operating and maintenance requirements have been identified and engineered to function together as a system.

#### **4.5 System Integration Process**

- 4.5.1 The Contractor shall systematically identify and formally document all design, manufacturing and operational interfaces between equipment within the System, and between the System and external systems, facilities, operations and the environment likely to affect or be affected by the System.
- 4.5.2 A mechanism and assigned project responsibility for interface management and control shall be provided, such that every identified interface has a defined resolution process that can be monitored.
- 4.5.3 The Contractor shall define methods to confirm compatibility between System equipment and carrying out integration tests at different stages of the design and interface management process to demonstrate that all equipment functions perform properly, both individually and as part of the complete System.
- 4.5.4 The Contractor shall ensure that performance, availability and safety requirements are addressed in the design process and that the reliability and maintainability of all equipment will enable the service performance to be met.
- 4.5.5 The system integration process shall be capable of audit by the “Engineer”.

#### **4.6 Interface Management Plan**

- 4.6.1 The Contractor shall submit to the “Engineer” for review an Interface Management Plan (IMP) and Detail Interface Documents, in accordance with the General Specification, which defines how the Contractor will systematically identify and document technical interfaces. This will not absolve the contractor of the ultimate responsibility for ensuring timely & appropriate interface.

#### **4.7 Design Submission Requirements**

- 4.7.1 The Contractor shall perform his designs for the Contract in accordance with the requirements of this PS and the GS. The Contractor shall submit to the “Engineer” for his review, relevant design information as identified under each stage. Such submissions shall incorporate the relevant Standards applicable.

4.7.2 The design submission requirements are detailed in the General Specification.

#### **4.8 Performance Features Required**

4.8.1 The Contractor shall provide built-in diagnostics and remote monitoring functions for each microprocessor-based equipment and module of the systems such that the performance requirements can be demonstrated.

4.8.2 The reliability and maintainability processes and procedures shall be planned, integrated and developed in conjunction with the operating environment, and the design, development and production functions to permit the most effective and economical achievements of the systems and equipment design objective. The Contractor shall prepare RAM analysis report based on the approved Escalator Design, which shall be validated by the contractor as per the actual performance data obtained during Defect Liability period.

In case the contractor is not able to achieve specified / provided target of RAM, the contractor shall take necessary corrective measures either by way of change of design of the relevant equipment / component or software modification at his own expenses to meet the RAM requirement.

4.8.3 The systems shall meet or exceed the requirements for safety and reliability as specified in National or International Standards for such mass rapid transit system. The reliability of the systems designed, supplied and installed is the principal element for availability. It is essential that the System reliability is as high as reasonably practicable.

4.8.4 A high design standard incorporating redundancy , flexible system arrangement, together with good quality products, and adherence to strict construction standards, are required to ensure high reliability of systems installed for smooth operation of train services.

#### **4.9 Reliability Requirements**

4.3.2 The Reliability requirements of this PS shall be subsidiary to the Availability and Maintainability requirements of this PS.

The reliability of equipment should be of the level that it does not result in harm or injury to passenger in the Escalators due to equipment failure. Any claim / damage / compensation claimed by the affected passenger / escalator user on account of equipment failure or poor design or poor workmanship of work shall be recovered from the contractor. In addition, Employer may impose a penalty of INR 15,000/- (INR. Fifteen Thousand Only) Per case. This penalty is applicable during Defect Liability Period (DLP) and Annual Maintenance Contract (AMC) Period.

The Reliability measure for the Escalators shall be the Mean Time Between Maintenance Action (MTBMA).

The Escalators shall achieve a MTBMA of not less than 7 days. Each day means 24 hours. MTBMA shall be calculated for each calendar month separately and MTBMA calculation shall be done based on the total number of escalators operational on 01<sup>st</sup> day of that applicable month.

## 4.10 Availability

### Service Availability Targets

- Quantitative targets have been set for the System availability to ensure that the reliability of the Systems does not jeopardise the reliability of services of the MRTS.
- The Systems shall be designed to ensure that failure of any major equipment, caused by an external accident or negligence of internal staff, will not lead to unavailability of the whole System, other than temporary outage of the failed equipment.
- All elements of the systems shall be able to be maintained during out-of-traffic hours to avoid interrupting passenger train services.
- For non-achievement of Availability Target as defined in chapter 17, Penalty shall be imposed as per Clause 17.7 of Chapter 17 of this PS
- If escalator is kept out of service for more than 24 hrs due to non – availability of spares or due to lack of proper attention, Employer shall impose a penalty of INR. 15,000/- (INR. Fifteen Thousand Only) per day, for each such case. This penalty is applicable during Defect Liability Period (DLP) and Annual Maintenance Contract (AMC) Period.
- The Employer will assess the reasons for the equipment not being in service, accordingly the penalty will be imposed. The Employer decision is final.
- The measure for Availability for the Escalators shall be based on failure reported.

$$\text{Availability} = \frac{\{(365 \times 20 \text{ hrs.}) \times \text{Number of Escalator population in a section}\} - \{\text{Total Unavailable hrs. in one year}\}}{\{(365 \times 20 \text{ hrs.}) \times \text{Number of Escalator population in section}\}}$$

The Escalators shall achieve minimum availability of 99.999% calculated as above

- For the purposes of availability calculation, the Contractor shall assume that the service operating hours are 20 hours per day (04:00 hours of morning to 00:00 hours of midnight or as decided by Employer), for 365 days a year for the design life.

## 4.11 Maintainability

- 4.11.1 The Contractor shall submit maintainability analysis to assess the preliminary maintainability targets of the systems.
- 4.11.2 The Contractor shall state the maintainability requirements, and demonstrate that System maintainability is sufficient to support the claimed System reliability and availability performance. The Contractor shall demonstrate that maintenance errors have been considered, and, as far as is practicable, the risk of maintenance-induced faults has been mitigated by the appropriate design.
- 4.11.3 The equipment to be supplied by the Contractor must be designed for minimum or no maintenance. Maintenance activity required must be capable of being performed with minimum or no impact on the train service.
- 4.11.4 Maintenance activities may be classified into two areas, routine/ preventive and corrective, both of which affect service availability. Other maintenance strategies such as condition monitoring may be incorporated.
- 4.11.5 Routine/preventive maintenance periods shall be limited to non-operational maintenance hours during the night or if essential during off peak periods.

- 4.11.6 To optimise speedy corrective maintenance, techniques employing automatic diagnostics test points, and rapid repair facilities shall be provided.

The MTTR (Mean Time To Restore) time measurement shall include on site diagnostics and rectification of the failure up to the point that the system is restored to full functionality. In the event that the failure cannot be rectified, the measurement shall include the time necessary to remove the failure piece of equipment from the system and replaced it with a functioning module.

The maintainability shall be measured by fault rectification time which should not exceed 4 hours since its reporting to contractor call centre or his representative by Employer.

Failure : Escalators not available for more than one hour for passenger service shall be registered as a failure provided:

- (1) Failure is attributable to –
  - (i) Design defect
  - (ii) Equipment failure / replacement
  - (iii) Manufacturing defect.
  - (iv) Poor workmanship during erection or installation or maintenance
  - (v) Maintenance lapse (during DLP & AMC by the contractor)

OR

- (2) “Accident” resulted because of any or all of the above defect.

For non-achievement of Maintainability Target as defined in chapter -17, Penalty shall be imposed as per Clause 17.7 of Chapter 17 of this PS.

- 4.11.7 Please note that for a period of Three months from date of Revenue Operation, the values of Reliability, availability and Maintainability will be calculated and monitored, but Penalty will not be admissible. After, three months from the date of Revenue Operation, Penalties as specified in the respective paras above will be applicable.

## 4.12 Safety

### 4.12.1 Safety Requirements

- The installation design shall incorporate measures to avoid presenting safety hazards to people.
- The Systems design shall incorporate measures to provide for its safe management and operation.
- The Systems shall not give rise, or be subject to, dangerous interactions within the railway or with other systems.
- The installation shall meet the fire safety requirements generally as per NFPA-130/NBC.
- The design of the earthing system shall conform to IS 3043 : 1987

#### 4.12.2 Safety Targets

- The Contractor shall show that the Systems can be maintained safely. The Contractor shall prepare a Quantified Risk Assessment (QRA) to model the risk to (a) travelling public and (b) maintenance and operations staff. The QRA may be based on a comparison of System features and operating practices with other metro systems for which risk levels are known.
- The Contractor shall demonstrate that the Systems have been designed to minimise the risk due to operator and maintainer error, considering both the ergonomic aspects of the System design to reduce the likelihood of error, and protective measures adopted to mitigate the consequence of such error.
- The Contractor shall demonstrate that risk to passengers, members of public, including trespassers is as low as reasonably practicable.

### 4.13 Conformity with Governing Specifications and other Statutory Requirements

4.13.1 The work shall be carried out in accordance with the following governing specifications and other statutory rules:

- Central Electricity Authority Regulation 2010 with latest amendments.
- Indian Electricity Act 1910 with latest amendments.
- Rules and Regulations prescribed by local authorities as applicable.
- Provisions of Applicable Lift and Escalator Act.
- Relevant, Indian Standards, IEC Standards, British Standards, and other National/International standards as applicable.

4.13.2 The Contractor shall furnish information asked for by a statutory body (e.g., Inspector of Escalators, Commissioner of Railway Safety, etc.) in particular format as directed by “Engineer/ Employer”.

### 4.14 Functional Requirements - Escalators

Escalators shall be provided in the stations to facilitate the movement of commuters between the different levels of the stations from Ground Level (GL) to the Concourse (C) or from Concourse (C) to Platforms (P) or the levels as specified by Employer. The Contractor shall verify the number of escalators, vertical rises, lengths, travels, stops, delivery routes and all other relevant information by co-ordination with the respective Civil Contractors or DDC or Architect as applicable etc.

### 4.15 Escalator Schedules

Refer volume-5 BOQ for Schedule of elevators to be supplied and execute.

- (1) The rises of escalators may vary by + 0.5 m based on site conditions, however the Contractor shall not be entitled for any extra payment on account of this variation. The payment will be made as per the applicable Band range of vertical rise defined in BOQ.
- (2) The Balustrade of escalator shall be either of Inclined Box Type Stainless Steel or of Glass as applicable with Newel Wheels/Roller for both type of Balustrades.
- (3) 4 meters of travel height = 3.5 < travel height ≤ 4.5 m and so on.



## **4.16 Codes and Regulations**

### **4.16.1 Local Codes, Regulations and Standards**

Unless otherwise stated herein, the design, installation, testing and commissioning shall comply with the latest edition of all applicable standards issued by the Bureau of Indian Standards and other relevant local regulations applicable.

- IS – 4591: Code of Practice for Installation and Maintenance of Escalators.
- Additional requirements imposed by statutory or government authorities not listed above shall be complied with.
- UP Lift & Escalator Act 2024.

### **4.17.2 Additional Standards**

Escalators (public service application) shall comply with the requirements of the heavy duty type for Mass Transit application in accordance with latest edition of British Standard BS EN 115, and European Standard EN115: Safety rules for the construction and installation of escalators.

The Contractor shall also comply with the requirements of the latest edition of NFPA – 130 (Fixed Guide way Transit Systems) & NBC.

## **4.4 Abbreviations**

The abbreviations used in this Specification are listed in Appendix - 'D'.

**END OF CHAPTER**



## CHAPTER 5

# DESIGN CRITERIA AND PERFORMANCE REQUIREMENTS - ESCALATORS

## 5. DESIGN CRITERIA AND PERFORMANCE SPECIFICATION - ESCALATORS

### 5.1 Definitions

The following words and phrases used in this Specification shall bear the meanings given below.

- a. Angle of Inclination -maximum angle to the horizontal in which the steps, the pallets or the belt move
- b. Anti-Slide Device - A device to be installed on the decking between the handrails of the adjacent escalators, or on the decking between the handrail and the adjacent wall, to prevent people or objects from sliding down on the decking.
- c. Balustrade - The enclosure at both sides of the moving steps, consisting of decking, inner and outer panels, and skirts.
- d. Ceiling Intersection Guard - A guard provided at the intersection of escalator decking and ceiling or soffit.
- e. Comb - The pronged portion of the comb plate at the landing which meshes with the step tread grooves.
- f. Comb plate - The plate supporting the combs at the landings.
- g. Control Equipment - The components by means of which motion, direction of travel, speed and stopping are controlled.
- h. Deck, decking and decking extension - The portion of the balustrade outside the moving handrails that are transversely horizontal. This shall include anti-slide devices where applicable.
- i. Driving Machinery -the motorized power unit for driving the escalator.
- j. Electro-mechanical Brake - A brake consisting of friction shoe(s) applied to a brake drum or disc by means of springs that are electrically released.
- k. Handrail - A power driven moving rail for passengers to grip whilst using the escalator.
- l. Handrail Guard - A guard for the moving handrail at the point where the handrail enters or leaves the balustrade.
- m. Landing - The stationary areas at the entrance to or exit from an escalator.
- n. Landing Plate/Floor plate - The portion of floor plate next to the comb plate at the landing.
- o. Newel - The portion of the balustrade on the landing at the end where the moving handrail changes direction.
- p. Number of Flat Steps - Flat steps shall be measured from the point at which the first step emerges from under the comb plate in a horizontal direction to the first exposure of the riser of an adjacent step, both at the upper and lower landings.
- q. Panel - The portion of the balustrade occupying the vertical space between the top of the decking and the moving stairway excluding space occupied by the skirts.
- r. Skirt - The portion of the balustrade immediately adjacent to the moving stairway, occupying the vertical space between the steps and the deck or inner panel.
- s. Step - The unit which forms the moving stairway.
- t. Step Chain - The main chain to which the steps are attached.

- u. Step Roller Track - The track on which the step roller runs.
- v. Step Tread - The horizontal portion of the step grooved in the direction of travel and on which the passengers are carried.
- w. Step Roller - The rollers attached to the step and supporting the step.
- x. Truss - The supporting structure on which the various components are mounted.
- y. Working Point – The intersection of the escalator step nose line and the projection of the escalator floor plate level.
- z. Constant length – The horizontal distance between the escalator working point and the end of escalator support.

## 5.2 General Requirements

5.2.1 Escalators shall be heavy duty with proven design of energy efficiency with VVVF (Variable voltage variable frequency) drive, reversible type and capable of operating safely, smoothly and continuously in both directions for a period of not less than 20 hours a day, seven (7) days a week with a alternating passenger load reaching 100% of Contract Load (120kg per step, including all horizontal steps) for half an hour in any 3 hour interval within the environmental conditions as stated in the General Specification and at the location where the escalators are to be installed. The heavy duty escalator should be a proven, tested and sustainable product for MRTS applications in terms of technology and design, as defined in clause 4.3.1 of PS.

All escalators with rise band  $\geq 10$  meters should have regenerative drive to generate electricity during their downward movement by virtue of gravitational effect the same shall be reviewed during detailed design stage, Contractor to submit design details, proposal, scheme and layout, etc. for the same.

5.2.2 Escalators shall be designed for installation and operation at an angle of inclination of  $30^\circ$ .

5.2.3 Operating speeds of the escalators shall be as follows: -

- (a) Service (rated) Speed - Nominal speed 0.5 m/s.
- (b) Maintenance / Idling / Crawling Speed - Less than 0.2m/s.

5.2.4 Step width shall be at least 1000 mm.

Three flat steps shall be provided at both upper and lower landings.

5.2.5 Safety factors used in the design shall, as a minimum 5 conform to EN 115 for the following: -

- (a) Trusses – As per EN 115 (as applicable for Public Service Escalators)
- (b) Step roller tracks and steps – 5
- (c) Driving Machinery – 5 for steel and bronze components; 10 for cast iron parts.
- (d) Chains – 5
- (e) Any other item (if not specified elsewhere) – As per EN 115 (as applicable for Public Service Escalators).

5.2.6 Ceiling intersection guards and anti-slide devices shall be provided where necessary.

5.2.6.1 The anti-slide devices shall be constructed from 1.2 mm stainless steel of grade 304. They shall be located not more than 1.8m apart along the decking, where

- (a) The outer edge is more than 300 mm from the centerline of the handrail.
- (b) The distance between centerline of handrails of two adjacent escalators is more than 400 mm.

5.2.7 Heavy duty Escalators shall be self-contained units consisting of truss, tracks, step drive units, steps, step chains, comb plates, handrails, landing plates, driving machines, controllers, safety devices, balustrades and all other components required to provide a complete installation. Materials used shall be non-combustible and selected to achieve a fire-resistant installation. The design of the escalators exposed to outdoor conditions shall take into account the adverse effects due to the inclement weather conditions..

5.2.8 Heavy duty Escalator design shall be such that no major repair shall be necessary for a period of at least fifteen (15) years from the date of issue of 'Certificate of Taking Over', assuming that regular inspection and maintenance are carried out in accordance with the manufacturer's recommendations. Major repairs shall consist of repairs to the major components like steps, track system, step chains, main drive system, traction machines, landing plates and tension carriage due to causes other than those attributable to normal wear and tear.

5.2.9 Escalator design shall give consideration to fire prevention, elimination of dust and oil trapping configurations, ease of handling, access into the station and easy accessibility for routine maintenance. There shall be provision for passenger guidance through audio system. Speakers shall be provided at suitable location in the escalators itself or at location as specified by employer during approval stage. The volume of the instructions is adjusted so that the instructions are clearly audible to the passengers on board at the time when no train arrived /standing at the station. The instructions shall be provided on "Integrated Chip". The "Integrated Chip" will be in the scope of the contractor. Speaker's location/ layout will be finalized during design stage. It shall be possible to increase or decrease the number of audio instructions to be played or modify the audio instructions as per requirement of Employer however contractor will not be liable for any extra payment on this account during the DLP period and the contractor shall handover the software/editable file (in electronic form) having all contents to UPMRC and also provide adequate training for altering/modification in above said digital voice system..

In addition, the escalator contractor shall provide passenger guidance / Do's and Don'ts for the use of escalators in suitable video format which can be played on the screen provided in the station public areas. Details of the playable format will be finalized during design stage.

5.2.10 In the case of adjacent escalators, it shall be possible to remove or replace all components of one unit, without stopping or interfering with the operation of the adjacent unit.

5.2.11 Not Used

5.2.12 Escalator components shall be protected against corrosion as follows: -

- |     |                                    |  |
|-----|------------------------------------|--|
| (a) | (i) Truss,                         | : - Hot-dip galvanized, minimum thickness 85µm.            |
|     | (ii) tension carriage, main drive, | Anti-corrosion protective paint (3 layers)                 |
|     | (iii) floor plate and comb plate   | Zinc plated  |
|     | Supporting structure and backing.  |  |
| (b) | Tracks and Hand rail Guide         | :- Zinc plated with stainless profiles or Stainless steel. |

- |     |   |   |
|-----|---|---|
| (c) | Step chain  | :- Special protection during installation to be provided.   |
| (d) | Steps   | :- Corrosion proof materials  |
| (e) | Floor plate infill  | :- Corrosion proof materials  |
| (f) | All bolts, nuts, shims and Other and hardware   | :- Zinc plated  |
| (g) | Balustrade supports and all other parts   | :- All parts constructed from steel or sheet steel shall be either galvanized by hot-dipped process complying with BS 729 or fabricated from hot galvanized sheet steel or with epoxy powder coated finishes. Cast iron assemblies shall be cleaned and painted with corrosion resistant paint. |
| (h) | Balustrade profiles, decking panels, skirt panel, outer cladding panels, Decking extension. | :- 2.0 mm thick for skirt panels & Minimum 1.5mm thick for decking panels, decking extension, inner cladding and minimum 1.5mm thick for outer cladding panels, grade stainless steel in accordance with ASTM A 182-61T or F-304H or ASTM A 167-61T T-304 or DIN 1.4301 or equivalent.          |
| (i) | Interior balustrade panels  | :- Refer to clause 5.3.8  |

All escalators should have provision of decorative LED Lighting in the Soffit of Escalator whose design shall be finalised during design and prototype testing stage.

5.2.13 All electrical equipment supplied and installed shall at least have the following class of protection.

- |                      |                           |
|----------------------|---------------------------|
| Machine              | : Protection IP Class 55. |
| Controller           | : Protection IP Class 55. |
| Isolating Switches   | : Protection IP Class 55. |
| All safety switches  | : Protection IP Class 55. |
| and interface boards |                           |

5.2.14 The elongation of the main drive chain and handrail drive chain shall not exceed 2% of the length of chain during its design life as mentioned under chapter 8 of particular specification The elongation in main drive chain, handrail drive chain and step chain shall be recorded by contractor periodically during

maintenance (DLP/CAMC) and report shall be submitted to Engineer for review. each year of DLP/CAMC.

- 5.2.15 All key switches used shall have the same type of switch cylinder and the key shall be common to all escalators. The cylinder used shall be unique. Details of Keys for different applications shall be finalized during Detailed Design Stage
- 5.2.16 The lower pit of all escalators shall be provided with detection device, such as float switch / flooding sensor, to stop the escalators if the pit is flooded. with level above 100 mm
- 5.2.17 Except for those items where use of PVC unavoidable all items should be non-PVC type. All cable should essentially be fire retardant low smoke. In a nutshell, use of PVC should be minimized as far as possible.
- 5.2.18 If any intermittent obstacle such as intersecting floor slab, is less than 400 mm from the center line of the nearer handrail, an intersection guard fabricated by light weight material reviewed without objection by the "Engineer", shall be provided in accordance with EN115.
- 5.2.19 It shall be possible to reverse any escalator manually irrespective of the direction of travel. After being reverse, the escalator shall run smoothly in the desired direction without adjustment and under any passenger load conditions.
- 5.2.20 All similar parts, elements, sub-assemblies and assemblies shall be totally interchangeable between escalators of same type and duty.
- 5.2.21 All ball or roller bearings whether or not sealed for life time greasing shall have a working life of at least 110,000 operating hours under operating conditions as laid down in Clause 5.2.1.

### **5.3 Mechanical Requirements**

- 5.3.1 Structural truss shall be of sufficient strength to carry the dead weight of the escalator which shall include any exterior claddings and decking extensions plus passenger load. Passenger loading shall be assumed as 5000 N/m<sup>2</sup> (load carrying areas = nominal width of escalator x distance between supports). The truss shall be designed to retain the steps and the running gear should the track system fails.
- 5.3.2 Truss shall be supported at both ends (top and bottom support), no intermediate support shall be provided for rises up to 8.5 meters and one intermediate support shall be provided for more than 8.5 meters rise in consultation with civil contractor with resilient supports and bearing plates. The provision of bearing plates and resilient supports shall be included in this Contract but shall be co-ordinated with the respective Civil Contractors. Resilient supports shall be designed for the purpose of preventing the transmission of noise and vibration to the station structure considering the design speed of Train as 95 kmph and service Speed as 85 kmph. Bearing rubber plates shall be provided at three locations (Left/Centre/Right) at both upper and lower landings, sized to suit design loads, with appropriate hardness and thickness, to ensure uniform load distribution, leveling, and effective vibration isolation. The design shall meet EN 115 structural and vibration requirements. The truss shall be designed to support the dead weight of the escalator plus the passenger load. Considering the passenger load, the maximum calculated deflection shall not exceed the limit/value as prescribed by EN-115.
- 5.3.3 The lower constant lengths from the edge of support to escalator lower working point will be assumed as 3500 mm while the pit sizes will be assumed as approximately 1700 mm (W) x 1450 mm (D) x



6000 mm (L) for Single Escalator for the preparation of civil works. The upper constant length will be assumed approx. as 4000mm for vertical rises up to 15 m. The Contractor shall coordinate with the Civil Contractor for their Civil requirements for all interfacing requirement. In the event that there are some civil constraints such that the "Engineer" may or may not required to revise the escalator shaft dimensions either as a whole or in part, the Contractor shall provide the escalator(s) with the truss so designed to suit the civil structure as directed by the "Engineer" at no cost to the Employer.

The temperature of escalator top pit (i.e. driving station having motor and gearbox) shall be monitored and escalator shall be stopped if temperature rises beyond a pre- fixed value and an alarm mentioning "top pit temperature high" shall be displayed.

- 5.3.4 Track system shall be designed and fabricated to support and retain the steps, running gears and prevent step up-lifting continually or intermittently during operation of escalator, under all load conditions at design speeds. The design shall allow installation and removal of mechanical components without dismantling the structure. The track system shall be constructed of steel. The track surface shall be straight and smooth. All joints, where possible shall be diagonal across the width of the running surface. The maximum deflection of the track system shall not exceed 1.00 mm between any two adjacent track supports under 6000N/m<sup>2</sup>. However minimum thickness of step roller track and chain roller track towards passenger side shall be minimum 5mm.

Radii of the upper and lower transitional tracks shall be equal to or greater than the following: -

- (a) Upper – 1.3 m
- (b) Lower – 1.0m

- 5.3.5 Non-slip, ribbed SS/ aluminum surfaced comb with yellow – coloured subject to the Employers acceptance at the design stage. Corrosion resisting aluminum alloy comb teeth shall be provided at both landings of each escalator. The comb plate structure shall withstand a load of 6000N/m<sup>2</sup> with a deflection not exceeding 2.0 mm. The teeth of the combs shall properly mesh with the cleats on the step treads and shall be designed to permit simple replacement in sections. The yellow colour light in the pits shall be provided to demarcate the moving and the non-moving parts of the escalators. The escalator Contractor shall make suitable provision in escalator panels for the UPS power connection from the station UPS for comb light, pit light, etc.

- 5.3.6 The comb sections shall be so designed such that when a foreign object is caught between the comb teeth and the step tread surface, the comb teeth shall either deflect, whilst remain matching with the grooves of the tread surface, or break. The load which may cause a comb tooth to break at its tip shall be not less than 700N nor more than 1900N. In the event that a foreign object caught between the comb teeth and the step tread surface cannot be removed as mentioned above, and is likely to cause damage to the steps, comb plate or its supporting structure, the comb plate safety switch as specified in Clause 5.8.10 shall be actuated and shall cause the escalator to halt.

- 5.3.7 Escalator landings shall be provided with easily openable, hinged landing plates suitable for access to the drive mechanism with some locking arrangement. There should be antitheft provision in the landing plates of SS balustrade escalators whose design should be reviewed at design stage. Landing floor plates shall have a non-slip etched stainless steel/aluminium surface with preferably square checkered finish whose groove depth should be minimum 1mm. Top surface of landing floor plate must be able to withstand wear and tear during heavy usage of escalator for 15 years which will be effective from issuance of taking over certificate, construction details will be reviewed during detail design stage. Lifting handles shall be provided to facilitate opening of the landing plate. Means, such as hydraulic cylinders, shall be provided so that the force required to lift the floor plate is not more than 200N. The floor plate shall withstand a uniformly distribution load of 6000 N/m<sup>2</sup> over its entire area,

the deflection shall not exceed 4mm during load application and there shall be no permanent deformation after the load is removed.

5.3.8 Escalators shall be provided with balustrade as specified in the Escalator Schedule in the Tender Document. Balustrades shall consist of handrail decks, inner panels, outer cladding panels, skirts and lighting installation as given below:

- (a) Handrail decks profile : Minimum 1.5mm thick stainless steel and hairline finish (Grade 304). The balustrade decking should be covered by hairline finish stainless steel (grade 304) of minimum 1.5 mm thickness.
- (b) Inner panels : For stainless steel panels, minimum 1.5 mm thick stainless steel, hairline finish (Grade 304), Required with reinforcement and sprayed-on fire resistant vibration/ sound attenuating backing subject to the acceptance of the "Engineer"
- (c) Outer cladding panels : Minimum 1.5mm thick stainless steel with hairline finish (Grade 304) in Visible as well as Non – visible section as per approval of "Engineer". Panels shall be with reinforcement and sprayed – on fire resistant vibration / sound attenuating backing material subject to the acceptance of the "Engineer". The cladding shall be provided on all three sides including bottom side.
- (d) Skirt panels : Minimum 2.0 mm thick stainless steel, grade SS-304 hairline finish, with a material of low coefficient of friction such as Teflon or equivalent as reviewed without objection by the "Engineer" applied on the surface. Appropriate type lubrication dispenser shall be provided on both sides of maintenance step(s) for lubrication of moving steps and skirts.
- (e) Lighting : LED comb lighting. Power supply shall be supplied from the UPS, to be supplied by the E&M Contractor.

Measures other than frictional or gravitation methods shall be provided to prevent the inner panels from dislodging during normal operation. The fixing method shall be subject to the acceptance of the "Engineer".

5.3.9 (a) The distance between the inner decking immediately below the handrail shall be as per EN 115.

5.3.9 (b) Horizontal clearances between skirt and the steps should be kept as per EN 115.

5.3.10 Where necessary, all outer sides of the balustrades and truss shall be provided with reinforced claddings. The gap between escalators and the sides of escalator and the adjoining walls/ parapet walls/ stairs shall be provided with decking extensions. The Contractor shall allow a gap of approximately 15mm between the decking and the adjacent walls/ parapet walls. The gap shall be filled up by the Escalator Contractor with flexible sealant subject to review without objection by the "Engineer". The claddings and decking extensions shall be fabricated from 2 mm thick stainless steel with hairline finish (SS 304). The inner surface shall be reinforced to prevent warping. It shall be sprayed with fire resistant vibration/sound attenuating backing material to the acceptance of the "Engineer". The claddings and decking extensions shall have tight butt joint and be fastened to the truss with concealed stainless steel bolts, nuts and washers. The joint line shall be perpendicular to the escalator step nose line without any longitudinal joints. All joint lines of interior decking, exterior decking/decking extension shall be aligned and staggered in arrangement in line with the joint line of interior panel. The design and the fixing details are subject to the acceptance by the "Engineer".

- 5.3.11 The balustrade shall withstand the loading without permanent deformation after removal of loading as specified in EN115.
- 5.3.12 Glass Balustrade shall meet the following requirement: -
- The glass balustrade shall be fabricated of tempered safety glass with minimum thickness 10mm and sufficient mechanical strength and rigidity in accordance with EN115 as a minimum.
  - Glass and glazing shall gently comply with BS 952 Part 1, BS 5713, BS 6206 and BS 6262.
  - All glass shall be capable of easy replacement.
  - The balustrade shall be glazed at the entire section from upper to lower newel ends.
  - The glass balustrade shall be self-supporting without mullions and the edges of the glass panels shall be bevelled and polished with joints perpendicular to the escalator step nose line rather than the horizontal.
  - Handrail drive system of escalators with glass balustrades shall be designed such that the drive system is below the passenger side and cannot be seen in the glazed portion.
  - All glass shall be manufactured and processed in a factory where the Quality Control Procedures comply with ISO 9000 and are independently maintained.
  - The thickness and safety design of the glass shall be the responsibility of the Contractor, having due regard to the performance requirements of this Particular Specification and the location where they are installed. Written confirmation from the glass manufacturer in respect of these matters shall be submitted for review without objection by the "Engineer".

## 5.4 Handrail and Handrail Drive System

- 5.4.1 Balustrades shall be provided with smooth and continuous handrails moving in the same direction and at the same speed as the steps with tolerance of - 0% to + 2% of the speed of the steps as per EN-115. The handrail shall have a service life of at least four (4) years under operating conditions as stated in clause 5.2.1. The color of the handrails shall be black. Appropriate uniform horizontal clearance throughout the direction of travel (minimum 80 mm) shall be provided from the outer edge of the handrail to the walls and other obstacles.
- 5.4.2 All handrails shall have inserts and sliding surfaces of endless construction designs, synthetic materials, traction type, with a single, smooth, vulcanized joint. Both the inserts and sliding surfaces shall be made from synthetic material. The minimum braking strength of the joint shall be greater than 85% of the minimum breaking strength of the handrail. The hardness of the outer stock shall not be less than Shore 70° A  $\pm$  5A°. The handrails shall run on specially formed guides except when in contact with a tension device. Appropriate action shall be taken to prevent the buildup of static electricity in the handrail. Hand and finger guards shall be provided at the point where the handrail enters the balustrade. The clearance between the guard and handrail shall not exceed 3.0 mm to prevent trapping.
- 5.4.3 The handrail drive system shall be provided with guides immediately before and after the drive wheel. The returning portion of the handrail shall be supported by guide roller shaving bearings at not more than 2m interval. Adequate provisions shall be provided to maintain proper tensioning throughout the service life of the handrail and prevent tightening/loosening and excessive heating up of the handrail during operation. The temperature rise of the handrail during operation shall not exceed 6°C above station ambient temperature.

- 5.4.4 The handrail shall overlap sufficiently with the handrail decking (top deck), to prevent pinching and trapping fingers or hands due to running clearance. The lips at the handrail shall be of sufficient rigidity to prevent the handrail being easily removed from the handrail guides by a force of 300N.
- 5.4.5 Lifetime greases packed roller bearings of manufacture reviewed without objection by the “Engineer” are preferable for all newel wheels. However, if non-lifetime bearings are used, greasing nipples for the wheel bearings shall be accessible without necessitating removal of balustrade panels from the passenger side.
- 5.4.6 The newel stands shall be of sufficient rigidity and suitably braced to the main structure of the truss to prevent undue distortion. Provision shall be made to permit checking of alignment of the newel wheels/roller on site.
- 5.4.7 Stainless steel hand railing on the sides of the escalator shall be provided at the landings to guide the passenger movement safely. Stainless Steel Railing shall be provided by Civil / Architect Contractor. Escalator contractor is required to interface with the designated contractor for provision of the same and to finalize location of the commuter instruction board at both landings.

The handrail entry boot shall be made up of Stainless Steel sheets having a thickness of 2 mm.

There shall be provision of decorative LED Lighting along with the lights below Handrail profile for Glass balustrade escalators, the details for the same shall be finalized during design stage.

## 5.5 Steps and Step Chains

- 5.5.1 Each step shall be supported on four wheels, two of which shall be the step chain wheels and shall be capable of carrying the basic load with the safety factor as per clause 5.2.5. Individual step loading shall be assumed as 6000N/m<sup>2</sup>. The design of the mounting of all wheels on the step shall ensure that the centre line of the wheel shall remain perpendicular to the running track under all load conditions. Step dimensions shall have a tread width of at least 400 mm deep and not more than 210 mm high.
- 5.5.2 The step shall be one piece, pressure die-cast, high wear and corrosion resistant aluminum alloy. The step casting shall bear a marking, which clearly indicates the month and the year of manufacture. The ingot materials for die-casting of steps shall be new and not previously used. Certificates of origin and chemical composition for the material shall be provided when required by the “Engineer”. The L-Angle/projection in the step, to operate step up-thrust safety device should be detachable and replaceable type (fixed through counter sunken bolts) there by facilitating replacement of L-angle, if it breaks.
- 5.5.3 Both sides and the rear edge of each step shall be painted with yellow demarcation lines of at least 20mm wide and the paint shall be applied on the entire surface of the step riser and the grooves of the step tread except the walking surface shall remain unpainted in natural aluminium finish.
- 5.5.4 Step riser shall be of a cleat-and-groove type. The grooves shall be painted black and dull finish except those area specified in Clause 5.5.3 above.
- 5.5.5 Step chains shall be of the endless roller type located on both sides of the moving step. The chains shall be provided in matched lengths and be of high quality steel construction incorporating links, pins, bushes, axles and rollers with three pitches between adjacent rollers. The chain rollers shall be located inside the chain links ~~with relieving curve~~ at four locations (toptop-left, toptop-right, top bottom-left and top-bottom right) and shall be easily replaceable without dismantling the links. All chain pins shall be circlipped. Each step chain shall be provided with an automatic tension device to ensure proper tension under varying load conditions. A method shall be provided to shorten the chain by one step to compensate for chain elongation.
- 5.5.6 The design of the fixing of the step to the step axle including detail of bushing, pin or any other means, shall be of proven design and have been in used for an extended period in existing mass transit

system(s) at a speed of 0.5 0.65m/s. The fixture shall permit quick and easy removal of step without dismantling any part of the step chain and the balustrade.

#### 5.5.7 Step Chain Pin Pressure

The step chain pin pressure of all escalators shall not exceed 20N/mm<sup>2</sup> with a design life of at least 110,000 operating hours.

#### 5.5.8 The step shall be type tested according to EN-115.

#### 5.5.9 The chain rollers/wheels shall have durable elastomer materials bonded to a metal die case hub/PU Hub . The shore hardness of the tyre materials shall be 92° A to 98 °A when cured. The bond shall have sufficient strength to avoid de-tying under all load conditions.

#### 5.5.10 The diameters and width of chain roller shall be provided as per EN 115 with a minimum diameters of the chain roller and the trailer rollers shall 75mm. The rollers shall have a minimum width of 20mm however service life of rollers shall be as mentioned in PS Clause No.8.1.1.

#### 5.5.11 The step chain tension device shall be designed and constructed to maintain the step chains at correct tension automatically and continuously under varying load conditions by means of compression springs. The tension device shall be located at the lower landing, mounted within the truss and supported on truss members, with adjusting bolts of the compression springs readily accessible and easily adjustable. Measurement Scale shall be fixed alongside to spring to measure the length of Spring.

### 5.6 Drive Mechanism

#### 5.6.1 Each escalator shall be independently driven by a traction machine.

#### 5.6.2 The traction machine shall be of the suitable geared type with the proven and established design. Each traction machine shall be mounted within the truss or the machine pit/room and connected by chain or directly coupled to the main drive shaft of the escalator.

#### 5.6.3 Traction machines shall be easily removable from the truss i.e. without dismantling the machines. Suitable lifting points shall be provided.

#### 5.6.4 The traction machines shall be provided with mechanically applied and electrically released brakes. The brake shall automatically bring the escalator to a halt whenever the power is interrupted, or any of the operating and safety switches is operated. If more than one brake is provided, all brakes shall operate simultaneously. The minimum and maximum stopping distances for the various conditions as per EN-115 are as follows: -

Nominal speed of escalator	Stopping distance between
0.50 m/s	0.20m-1.00m

#### 5.6.5 A device shall be provided to prevent the starting of the escalator if the brake does not operate properly. An indicator to indicate the wearing of the brake lining shall also be provided.

#### 5.6.6 A data plate indicating the brake torque, in Newton-meters shall be provided. Provision for testing the brake torque shall be provided.

#### 5.6.7 Where chains are used to connect the traction machine to the main drive shaft, an additional brake (auxiliary brake) shall be provided which will operate automatically on the main drive shaft should the chains fail. Sound Damping Bumper in sprockets grooves shall be provided to reduce the Sound of Chain Pins with Sprocket.

- 5.6.8 Provisions for hand winding and the necessary tools to effect the hand winding shall be provided for each escalator. As per EN-115, corresponding instructions for use shall be available in the vicinity and the direction of travel of the escalator shall be indicated clearly.
- 5.6.9 Where possible, self-lubricating maintenance free sealed bearings shall be used in the traction machine. Where regular greasing of the bearings is required, this must be accomplished without removing any part of the traction machine and yet provide adequate lubrication. If face-to-face roller bearings are used, matched pairs with provision for greasing of each bearing shall be provided.
- 5.6.10 The design of the traction machine shall ensure that there shall be no oil leakage from any part of the machine under normal operating conditions. Synthetic oil shall be used in the gearbox. Use of circulation pump for gear oil will not be accepted.
- 5.6.11 The gear system of the machine shall comply with relevant international standard.
- 5.6.12 The starting current shall not exceed 3.5 times full load current. The starting current characteristic and the speed/torque characteristic for different duty ranges shall be submitted for the acceptance by "Engineer".
- 5.6.13 The overall efficiency of the combined motor and gearbox shall not be less than 82% at full load which shall be demonstrated by the contractor during Prototype testing.
- 5.6.14 Suitable provision for monitoring oil level in gear box shall be provided. An inspection plate/dipstick shall be provided to check the condition of the gear.
- 5.6.15 Vibration isolation for drive units and switching must be sufficient to ensure no measurable increase in noise levels in local occupied areas during operation of the escalators.
- Escalator shall be equipped with auxiliary brake, and its operations should be as per EN115. The Auxiliary brakes shall be capable of stopping a fully loaded escalator independently without the support of service brakes.
- Resistance boxes used for dynamic braking of escalator shall be installed inside the truss of escalator to facilitate easy removal of heat generated.

## 5.7 Lubrication System

- 5.7.1 Automatic means shall be provided to lubricate the main drive chains, step chains and handrail drive chains efficiently and economically. Lubricants shall be selected on the basis of maintaining the highest possible flash point consistent with effective lubrication. The duration between two successive lubrications shall be adjustable from 15 to 150 hours of operation of the escalator. The duration for lubrication for each individual chain shall also be adjustable according to operational requirements. A low oil detection device based on the principle of 'oil level detection' or 'oil pressure detection' shall be provided to prevent the re-starting of the escalator after a predetermine time as recommended by the manufacture's but is no case more than one week when low oil is detected. Grease shall not be used for chain lubrication. Detailed proposal shall be submitted for review and approval of the "Engineer".
- 5.7.2 Corrosion resistant, oil tight drip pans of galvanized sheet of not less than 2.0 mm thick shall be provided for the entire length of the truss and shall be of sufficient rigidity. Drip pans shall be designed to collect and drain off both oil from the machines and water that may enter through the landings, floor plates, exposed portions of escalators or from fire suppression systems. All gaps shall be properly sealed to prevent leakage. Means shall be provided to drain and collect any excess lubricating oil from the chains to removable container(s) at the lower landing machine pit for easy removal and cleaning. The connection of Escalator's Drainage Point to Station Drainage System to drain out water shall be made by Civil Contractor but Escalator's Contractor shall do necessary interfacing with Civil Contractor for the connection of same. Dust Collecting Tray shall be additionally provided in both TOP/BOTTOM Pits to collect the dust falling from the Steps.

- 5.7.3 Guards shall be provided at the truss adjacent to the main drive chain, handrail drive chain and step chain to reflect oil splatters from the chains back to the oil drip pan. No oil splatter shall be allowed to get onto the truss, the back of the outer cladding panels, the outside of the truss and brakes. There shall be no oil spillage through the outer panels, claddings or the truss to the surrounding areas. Proper means reviewed without objection by the "Engineer" shall be provided to prevent the problem of oil spillage onto machinery spaces, step risers and step surfaces.

## 5.8 Operating and Safety Devices

Operating and safety devices conforming to the following requirements shall be provided: -

### 5.8.1 Starting Switch

Spring-return key operated starting switch with running directions marked on the face plate shall be provided at both ends of the escalator. These switches shall be positioned to enable the operator, when using the key to start the escalator, to see the entire escalator. The key shall be removable only in the neutral position.

Restarting of Escalator after stopping due to Emergency conditions, Fault or due to disruption of Power supply shall not be automatic. Restarting of Escalator should be on "NO – LOAD" as per EN 115.

### 5.8.2 Service Stop Switch

Service switches shall be provided within the machinery spaces at both ends of the escalator. The switches shall be conspicuously and permanently marked and located such that switching can be accomplished without passing or reaching over any part of the machinery. The operation of these switches shall disconnect electrical power to the controller and the drive mechanism and shall activate the brakes. The switch shall be rated to interrupt the starting current of the motor, and the fuses shall be rated for the available fault current at the switch. Inspection run shall also be prohibited.

### 5.8.3 Emergency Stop Switch

Recessed type, momentary pressure, emergency push button stop switches with extended sleeve to protect against accidental operation shall be provided on each escalator. A minimum of three switch (Top, Middle and Bottom Landings) shall be located in conspicuous and accessible positions at the incline section as well as at the newel at both ends of the escalator. The switch provided at the incline portion shall have protection from the dust ingress which may join its operation. The distance between the switches shall not exceed 15m for the escalators, otherwise, additional switches shall be provided. The operation of these switches shall disconnect electrical power to the drive mechanism and activate the brake(s). It shall not be possible to start the drive mechanism by the use of these switches. Proper signage as per EN 115 shall be displayed so that the location of the switch can be easily identified.

### 5.8.4 Speed Governor/Over Speed Safety switch

Speed governor shall be provided which disconnects electrical power to the drive mechanism and activates the brake, should the speed of the steps exceed the rated speed by more than 20%.

The speed governor is not required in cases where alternating current induction driving motors are used, provided the slip does not exceed 10% and the motor is directly connected to the drive mechanism.

### 5.8.5 Broken step Chain Safety Device

Devices shall be incorporated as part of each tension carriage which shall disconnect electrical power to the drive mechanism and activate the brake if the step chain breaks, or if the tension on either chain drops below (or exceeds) a predetermined value, or if the motion of a chain is interrupted.

### 5.8.6 Broken Drive Device

Where the drive mechanism is connected to the main drive shaft by chains, a device shall be provided which will disconnect electrical power to the drive mechanism and shall activate both the operational brake, and the additional brake in the event if the driving chains fail or excess sagging.

5.8.7 Non-Reversing Device

A device shall be incorporated to detect reversal from the pre-set direction of motion and activate the operational and auxiliary brakes to stop the escalators.

5.8.8 Handrail Finger Guard Safety Device

Detection devices shall be provided at points where the handrails enter the escalator newels. These devices shall disconnect electrical power to the drive mechanism and activate the brake in the event of an object entering the gap between the handrail and newel.

5.8.9 Step and Skirt Safety Devices

Detection devices shall be provided in escalator skirting panels in close proximity to the upper and lower comb plate tips, on the track system at the upper and lower curves and at 7.5m intervals along the incline of each escalator. Electrical power to the drive mechanism shall be disconnected and the brake(s) applied should any one of these devices be activated due to the skirt panels being forced away from the steps.

5.8.10 Comb plate Safety Device

Safety devices shall be incorporated at both sides on the comb plates at each landing, which shall disconnect electrical power to the drive mechanism and activate the brake should any object become wedged between the comb and the step. The device shall be able to operate in the vertical and horizontal direction.

5.8.11 Step Lowering Device

Devices shall be provided which will disconnect electrical power to the drive mechanism and activate the brake, should a step be lowered due to excessive load or breakage. The detection shall be effective at the left, centre and right side of the step. The device shall be located near the top and bottom curves for the escalators. These shall be located such that the lowered steps stop in front of the comb in order to prevent further damage.

5.8.12 Normal Stop Switch

Normal stop switch in the form of a key switch shall be provided at each landing to stop the escalator without activating the fault (trip) signal. Proper signage shall be displayed so that the location of the switch can be easily identified.

5.8.13 Inspection Control

Inspection control complying with EN-115 shall be provided at both landings.

5.8.14 Missing step detection device

Detection device(s) shall be provided to stop the escalator before the missing step opening appears on the passenger side of the escalator. In case a 'step' gets damaged then there should be provision of a device which ensures that the escalator shall stop before the damaged 'step' reaches the landing.

5.8.15 Handrail Speed Detection Device

Each handrail shall be fitted with a device, which shall stop the escalator in the event of a handrail speed deviation of more than -15% to the actual speed for more than 15 s while the escalator is in motion.



- 5.8.16 Broken Handrail Device
- Each handrail shall be equipped with a mechanically operated electrical safety device of Approved design to detect undue tension, excessive elongation and handrail failure.
- 5.8.17 Floor Plate Safety Device
- Safety switch of Approved design shall be provided underneath each hinged floor plate at both the upper and lower landings. The escalator shall stop when the floor plate is opened unless under maintenance / inspection mode.
- 5.8.18 Step Up-thrust Device
- Safety device of Approved design shall be provided at the upper and lower landings to stop the escalator should a step be lifted or displaced against the “up – thrust” track at the transition curve from incline to horizontal in the passenger carrying side of the track system.
- 5.8.19 Dress Guard
- Double layer type deflector device shall be provided along the step nose line on the skirt panel to keep feet and loose clothing clear of the possible trapping point. The brush bristles shall be made of fire resistant nylon filaments with split ends to give a soft face.
- 5.8.20 Brake Lining Safety Switch
- Safety device of design review without objection by the “Engineer” shall be provided at each brake shoe of the machine brake to monitor the lining thickness and to detect any abnormal or uneven wear of brake lining.
- 5.8.21 Phase Protection Device
- A phase protection device shall be provided in the control cubicle to prevent setting in motion or to stop the escalator in the event of phase failure or phase sequence reversal of the power supply. An illuminated visual indicator shall be provided on the control cubicle to signify actuation of this device due to phase failure or phase sequence fault. The indicator shall remain illuminated until the fault is rectified.
- The Contractor shall provide necessary equipment i.e. Surge protection, power filters and other necessary equipments to avoid failure of escalator equipments on account of quality of incoming power supply.
- 5.8.22 Motor Overload Device
- a. The driving motor shall be protected against excessive current due to either overloading or short-circuiting by means of a suitable device to be submitted for review without objection by the “Engineer”. Such protective devices shall be provided for each phase of the motor winding. After the intervention of this safety device, the power supply to the motor shall be disconnected and it shall only be possible for a competent person to reset it back to its normal working condition.
- 5.8.23 If the detection of excessive current depends upon a temperature increase in the motor winding, such a device may be automatically reset after the fault is removed and the winding cooled down sufficiently, but shall not restart the escalator automatically.
- 5.8.24 Built-in type thermal protection, if offered, shall conform to BS 4999 Part 72.
- 5.8.25 Earth Leakage Protective Device
- 5.8.26 An earth leakage protective device, or Residual Current Device, to be submitted for review by the “Engineer” shall be provided such that any dangerous earth leakage to the escalator metalwork shall

cause the immediate stopping of the driving machine and disconnection of the power supply. The return to service shall not be possible except reset manually by a competent person.

## **5.9 Monitoring and Fault Diagnostic System**

5.9.1 A micro-processor based monitoring and fault diagnostic system to provide information on the operation, identification and display of all faults that have caused the escalator to stop including emergency stops shall be provided. The system shall be able to record at least 100 events in their order of occurrence and display them sequentially in a last-in first-out sequence.

5.9.2 An alpha – numeric display unit indicating the fault code and fault message shall be installed at an easily accessible and protected location on the handrail decking at both the landings.

The display of the last fault can only be re-set, after the fault causing the stop is cleared but the historical record shall remain in the micro-processor.

Faults that do not require the attendance of the maintenance staff shall be easily identified to enable the operator to re-set and re-start the escalators.

5.9.3 The system shall capture, display and retain the following information,

- a. Record number
- b. Fault/status code/alphanumeric display
- c. Date
- d. Time at which fault started
- e. Time at which fault cleared
- f. Direction of operation with starting time
- g. Total operation hours with break down for “Up” and “Down” operations.

5.9.4 An LCD display panel and means for programming the system shall be provided at the controller.

In addition, serial interface output ports shall be provided at the controller to allow the system to be connected to a Notebook computer for downloading the historical data for trend analysis. Suitable compatible driver software has to be provided to download data for analysis and presentation by Microsoft office software.

Suitable arrangement for downloading the historical / fault data in a Hard Disk / Pen or Flash Drive to be made in escalator control panel itself. There should be provision of an independent data downloading port.

The power supply for the system shall be provided by Designated Contractor, and the escalator contractor has to interface with Designated Contractor for arranging back-up power supply so that the data can be retained for a period of at least 8 hours. The Contractor shall co-ordinate with the Designated Contractor on the load requirements. This shall be taken from the same incoming isolator/switch as the comb light.

5.9.5 Remote Monitoring system (RMS) shall be provided by the escalator contractor for the monitoring of Lift and Escalators.

## 5.10 Provisions for the Remote Monitoring System(RMS)

5.10.1 The Contractor shall provide a PC based Remote Monitoring and Control System (RMS) to be run on the computer in the Station Control Room provided by Escalator Contractor. The RMS shall provide continuous monitoring and controlling of the escalators.

5.10.2 The following monitoring function shall be provided for RMS.

- a. Power On /Off status indicator
- b. Status of Starter Key Operation: Whether the Starter key is on or off.
- c. Current operation status: Automatic/Maintenance/ Fault (breakdown) status
- d. Current Operation mode status: Normal operation/ Fireman operation/ Seismic operation.
- e. Status of the Emergency Stop Operation: Whether the Emergency Stop Push buttons have been pressed, in a crisis/panic situation
- f. Trip (fault) indicator for all faults with fault code (Should also include instructions to local operator / Controller to act in case of fault.)
- g. Safety switch tripped
- h. Location of tripped safety switch
- i. Up (escalators) direction indicator
- j. Down (escalators) direction indicator
- k. Start override indicator
- l. Speed of the escalator (0.0, 0.2,0.5 m/s)
- m. Running Time
- n. Trip Signal Log
- o. RMS Mode / Local mode
- p. Down time log
- q. Maintenance support (Maintenance Log, Maintenance Schedule & Non maintenance alarm.)
- r. Monthly Report with parameter jointly decided by employer & contractor
- s. History of different faults with code for min one month at OCC
- t. Any other parameter desired by Employer during the Detailed Design Stage.

5.10.3 The trip signal shall be activated whenever the escalator is stopped by any fault or emergency stop button during operation and the activation of the control functions in(a) and(b) in Clause 5.10.2 above. The signal shall be latched on until it is manually re-set by key switches located at the two

landings or remotely via the RMS. The escalator shall only be re-started after the “trip” is cleared and the “trip” signal has been re-set. Re-starting of escalators shall also be allowed for those fault signals activated by safety devices without the necessities of maintenance personnel to carry out inspection and the safety device is automatically re-set. Detail proposal shall be submitted by the Contractor for review without objection by the “Employer/ Employer’s Representative” prior to manufacture.

5.10.4 The following control function shall be provided for RMS:-

(a) Deleted

(b) Override control switches to prevent unauthorized starting of the escalator for both normal run and inspection run locally. This shall only function when the escalator has been stopped. A by-pass (Local/Remote) switch with illuminated indication which shall by-pass this function shall be provided in the controller.

(c) Remote re-setting of trip (fault) signal.

(d) Deleted

(e) Upon receiving a fire alarm signal all escalators going against the direction of egress at that time will stop. All escalators going in the direction of egress will continue to operate.

5.10.5 The RMS PC shall be used jointly to operate the functions of the Remote Monitoring and Control Systems of lifts also. The choice of size, system of display and background shall be furnished for the consent of the Employer or his representatives. The Contractor shall interface with Signaling and BMS Telecom contractor for integration of RMS system at SCR with Building Management System at underground stations. It is also the responsibility of escalator contractor to match protocol of escalator software with the software of equipment in OCC.

5.10.6 The Contractor shall be responsible for the provision of all conduits, trunking, cabling and interface terminal board (ITB) in connection with the installation of the RMS except that the conduits and trunking from the Escalator Controller in the pit to the Station Control Room will be provided by the respective Electrical Contractor. The Contractor shall coordinate and interface with Electrical Contractor and/or his sub-contractor in association with conduits/trunking routing and sizing requirement.

5.10.7 It is preferable that the Contractor proposes the use minimum of a serial data link for RMS e.g.RS485. The physical characteristics and data transmission protocol proposed shall conform to an internationally recognized publicly available standard. The Contractor shall also provide serial data link of each escalator, terminated in the interface terminal board (ITB) located in the Station Control Room for connection to OCC by “Telecom Contractor”. The information to be Carried by serial data link is detailed in Clause 5.10.2 above. The Contractor shall interface with “Telecom Contractor” in this regard.

5.10.8 The failure log of the escalator as mentioned in para 5.10.2 shall be made available at OCC.

5.10.9 Screened cables shall be used for the connection between the communication as described in contacts in clauses 5.10.2 & 5.10.3 above.

**5.10.10 Centralized Remote Monitoring System (RMS), Guided Troubleshooting & Intelligent Trouble Shooting Directory (TSD) for Escalator**

The Escalator Contractor shall provide a complete Remote Monitoring System (RMS) for all escalators, enabling centralized monitoring, real-time fault reporting, and intelligent troubleshooting at both the Station and the Operation Control Centre (OCC). The system shall comply with the following requirements:

**a. Data Monitoring**

The RMS shall continuously monitor and record at least the following parameters:

- Voltage
- Current
- Energy consumption of each escalator
- Running hours
- Brake operation counter
- Failure Trend for each Escalator
- Down Time and Up Time
- Energy regeneration (if applicable)
- Power On /Off status indicator
- Status of Starter Key Operation: Whether the Starter key is on or off.
- Current operation status: Automatic/Maintenance/ Fault (breakdown) status
- Current Operation mode status: Normal operation/ Fireman operation/ Seismic operation.
- Status of the Emergency Stop Operation: Whether the Emergency
- Stop Push buttons have been pressed, in a crisis/panic situation
- Trip (fault) indicator for all faults with fault code (Should also include instructions to local operator / Controller to act in case of fault.)
- Safety switch tripped
- Location of tripped safety switch
- Up (escalators) direction indicator
- Down (escalators) direction indicator
- Start override indicator
- Speed of the escalator (0.0, 0.2,0.5 m/s)
- Running Time
- Trip Signal Log
- RMS Mode / Local mode
- Down time log

- Maintenance support (Maintenance Log, Maintenance Schedule & Non maintenance alarm.)
- Monthly Report with parameter jointly decided by employer & contractor
- History of different faults with code for min one month at OCC
- Any other data point required by the Engineer

The above data shall be visible at the Station RMS Terminal and at the OCC RMS Workstation.

#### **b. Centralized Fault Reporting to OCC**

All Escalator events, alarms, faults, safety-device activations, warning conditions, energy data, and operating status changes shall automatically be transmitted in real time through:

**Escalator → Station SCR → S&T Network → OCC RMS Workstation**

Every transmitted event shall include, at minimum:

- Station name
- Escalator number
- Fault code
- Fault description/message
- System involved (e.g., Drive System / Step Chain System / Brake System)
- Subsystem involved (e.g., Drive Motor, Step Chain Tension System, Brake Coil Circuit)
- Specific equipment/device involved (e.g., Motor Thermal Sensor, Tension Switch #1, Brake Micro-switch)
- Time of occurrence and time of clearance
- Escalator status (Running / Fault / Out of Service / Maintenance Mode / Fire Mode)
- Direction of travel (Up / Down)
- Any other information required by the Engineer

The RMS shall store data during communication failures and automatically forward it once the network is restored.

A minimum of **30 days of local data storage** shall be provided.

#### **c. Troubleshooting Guidance**

For every received fault or event, the RMS shall display clear troubleshooting instructions for the Operator, including:

- Station name
- Escalator number
- Fault code

- Fault description/message
- Systems, subsystems, and devices involved in the fault
- Possible causes based on the fault details
- Step-by-step actions that can be safely performed by the Operator at the station
- Conditions under which the escalator can be safely restarted
- Clear indication of faults that must only be attended by the Contractor
- Necessary safety precautions

Troubleshooting guidance shall be displayed at both:

- The Station SCR RMS Terminal
- The OCC RMS Workstation

#### **d. Intelligent Trouble Shooting Directory (TSD)**

The escalator controller shall include a microprocessor-based Trouble Shooting Directory (TSD), available at both the station and the OCC. The TSD shall include:

##### **(i) Functional Block Diagram (FBD)**

- A detailed FBD showing the internal fault-detection logic of the controller
- Automatic highlighting of the exact logic path related to the fault
- Ability to view upstream and downstream logic steps

##### **(ii) Fault-Tree-Based Troubleshooting**

- Automatic reference to an internal fault tree for each fault
- Troubleshooting instructions updated dynamically based on the fault tree
- Grouping of related faults belonging to the same subsystem

##### **(iii) Editing, Upgrades, and Security**

- TSD shall be editable and upgradable throughout the contract period
- Editing rights shall be restricted to authorized maintenance personnel
- All new fault codes, updated logic sequences, and device changes shall be incorporated at no extra cost
- The Contractor shall train station staff and maintenance teams on how to use the TSD, read the FBD, and follow diagnostic steps

#### **e. Contractor Responsibilities**

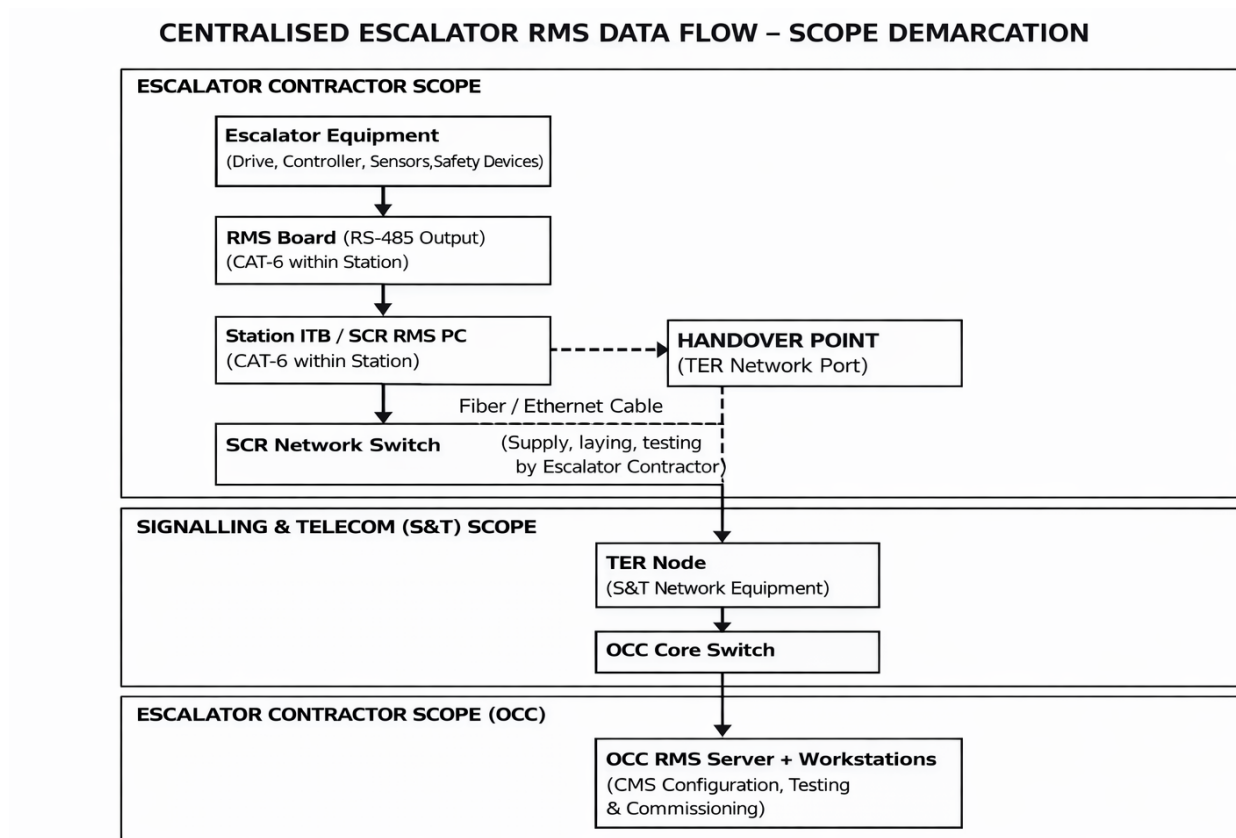
The Escalator Contractor shall:

- Provide complete mapping of all systems, subsystems, and equipment for every fault

- Submit the full fault tree diagrams and FBD logic during the design stage
- Integrate the RMS with the S&T network for communication up to the OCC
- Ensure all RMS terminals (Station and OCC) always remain synchronized
- Supply all required documentation, training, diagnostic tools, and software. Software provided shall be

**Note:** Refer Appendix H for more details

**Tentative Scheme:**



#### 5.10.11 Retention for Non-Delivery of RMS System

Delivery, integration, and commissioning of the Remote Monitoring System (RMS) with all specified features shall be treated as a critical contractual obligation.

If the RMS system, complete in all respects and fully compliant with the Technical Specifications (including centralized monitoring at OCC, fault reporting, data monitoring, and troubleshooting features), is not delivered and commissioned within the stipulated contractual timeline, the following shall apply:

(i) **Retention of Payment**



An amount equal to 10% of each running bill of SOP-1 shall be retained by the Employer until the RMS system is fully delivered, integrated, tested, and commissioned to the satisfaction of the Engineer.

(ii) **Recovery Clause**

If the Contractor fails to deliver and commission the RMS system even after the completion of the contract period, the retained amount shall be recovered by the Employer, and the Contractor shall have no claim whatsoever on the retained or recovered amount.

(iii) **Release of Retention**

The retained amount shall be released proportionately to the stations commissioned, only after successful commissioning and acceptance of the RMS system by the Engineer, supported by complete documentation, training, and demonstration of all specified functionalities.

5.10.12 Escalator Control Panel (ECP) shall have data downloading facilities for fault diagnostic through RS –485 Port and USB Port. Fault data logging in ECP should have date & Time stamping facilities of 500 events. There should be provision of resettable type counter {Resetting of fault codes should follow First In First Out (FIFO) Principle} for recording fault codes of escalator failure.

5.10.13 Also, there shall be provision of escalator data transfer including signals of fault codes, failure details, number of operations, energy consumption i.e. energy consumed, from open-source protocol either BACNET or MODBUS inside LED based RMS Panel through RS 485 or TCP / IP Port to Centralized Monitoring System by which Employer can access the data. Flexible controller to be provided for Communication whose setting can be changed.

In addition to above, contractor will provide facility to transfer Fault Data / Log of Escalators through Short Message Service (SMS) to designated Contact Numbers also. Details of the scheme shall be finalized during Design stage. Cost of SIM Card shall be borne by Employer.

5.10.14 Breaking distance of Escalator shall be displayed at the escalator control panel (ECP) display and at least 20 events of braking distance should be recorded in display.

## 5.11 **Energy Saving Device**

An energy saving device to conserve energy when the escalator is operated at no load and light load shall be provided such as by means of provision of speed reducing, load sensor and timer. When operating in the energy saving mode the device must not cause abrupt change in speed or jerk in normal operation, if required, suitable detection technology such as radar sensors or equivalent, and shall be finalized during the design stage, subject to approval of the Engineer. The devices shall cause minimal harmonic distortion in the power supply system or emit electromagnetic interference to other systems. OEM shall also provide suitable harmonic filters to eliminate harmonics in 'Energy Saving Device'. Provision shall be made to allow the escalator to be operated without this device. The Contractor shall submit the detail calculation of saving of energy for following options considering the MRTS load

- i. On no load after certain time (depend upon the travel time on escalator) escalator should come to crawling speed and then stop.
- ii. On no load after certain time (depend upon the travel time on escalator) escalator should come to crawling speed and remain at crawling speed of 0.2m/s.

When the escalator is operating at no load, the quantum of energy saved with this device should not be less than 30% as compared to operation without this device.

Data and calculation shall be provided to substantiate energy savings claimed by the Contractor for various loading on the escalator.

There shall be provision of Energy meter (Hour meter) to record consumption of Energy in all Escalators Panels, with the recording of energy per equipment with Time of Day (TOD) facility. Suitable provision shall be provided to record and generate Energy consumption logon the basis of Working hours i.e. Scheduled non-working hours, breakdown hours, waiting time/hours for attention of breakdown, actual period during breakdown maintenance done and period during which the equipment was kept working for monitoring but not offer for service with further differentiation as per TOD.

Energy Meter with provision of Recording of regenerative Power and Consumption power separately shall be provided by Escalators Contractor.

## **5.12 Machine Rooms/Pits and Closets**

5.12.1 The space required for machinery and other accessories shall be provided by the Civil Contractors in accordance with the co-ordinated requirements of the Contractor. Controllers and other accessories such as incoming isolators, ITBs, switches, shall be housed outside the truss in Enclosure of controller below the escalator inclined section or in wall recess/closet besides the upper landing. Further wiring work excluding conduits/ trunking from the incoming isolators to escalator equipment shall be provided by the Contractor.

The Contractor shall co-ordinate with Civil contractor for the layout of the equipment in the wall recess/closet.

5.12.2 Each machine pit and controller enclosure shall be provided with suitably protected permanent light fixtures, electrical outlets, mechanical or natural ventilation and suitable access as part of this Contract. The lighting, electrical outlets and mechanical ventilation (if required) shall be independent from the power supply to the escalator machine and may be fed either by a separate cable or a branch cable which is connected before the main switch of the escalator.

5.12.3 The Contractor shall provide a 16A single phase switched socket outlet and a protected permanent lighting in the lower landing machine pit/returning station pit, upper landing machinery space and escalator control panel.

5.13.4 The various power cables and control cables / wires inside escalator truss shall be laid neatly inside cable raceways or through appropriate mechanism to be finalized during prototype testing as decided by Employer.

## **5.13 Electrical Requirement and controller**

5.13.1 Escalators shall be designed to operate on power supplies of 415 V AC + 10%- 15%, 3 phase, 50Hz, 4 wire, or 240 V AC + 10% -15%, single phase, 50Hz. All electrical components shall be rated to these voltages. The control circuit shall be so designed that quality of power supply (surges, harmonics, voltage variations, frequency, etc.) shall be properly maintained. Escalator power supply shall be provided by designated contractor. The Contractor shall co-ordinate with them for the appropriate electrical requirements to be terminated with suitable fused isolators/switches installed within each controller enclosure / closet next to the controller. Suitable provisions shall be made for protection against single phasing, unbalance loading and any other abnormal condition.

5.13.2 Cables, trunkings, conduits and conduit fittings necessary for the power, control and lighting circuits shall be installed in accordance with the latest edition relevant BIS standards.

- 5.13.3 Trusses, machines, motors and all other non-current carrying metal parts and components shall be effectively earthed by the Contractor to the incoming earth in the isolator provided by designated contractor.
- 5.13.4 Electrical safety switches and controllers shall be suitably enclosed to provide protection against accidental contact.
- 5.13.5 Motors shall be of ample capacity and rated to continuously operate the escalators efficiently, quietly and smoothly under all conditions of load as specified. The motor insulation and temperature shall comply with minimum class 'F' standard in BS2757.
- 5.13.6 Controllers shall be provided to control starting, rotational direction and stopping of escalator motors. The controller shall bring escalators to a stop in the event of activation of any safety device, power failure, or normal shut down. Controllers shall be provided with the double door arrangement such that the small door (which can be closed with a lock & key) is having provisions of Mushroom Type Emergency Stop Button, Fault Reset Switch, RS485 Port, USB Port, Alpha Numeric Escalator LCD Fault Display, Mimic Panel to check and see various historical faults and parameters of escalator with date and time stamping facility etc. (Details to be finalized during Design stage) are accessible to through the small door for the normal operation of escalator and larger door is for the maintenance purpose only. The controllers shall be designed in such a way that power and control circuit is physically separate, so as to ensure safety of the maintenance staff. The control and electric wiring diagram to be laminated and provided on the controller. A copy of main diagram and Maintenance manual shall be provided in the controller.
- 5.13.7 Controllers shall incorporate power supply switches (3 phase, 3 pole and one phase one pole), main switch, selectable manual/auto resetting thermal overload, inherent low voltage release, unbalanced and reverse phasing protection and earth leakage protection. The Main switch for ON/OFF to be provided in Escalator Control Panel should have provision for Auto OFF through Timer. Temperature of Escalator Control Panel (ECP) shall be displayed at the front of the panel. For heat dissipation in the Escalator Control Panel (ECP), Fans have to be provided. They should have metallic body & blades with sealed maintenance free ball bearing. Fans shall have a life of minimum 8 years. Fans should work with timer/temperature logic to give them periodical rotation i.e working and standby configuration rotation at equal interval. The alarm should be generated whenever the required fans are not working. Calculation for heat dissipation in ECP panel to be submitted during design stage to finalize fan rating and quantity.
- 5.13.8 Control circuits shall be protected by fuses or equivalent means independent of the protection for the main circuits. All electronic components and relays shall be protected against starting and voltage surges by appropriate surge suppressers / surge arresters.
- 5.13.9 Control system shall not depend upon the completion or maintenance of an electrical circuit for the interruption of the power supply to the drive mechanism or brake.
- 5.13.10 All switches, relays, timers, and all auxiliary apparatus shall be of accepted design and labeled for identification.
- 5.13.11 The power and control wiring shall be laid out neatly and terminated with suitable cable termination sleeves. All terminals and cables shall be labeled and marked for identification. All power wiring shall be with the color coding for the phases i.e Red, Yellow, Blue: and Black for Neutral and Green for Earth. All live terminals from other sources shall be properly protected and identified with yellow warning signs.
- 5.13.12 The escalator controller shall be housed in a 1.5mm thick, IP55 (ingress protection of panels shall be achieved through good quality polyurethane gasket suitable for continuous use from -30°C to 80°C) spray painted or galvanised sheet (with minimum 85 µm thick Galvanising) metal cabinet with hinged door, lockable with a dedicated key. The operating buttons / switches etc. shall be provided

in lockable enclosure to restrict access to authorized person only. The size of the controller cabinet shall be suitable for mounting into a wall closet of maximum dimensions 2000 mm (width) x 2000mm (height) x 500 mm (depth) with doors and shall be suitable to house the incoming power supply isolators and ITBs.

The contractor will have to suitably design the layout after due interfacing with other designated contractors and with the approval of "Engineer".

Generally the distance between Escalator and Escalator Control Panel (Controller Cabinet) shall not be more than 30 meters. However, depending on site conditions, it may vary and No additional payment on account of any variation in distance will be made to the contractor.

5.13.12 Escalators controller shall be fixed properly. Fixing Arrangement details to be submitted during design stage for approval of "Engineer".

5.13.13 The Controller equipment shall be designed as per design environment specified under clause 4.2.

## 5.14 Special Cable Requirements

All cables used except those within the enclosed controller shall comply with the following requirement:  
-

5.14.1 All control cables used shall be rated for minimum grade of 650 V and all power cables for minimum grade of 1000V

5.14.2 The conductor shall be of stranded conductor composed of plain annealed copper wire complying with IEC 228, Class 2.

5.14.3 The insulation shall consist of an extruded layer of cross-linked polyethylene complying with IEC 502.

5.14.4 All cables shall be manufactured from fire retardant, low smoke, materials.

5.14.5 Fire retardant, low smoke, materials shall meet the following requirements:-

- (a) London Transport Executive Three Meter Cube Smoke Emission Test, using optical measuring instruments. The maximum value of absorbance AO (ON), AO (OFF) shall be 0.8 & 1.2 respectively.
- (b) The US National Bureau of Standard Smoke Chamber Test, used to evaluate plaque samples of materials of constant thickness. (NFPA-258 Smoke Generation of Solid Materials 1982). The maximum specific optical density shall be 170 under the non-polluted condition.
- (c) The flame propagating criteria of US IEEE Standard 383, with a minimum test short circuit time of five minutes, in the IEEE Standard 383 test.
- (d) IEC 332 Parts 1 and 3, Category B, tests on single and bunched cables under fire conditions.
- (e) Limiting Oxygen Index of at least 30, to ASTM D-2863.
- (f) A temperature index (TI) of 260°C to ASTM D-2863.
- (g) All insulation is to be moisture and heat resistant, with temperature ratings appropriate to the application conditions, and in no case lower than 90°C.
- (h) When a sample of the cable is subjected to a combustion test for the determination of the amount of halogen acid gases (other than hydrofluoric acid) as set out in IEC 754 - Part 1 the halogen acid evolved shall not exceed a maximum of 0.5%.

Fire retardant materials shall meet the requirements of item (c), (d), (e), (f) and (g) only.

- 5.14.6 The above requirements shall be met without compromising the anti-termite, pest-resistant, mechanical and electrical properties of the cables both during and after installation to meet the other requirements of this Specification.

## **5.15 Interface with Fire Protection Systems**

All the escalators (**only in underground Stations/areas**) shall be equipped with a sprinkler system, Sprinkler heads (outlets) in the landing pits/ machine rooms and sprinkler pipes along the Truss. The Escalator Contractor shall provide sprinkler pipes and heads inside truss for the Escalators. The locations of the sprinkler heads shall be finalized during design stage. The Escalator contractor shall co-ordinate with designated Contractors and make adequate provision to incorporate all the required fire protection equipment and to get the sprinklers provided in the landing pits and machine rooms connected to the main Fire Sprinkler / Suppression system. Extension of water supply connection to the Sprinkler pipes of Escalator from the nearest Fire Hydrant / Sprinkler hydrant will be done by the Fire Hydraulic / E & M Contractor, for which necessary Interface will be the responsibility of Escalator Contractor.

All the escalators should have provision of Smoke cum Heat detection system in the escalator system at appropriate positions like in machine room, controller, etc. Provision of smoke detection system shall be in scope of Escalator Contractor. Escalator Contractor is responsible for demonstrating working of the Fire Alarm system in the escalator to the statutory authority ( as and when required). Escalator Contractor shall arrange these smoke detection signals in the form of potential free contacts at each escalator control panel to E&M Contract or for displaying in station fire alarm control panel system.

## **5.16 Lighting**

- 5.16.1 Lighting for areas surrounding escalators will be provided by others and contractor will interface with designated E&M contractor for sufficient illumination over the escalator and escalator landings. The minimum lighting level is 50 lux (under normal conditions) at the center of the floor plate between the balustrades. The Contractor shall co-ordinate with designated Contractor to provide adequate lighting.

- 5.16.2 The comb lighting, pit lighting inside each machine room and step gap lighting shall be provided by the escalator contractor. All lighting shall be of LED type complete with all operating circuitry. The step gap lighting shall be of green color. The step gap lighting shall be provided so that the passengers can adjust there feet on the step and it shall be provided under the steps near the comb plate at each landing.

The lighting level of the comb light shall not be less than 50 lux at the center of the comb.

All the lightings shall be completely water and dust proof and shall be provided by the Escalator Contractor.

## **5.17 Noise Generation**

- 5.17.1 Equipment shall be designed to operate quietly and smoothly. The sound level should not exceed 70dBA at a distance of one meter from the surface of the machinery at a height of 1.6 m from floor plate as per EN115. as measured by a slow response sound level meter. The required acoustic treatment shall be supplied and fitted as necessary to meet this requirement.

## **5.18 Fault Diagnosis Procedures and Circuit Diagrams**

Fault diagnosis procedures and circuit diagrams down to component level of the printed circuit boards, detail information software and technical data shall be provided to assist in trouble-shooting for breakdown during normal operation and maintenance. The Escalator contractor shall supply interactive O&M and Training manuals in hard and soft copy.

**5.19 Escalator Signage's and Interface with Station Signage Contractor**

5.19.1 The contractor shall provide signage's and user instructions on each escalator as per EN115. This design shall be subject to review by "Engineer".

**5.20 Data Plate**

A data plate of durable material containing all relevant technical information essential for maintenance and replacement of parts such as rise, length, part number, etc., shall be provided in the machine pit of the escalator.

**5.21 Accessories**

Each escalator or stated otherwise shall be provided with the following accessories:

- (a) Two sets of maintenance barriers per Station.
- (b) Two sets of starting keys.
- (c) One hand-winding tool per escalator. (If applicable)
- (d) One set of hand lamp.
- (e) One set of inspection boxes with cable per escalator.
- (f) One set of floor plate opening tools.
- (g) Two sets of inner panel opening/removal tools per station.
- (h) Two sets of keys for controllers.
- (i) Two sets of keys for each type of by-pass switch.
- (j) Screen – printed Commuter Instructions on both Landings (both should be on Steel frame) the design shall be finalized during approval stage.

The contractor will submit the sample of all above material for the approval of Engineer before actually delivering them in mass quantity.

**5.22 Maintenance Barrier**

A barrier shall be provided for both escalator landings, which shall prevent people for entering the pits and escalator. The barrier shall be painted yellow, made from steel and be of minimum height 900mm. The barrier should be on wheels with lock and easy to handle and shift over a distance of 100 meters, with maximum 2 persons. The design of maintenance barrier shall be approved by the engineer before it is delivered at site.

**5.23 Variable Speed Control/Drive**

Variable speed control/drive shall be provided. The control shall be integrated with the escalator control. It shall be able to operate the escalator at nominal speed of 0.5 m/s and reduced crawling speed of 0.20 m/s, with all other requirements and performance remain unchanged. An easily accessible manual change-over switch, with clear label to the "Engineer" acceptance, for selecting the normal and reduced speed, shall be provided in the controller.

If there is no movement of passenger for adjustable predetermined time (say 3 minutes) (Adjustable between 0.50 to 5 minutes) the escalator shall operate at crawling speed 0.2 m/s and further if there is no passenger movement for 10 minutes (adjustable 1.50 to 30 minutes) the escalator will stop.

When commuter approaches the escalator, it will start and attain nominal speed.

When escalators detect no load or light load under a predetermined period, the service speed shall decrease to the idling speed (0.2 m/s) or stop after pre-determined time (Adjustable time).

To meet the above requirements, the drive shall be capable of Operating as follows: -

- (a) Service (rated) speed - Nominal 0.5 m/s
- (b) Maintenance / idling speed  $< 0.2$  m/s.
- (c) Stop, if No Load for predetermined time (Adjustable from 1.50 to 30 minutes)

OEM shall also provide suitable harmonic filters to eliminate harmonics. Ceiling limit for total harmonic distortion (THD) shall be as per IEEE 519-1992.

## **5.24 Earthing System**

All the escalator equipment, structures and other metallic parts shall be suitably earthed with the station earthing system as per the standard practices. The station earthing system shall be provided by the Designated E&M Contractor up to Escalator Controller and the Escalator Contractor shall make necessary arrangements to extend the earthing connections up to other escalator system. Interfacing and co-ordination with the Designated Contractor will be in the scope of Escalator Contractor.

## **5.25 Additional feature for Outdoor Escalators**

Contractor shall note that the Stainless Steel escalators are assumed to be installed in fully outdoor environment. The contractor shall take necessary measures while designing, manufacturing and installing such escalators so that ingress of water or dust shall not deteriorate the performance and reliability of escalators and the finish/properties/strength of the escalators' exposed parts. The contractor shall also incorporate necessary additional safety devices for these escalators..

**END OF CHAPTER**





## CHAPTER 6

NOT USED

## CHAPTER 7

# QUALITY ASSURANCE AND SYSTEM ASSURANCE

## **7 QUALITY ASSURANCE AND SYSTEM ASSURANCE**

### **7.1 General**

A Quality Assurance programme shall be developed and implemented as a means of determining compliance with the Employer's Requirements. This programme shall comply with the requirements as set out in ISO 9000. The programme shall include but not be limited to the procedures necessary to ensure that all equipment, materials, systems and sub-systems are properly specified, designed, purchased, recorded, inspected, installed and tested at all appropriate stages. The procedure shall also ensure that handling, storage and delivery arrangements are satisfactory.

### **7.2 Quality Assurance Programme**

The Contractor's quality assurance programme shall include as a minimum, the following functions:-

7.2.1 Inspection System: A system for in-process inspection of work operations and manufacturing as well as installation processes, including observations, measurements and tests, to ensure conformance with the requirements of the Contract.

7.2.2 Calibration System: A system for periodic calibration and control of the accuracy of precision instrumentation and gauges.

7.2.3 Record System: Data and records essential to the operation of the quality programme shall be maintained by the Contractor and made available to the "Engineer" in every Month during the DLP. These records shall include work performance, inspection and testing observations and the number and type of deficiencies found. In addition, records shall be maintained for monitoring work performance, inspection and testing which indicate the acceptability of work or products and the remedial action taken in connection with deficiencies.

7.2.4 Supplier Control System: A system for ensuring that all supplies and services procured from suppliers (subcontractors and vendors) conform with the requirements of the Contract.

7.2.5 Manufacturing Control System: A system for providing necessary control over manufacturing operations to ensure that the final product conforms with all requirements of the Contract. This system shall include controls for the following areas:

(a) Materials

Suppliers' materials and products shall be subject to inspection to demonstrate conformance with the technical requirements.

(b) Production Process and Fabrication

The Contractor's quality assurance programme shall ensure that all machinery, wiring, batching, shaping and basic production operations (of any type) together with all processing and fabricating are accomplished through documented work instructions. These instructions shall be the criteria for acceptable workmanship.

(c) Completed Item Inspection and Testing

The quality programme shall ensure that there is a system for final inspection and testing of completed products. Such testing shall provide a measure of the overall quality of the completed product and be performed so that it simulates, to a sufficient degree, product end use and functioning.

(d) Statistical Quality Control and Analysis

Statistical methods may be utilised for planning, analysis, tests and quality control whenever such procedures are suitable for maintaining the required control of quality. Sampling plans shall be subject to the acceptance of the “Engineer” prior to use.

(e) Indication of Inspection Status

The Contractor shall maintain a positive system for identifying the inspection status of products. Identification may be accomplished by means of stamps, tags, routing cards, move tickets or other control devices acceptable to the “Engineer”

7.2.6 Installation Control System: A system providing necessary control, monitoring, inspection of the progress, quality of work and protection of equipment, to ensure that the equipment is installed according to the requirements of the contract.

The system shall include but not be limited to the following, which shall be subject to the acceptance of the “Engineer” prior to use:

(a) Shop Drawings

All layout and shop drawings giving detailed layout of equipment, structural cut-outs, supports, openings, all dimensions, tolerances setting, etc.

(b) Assembly Procedures and Drawings

This shall show details of all installation and assembly procedures, including tolerances, tightening torque, alignment, precautions, etc.

(c) Inspection Checklist

Check lists giving all items to be checked and inspected with tolerances setting, etc.

7.2.7 The Contractor shall submit checklists to demonstrate compliance with all applicable standards.

## 7.3 Systems Assurance

The Tenderer shall demonstrate a clear understanding of all the requirements of this Clause in his tender submission.

### 7.3.1 General

- a) The Contractor shall develop and implement the requirements for Systems Assurance. These requirements shall be applied also to subcontractors and suppliers and shall be carried out during the design, manufacture, installation, testing and commissioning phases of the Works.
- b) The Contractor shall prepare and submit for review and acceptance by the “Engineer” a Systems Assurance Plan thirty days after Contract Award.
- c) The System Assurance Plan shall define the Contractor’s approach, procedures and schedules for conduct of Safety Engineering, Reliability Engineering and Maintainability Engineering. Human Factors Engineering is an integral part of Systems Assurance and shall be considered and reflected within the Systems Assurance Plan.
- d) The Contractor shall pro-actively engineer the systems to meet the safety, availability, reliability and maintainability performance requirements listed below and demonstrate that the requirements have been met by the system installed.
- e) In the process the potential hazards to safety, availability, reliability and maintainability performance should be further minimised where design options permit.
- f) The deliverables listed below are intended to provide the “Engineer” with a sound basis for acceptance of the safety, availability, reliability and maintainability performance; progress information; confidence that the design is proceeding with a low risk of failing to meet the

performance requirements; information that will aid the planning of work schedules; and part of the foundation of the safety case for operation of the line.

### 7.3.2 Systems Assurance Plan

- a) The Systems Assurance Plan shall be developed specifically for this Contract and shall address in particular the following items:
  - i) Safety engineering which shall provide analyses for the minimisation of the magnitude and seriousness of those events or malfunctions which could result in injury to passengers or staff and damage to equipment or property; and must eliminate category I and II hazards which are defined latter in this Clause.
  - ii) Reliability, maintainability and availability engineering analysis which shall ensure a high degree of failure free operation and minimise down time during routine maintenance and failure repair.
- b) The Contractor shall formulate and document criteria to satisfy the requirements for systems assurance through the Works.
- c) The Contractor shall produce a Systems Assurance Plan that integrates the systems assurance elements in all phases of the Works and incorporates a disciplined approach to evaluate the escalator system design. The Contractor shall prepare hazard identification, assessment and resolution; prediction of unreliability; and determination of degree of maintainability. At a minimum, this shall include:
  - i) Organising the Systems Assurance Plan to include specific sections for the disciplines of safety, reliability and maintainability engineering.
  - ii) Describing the procedures to perform the specific tasks necessary to meet safety, reliability and maintainability requirements.
  - iii) Clearly defining the responsibilities of personnel directly associated with systems assurance policies and implementation of the programme.
  - iv) Describing the systems assurance organisation.
  - v) Identifying the authority dedicated to the systems assurance organisation and the relationship between the assurance organisation and other organisational components.
- d) The Contractor shall co-ordinate results of systems assurance analysis with design disciplines, particularly as the results affect design and hardware development. The Contractor shall make recommendations for redesign or modifications necessary to assure compliance with specified requirements including installation of test points, built-in test capabilities and self-diagnostics; utilisation of in-service status displays to enhance fault isolation and test; the utilisation of high reliability components with easy accessibility and quick disconnect connectors; and, the use of mechanical keying to reduce errors during installation and repair.
- e) The Contractor shall document instances where evaluations or analyses indicate an unresolved problem area and formulate appropriate recommendations as well as maintain records which show that follow-up action has been taken to resolve the problem.
- f) The Contractor shall ensure participation of his systems assurance organisation in all design reviews.
- g) The Contractor shall maintain documentation of systems assurance throughout the design and make it available to the "Engineer" for examination.

- h) During consideration of precedence in the control of system hazards, the Contractor shall take account of human limitations as a design constraint. The Contractor shall take actions to satisfy requirements in the following order of precedence:
  - (i) Incorporation of fail-safe or vital features which would allow the system to transfer from a high loss or risk mode to a lower loss or risk mode upon the occurrence of a critical failure.
  - (ii) Reduction of the probability of occurrence of a failure by increased component reliability or by provision of supervised redundant components.
- i) The Contractor shall use safety devices to reduce the magnitude of the loss or risk once a hazardous mode has been entered; and ensure that the safety device does not introduce an additional hazard or system malfunction.
- j) The Contractor shall use warning devices and systems which are audio/visual portion of a vital system in which the human is the responder.
- k) The Contractor shall recommend special equipment operating procedures to reduce the probability of a hazardous event.

### 7.3.3

#### Safety Engineering

- a) The Contractor shall as part of the safety engineering activity prepare analyses of identified potential hazards to ensure resolution of hazards. The following analyses shall be prepared and submitted by the Contractor:
  - i) Subsystem Hazard Analysis (SSHA)
  - ii) Interface Hazard Analysis (IHA)
  - iii) Operating and Support Hazard Analysis (O&SHA)
  - iv) Quantitative Fault Tree Analysis (FTA)
  - v) Failure Modes, Effects and Criticality Analysis (FMECA)
- b) The Contractor shall compile a list of critical/ catastrophic hazard items identified as a result of hazard analyses, or by other means. This Safety Critical Items List (SCIL) shall be updated as required and carried forward throughout implementation until final resolution of identified hazards is achieved.
- c) The qualitative measures of hazard severity are defined as follows:
 

Hazard Category I -Catastrophic: Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause death or system loss.

Hazard Category II -Critical: Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause severe injury to personnel, severe occupational illness or major system damage.

Hazard Category III - Marginal: Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause minor injury to personnel, minor occupational illness or minor system damage.

Hazard Category IV - Negligible: Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies will not result in injury to personnel, occupational illness or damage to the system.
- d) The Contractor shall prepare a Fire Safety Design Report for review and acceptance by the "Engineer". At a minimum, this report shall contain documentation of the specific fire hardening

and life safety features and attributes the Contractor has incorporated in the escalator design; especially those relating to: -

- (i) Structural fire resistivity
  - (ii) Choice of electrical wiring and insulation for vital safety critical circuitry.
  - (iii) Flammability, smoke emission, and toxicity characteristics of selected materials.
- e) Further, the information presented by the Contractor shall be supported by the history of tests conducted and by approved test certificates from accredited laboratories which attest to the materials' characteristics and behaviour.

#### 7.3.4

##### Reliability, Availability and Maintainability (RAM) Engineering

- a) Reliability, Availability and Maintainability requirements and goals shall be developed in terms of Mean Time Between Maintenance Action (MTBMA), Mean Time between Failures (MTBF) and Mean Time to Restore (MTTR) respectively.
- b) Final Reliability, Availability and Maintainability predictions shall be verified by testing after system design has been completed.
- c) The subsystems and equipment shall be designed to maximise system availability during traffic hours, to minimise the amount of maintenance required and to ensure that any maintenance can be easily and quickly carried out at minimum cost.
- d) The Contractor shall perform Reliability, Availability and Maintainability analyses up to the point of interface with other systems.
- e) Reliability block diagrams shall be developed which show each equipment element that is essential to the performance of the system, including element interrelationships. Block diagrams shall be revised to keep current with design iterations.
- f) The Contractor shall develop a reliability model consisting of reliability block diagrams and probability of success equations. The model shall show the relationships required for system success. The Contractor shall revise the model to keep current with design iterations.
- g) The Contractor shall provide RAM prediction and apportionment in accordance with established techniques or standard or properly documented and verifiable field failure data for identical or similar equipment. The standards used or the source of field data shall be identified.
- h) Quantitative RAM assessments to all significant functional levels of the system, subsystems or equipment shall be allocated. Maintainability analyses during design, development and testing shall be used to evaluate the degree of achievement of the Maintainability requirements. The Contractor shall identify the standards by which these allocations are made.
- i) The Contractor shall develop predictions to judge the adequacy of the proposed design to meet quantitative RAM requirements and shall identify design features requiring corrective action during early stages of design and development.
- j) The Contractor may submit existing analyses which are properly documented and verifiable for equipment and applications which are identical or manifestly similar. The documents used for calculating the Reliability, Availability and Maintainability shall be certified by the Customer whose data's are used. Existing data need not conform to the agreed format but shall contain the same data presented in a neat, concise and logical manner.

#### 7.3.5

##### Reliability, Availability and Maintainability Demonstration Tests

- a) The Reliability Demonstration Testing (RDT) shall be carried out after commissioning the escalators. All equipment shall be included in the RDT and shall be fully operational. The Contractor shall perform failure/incident data analyses, component analyses and provide corrective action designs and tests. The Contractor shall submit weekly status reports, which shall include as a minimum a statement of failures, status of failure dispositions and achieved MTBMA for each subsystem.
- b) The Maintainability Demonstration Testing (MDT) shall be conducted on assemblies, components and subsystems jointly selected by the “Engineer” and the Contractor. The “Engineer” reserves the right to settle any disputes in the selection of subsystems to be tested.

## 7.3.6

## Submissions

- a) The Systems Assurance Plan shall be submitted 30 days after Contract Award for acceptance by the “Engineer”.
- b) The Preliminary Systems Assurance Report shall be submitted for acceptance as part of the Preliminary Design submission.
- c) The Final Systems Assurance Report shall be submitted for acceptance as part of the Pre-Final design submission.
- d) The Reliability, Availability, Maintainability and Safety Demonstration Test Plans shall be submitted for acceptance as part of the Final Design submission.
- e) Reliability, Availability, Maintainability and Safety demonstration test results shall be submitted for acceptance 30 days after completion of the demonstrations.

**END OF CHAPTER**



# CHAPTER 8

## DESIGN SERVICES

## 8 DESIGN SERVICES

### 8.1 Design Requirements

The Contractor shall perform all design functions necessary for the development, manufacture, installation and site testing of escalators as described in this Specification.

- 8.1.1 The design of each component shall achieve the minimum service life given below. The failure rate of the components shall not exceed 5%. Failure rate is defined as the number of failures (during the service life) divided by the total quantity of the components in of that section.

Escalators	Service life(years)
(i) Steps	15
(ii) Relays, timers and control gear	8
(iii) Handrail drive system	15
(iv) Step chains and step axles	15
(v) Tension carriage assembly	15
(vi) Main drive assembly	15
(vii) Emergency brake assembly	15
(viii) Step and chain rollers	8
(ix) Handrail	4

The Service life of other equipments / Parts shall be defined in the design submission.

\* Main Drive Assembly includes all sub-components i.e. Motor, Gear Box, Main Drive Chain, Handrail Drive Chain, Main Drive Shaft, Handrail Drive Shaft and Return Shaft whose service life shall be 15 years.

- 8.1.2 The Contractor shall prepare and submit drawings, which clearly illustrate details of equipment down to sub-assembly and component level, equipment locations and configurations. Drawings shall indicate plan views, elevations, sections, charts, tables, schematics and diagrams with legends, dimensions, part numbers, tolerances, setting clearances, materials, etc., as required to cover the facilities being provided under the Contract. Drawings shall also be prepared showing circuit wiring for each of the systems included in the Contract.
- 8.1.3 The Contractor shall prepare and submit specifications to provide a clear description of the functional requirements such as, loading, materials, clearances, tolerances, of all equipment and its components planned for use in the Contract. The specifications shall indicate acceptable levels of performance, the expected normal life span, and the mean time between failures (MTBF) for the equipment, materials and workmanship, with due consideration given to the service and environment to which such equipment will be subjected. The Contractor shall identify, by manufacturer and model or part number, each component, which he plans to install under the Contract.
- 8.1.4 The Contractor shall prepare and submit a Quality Assurance programme in accordance with requirements contained in the Specification.
- 8.1.5 The Contractor shall submit all applicable data, criteria, standards, directives and information used as a basis for the design of the escalators.
- 8.1.6 The Contractor shall comply with the drawings and graphic standards identified in the Employer's Requirements.

- 8.1.7 The Contractor shall submit the design calculations for the following, to demonstrate how the operational requirements are achieved.
- (a) Structural loading and deflection of the escalator truss (with and without intermediate support).
  - (b) The loading of the following escalator components: -
    - (i) bearings
    - (ii) drive chains
    - (iii) step chains
    - (iv) steps
    - (v) motor/machines
    - (vi) brakes
    - (vii) handrails
    - (viii) Combplate
    - (ix) track system
  - (c) Power requirements and efficiency of motor/machine.
  - (d) Escalator brake torque and stopping distances under no load and full load condition.
  - (e) Any other information necessary or asked by the Employer
- 8.1.8 The Contractor shall submit catalogues and samples for all parts and components used in this Contract. During the design stage some of the samples of the equipment can be asked by the Employer for review and acceptance without any extra cost. The samples will be released to the Contractor after commissioning of the equipments.
- 8.1.9 The Contractor shall prepare equipment layout plans and other documents necessary to facilitate the design interface co-ordination with other System-wide and Designated Contractors. These plans shall, (if necessary) be incorporated in design drawings but they must be prepared at appropriate times and in sufficient detail to permit successful co-ordination of space provisions for the escalators.

## 8.2 Endorsement Requirement

All drawings, calculations, test certificates, technical information, data and analysis submitted in this Contract shall be endorsed by the Contractor's registered Professional Engineer.

## 8.3 Co-ordination with Designated Contractors

The Contractor shall co-ordinate with the Designated Contractors, shall finalise and agree with the Designated Contractors all relevant matters relating to the equipment including but not limited to the following:

- (a) space requirements, including tolerances for construction of the civil works.
- (b) fixing requirements
- (c) loading
- (d) interface with architectural finishes
- (e) cabling routes, including providing information to the Designated Contractors.
- (f) information on embedded parts, box-outs, etc. to enable the Designated Contractors to provide the necessary works.

- (g) equipment access route and temporary lifting requirements. (In this connection, it may be noted that no provision of lifting hooks has been made in the civil engineering structure. As such, the contractor shall arrange his own alternative method for installation of escalators at site.)
- (h) lighting requirements
- (i) power requirements
- (j) ventilation requirements
- (k) fire protection
- (l) Interface with NP-SCADA system (if any).
- (m) Fire Detection requirement

**8.4 Interface with BMS System-** For the purpose of integration of escalator data in station BMS System over RS 485 Ethernet port the status of escalator are to be incorporated in the station BMS (if required by the engineer). The details of remote monitoring required for the escalators are mentioned in Appendix-H of these specifications. The Escalator contractor shall interface with the E&M /BMS contractor for the same and shall provide the necessary volt free contact and remote-control interface for BMS.

**8.5 Integration with Fire Alarm System (FACP)-** The escalators in elevated and Underground stations will be integrated with Fire Alarm Control Panel.

**END OF CHAPTER**

# CHAPTER 9

## INSTALLATION

## 9 INSTALLATION

- 9.1 The Contractor shall be responsible for the timely and proper setting out of the Works, which shall include verifying the positions, levels, dimensions and alignment of escalators, machine pits, supports, walls and floor openings, etc. Any error in the civil construction in so far as they relate to the Works shall be immediately brought to the attention of the “Engineer” and the Designated Contractor to allow prompt rectification by the Designated Contractor so as to avoid delays to the Works. The Contractor shall not be entitled to claim for any additional costs incurred by him arising out of such errors in the civil construction if such additional costs could reasonably have been avoided had the Contractor carried out timely and proper setting out of the Works. The method adopted for installation shall be in accordance with relevant standards with latest versions/ amendments stated at Clause 4.17 of this specification.
- 9.2 The Contractor shall be responsible for all aspects of the Work required to install the equipment, including the provision of all lifting facilities such as frames, etc. wherever the provision of hooks is not possible. The Contractor shall co-ordinate with the Designated Contractors on the necessary precautions to be taken by the both the parties to prevent damage to any part of the civil works during installation, including transportation of various part of escalators on rubber typed wheel and handling these with proper equipment so that floor finishes are not damaged by the Contractor during erection of Escalators at the stations. In case any finish is damaged by the Contractor the same shall be made good by the Contractor in full panel / area at his cost, so as to maintain uniformity.
- 9.3 All equipment shall be fully protected against the ingress of grit, dust and moisture during delivery, storage and installation.
- 9.4 The equipment shall be delivered to Site in accordance with an accepted installation programme with a minimum temporary storage period to avoid damage.
- Access into the station will be either by train or by road depending on site environment and constraints.
- 9.5 The Contractor shall design the equipment to comply with the Site access restrictions and shall ensure that the largest piece of equipment can be brought into the station through the access opening/entrances and passage ways. Method Statement of Installation shall be submitted for Employers review and approval at least 30 days prior to the starting the installation.
- 9.6 Under normal circumstances where the civil structure does not prohibit the provision of lifting facilities, such facilities in the form of lifting point will be provided by the Civil Contractors at the upper and lower landings and along the incline section of the escalator well ways for ease of installation. The contractor shall verify and satisfy themselves in respect to the loading capability of the lifting point/ hooks. The load test, if Contractor feels necessary/ required, can arrange in co-ordination with Civil contractor.
- Where, the structure does not permit the provision of lifting points, the Contractor shall make his own arrangements to provide the required lifting facilities such as “A” frames or similar to carry out installation work at no extra cost.
- 9.7 The Contractor shall be responsible for providing fencing and barricades to protect his working areas during the installation period for the safety of his workers and other personnel working in the station until the equipment is handed over to the Employer.
- 9.8 The Contractor shall provide protection, such as plywood board etc., to protect the landing plate, handrail and balustrade etc. from being damaged until the equipment is handed over at no additional cost. Any damages to the equipment are the sole responsibility of Contractor and shall replace the damage part without any extra cost. The equipment in full will be inspected and tested at the time of taking over of the equipment.

### END OF CHAPTER



## CHAPTER 10

# TESTING AND INSPECTION



## **10 TESTING AND INSPECTION**

### **10.1 General**

- 10.1.1 As part of the preliminary design submission the Contractor shall submit to the “Engineer” for acceptance a schedule of tests giving full details of all tests to be carried out.
- 10.1.2 Tests at places of manufacture to be witnessed by the “Engineer” shall be grouped together so far as can be arranged so that as many tests as possible can be witnessed on each visit.
- 10.1.3 The Contractor shall prepare and forward to the “Engineer” an original and four copies of all Test Reports as soon as practicable after completion of each test whether witnessed by the “Engineer” or not. All test data shall be certified by the Contractor’s Professional Engineer.
- 10.1.4 The Contractor shall perform all applicable test specified in these specifications as per the relevant standards at their cost. Any test required as per the applicable safety standards but not specified in this specification shall be performed without any extra cost to UPMRC.

### **10.2 General Requirements for Type Tests and Acceptance Tests**

- 10.2.1 The Tenderer shall provide details of any type and acceptance tests, which have been carried out on equipment offered, or any additional tests he recommends.
- 10.2.2 In general, certificates of previous type tests may be accepted at the discretion of the “Engineer”, provided that they are for identical equipment and conditions. Where appropriate, new and/or modified components to meet the requirements of this Specification shall be made available for type testing.
- 10.2.3 Type tests on equipment shall be carried out strictly as specified in the Specification.
- 10.2.4 The “Engineer” shall have right to witness tests and inspections on individual materials, components, or sub-assemblies, and details of these shall be agreed between the Contractor and the “Engineer”.
- 10.2.5 At the conclusion of all type tests, the Contractor shall compile all the test data together with any observations made during the tests, file them into a type test binder and submit it to the “Engineer” for acceptance and record.

### **10.3 General Requirements for Tests during Manufacture**

- 10.3.1 The Contractor shall carry out tests during manufacture as specified and propose any additional tests to be carried out. These tests shall be subject to the acceptance of the “Engineer”. Routine tests shall be integrated with the manufacturing programme. The “Engineer” or “Third Party Inspecting agency” appointed by Employerwill, at his discretion, witness the routine tests during the period of manufacture, or accept the records of the Contractor’s in-house quality control scheme, where appropriate, as sufficient evidence for the execution of the routine tests.
- 10.3.2 Routine tests shall be carried out strictly as specified in the test specification as outlined in Clause 10.4.
- 10.3.3 On completion of the manufacture of items or sub-assemblies, and following completion of the manufacturer’s own tests and inspection, the “Engineer” shall be invited to witness such tests as he deems appropriate. The Contractor shall schedule the routine tests to meet the manufacturing programme, whether or not the “Engineer” or “Third Party Inspecting agency” appointed by Employerwill be present at the tests, provided advance notice has been served to the “Engineer” in accordance with Clause 9.8 of GS.
- 10.3.4 The “Engineer” will determine and advise the Contractor of those tests where certification by the manufacturer may be acceptable in lieu of witnessed tests.

10.3.5 Before equipment is dispatched, the “Engineer” will signify his acceptance by signing certificates releasing such equipment from the place of manufacture or test.

10.3.6 Methods of packing and shipping shall be as specified in the Employer's Requirements, the “Engineer” reserves the right to visit the manufacturers’ or packers’ premises to ensure that accepted methods are employed.

## **10.4 Test Specification**

10.4.1 The Contractor shall submit for acceptance by the “Engineer”, test specifications for type tests, routine tests, tests on site, final acceptance tests and commissioning. The specifications shall detail the methods of conducting the tests, the tools and instruments used. Reference to the accepted documents and drawings shall be included in these specifications. The records/results shall be tabulated in a prescribed format applicable to this Contract.

10.4.2 Nothing in this Specification shall prevent the “Engineer” from calling for extra tests.

10.4.3 These test specification shall include the design values of all quantities to be verified, with allowable tolerance or limits. Summary drawings or diagrams shall be included with the test specifications to show the dimensions and tolerances of all structural assemblies and sub-assemblies. In the case of welded fabrications, key diagrams giving all weld data shall be provided to enable systematic inspection to take place.

10.4.4 Verification of accuracy shall be required for all tools, apparatus, testing jigs, measuring instruments and ‘go’ or ‘no go’ gauges used for the purpose of routine tests.

10.4.5 All test instrument shall be calibrated not more than one year prior to their use. The Contractor shall submit calibration certificate or other documents for proof of Compliance.

## **10.5 Testing of Materials and Details**

10.5.1 Where materials or components used in this Contract are not covered by separate test specifications, samples of such materials, or up to two per cent of such components shall, if desired by the “Engineer” be tested at the Contractor’s expense at an approved laboratory.

10.5.2 The Contractor shall supply the material required for testing free of charge and shall supply and prepare the necessary test pieces, labour and appliances for making all tests, and for carrying out all gauging and weighing on his premises in accordance with the terms of this Specification. If the Contractor is unable to provide approved facilities at his own factory for making the prescribed tests, the Contractor shall bear the cost of carrying out the tests elsewhere, at a place subject to the “Engineer” acceptance.

Such radiographic examination of welds or castings as the “Engineer” deems necessary shall be carried out.

## **10.6 Escalator Prototype Tests**

10.6.1 One complete average rise escalator which is generally representative of all types shall be available for the commencement of witness testing after Contract Award.

10.6.2 A complete escalator system including truss, track, chain, rollers, steps, controller, handrails, balustrade, monitoring and fault diagnostic system, electrical wiring, safety devices, supporting systems etc. shall be built at the Contractor’s works to undergo a comprehensive running and functional testing in accordance with the approved test specification to verify compliance with the Specification.

10.6.3 The tests shall include the following as a minimum:

- a) Truss deflection shall be recorded under full load conditions;
- b) Carry out a full escalator assembly inspection as specified in Clause 10.10.13.

- c) Verify the functionality of the monitoring and fault diagnostic System, all safety devices and all other electrical switches.
- d) Inspection to verify that the balustrade complies with the Specification and is aesthetically pleasing.
- e) Insulation resistance and pressure testing of all power and control circuits.
- f) Carry out a 24 hours continuous running test, 12 hours in each direction, without stopping except to change direction.
- g) Record the noise levels to verify compliance with the Specification.
- h) Braking Tests.
- i) Motor Gear Combined Efficiency Test.

## 10.7 Not used

## 10.8 Escalator Type Tests

Escalator Contractor shall ensure that Type Test Certificate for escalator equipment/ components should not be older than 05 years, if any certificate is older than 5 years the same must be got revalidated from time to time during the contract period (excluding defect liability period) by the escalator Contractor at his own cost from independent third-party laboratory. Type test certificate to be submitted by the contractor for any component / equipment / sub-equipment shall be the same make & type / model as proposed to be used in the project.

### 10.8.1 Driving Mechanism

One unit selected by the “Engineer” for each range of duty of the driving machines provided for this Contract.

#### Scope of Tests

#### a) Dimensional Checking

Dimensionally check gear assembly backlash and shaft end float as follows:

- i) Backlash with four consecutive 90° turns, in the same direction, of the input shaft.
- ii) Backlash with four consecutive 90° turns, in the same direction, of the output shaft.
- iii) Input shaft end float where applicable.
- iv) Eccentricity of shafts on ground section adjacent to glands or oil seals.
- v) Output shaft end float.

#### b) Dynamic Tests

The gears shall be “blued”, with non-oil soluble ink, in addition to the assembly in order that the transfer mark for the contact area can be determined. The input shaft shall be turned a sufficient number of revolutions to establish the position of the contact area prior to the dynamic tests.

The test machine shall be run at simulated full load conditions at contract speed continuously for 8 hours, 4 hours in each direction.

The following temperatures are to be recorded prior to the run, during the run, at 30 minute intervals and on completion of the run: -

- i) Oil

- ii) Input shaft bearing (drive end)
- iii) Input shaft bearing (non-drive end)
- iv) Output shaft bearing (output side)
- v) Output shaft bearing (non-output side)
- vi) Gear casing
- vii) Motor casing
- viii) Ambient

The temperature of the rim on the gear of the output shaft shall be recorded prior to the run and immediately on completion in each direction.

The contact area of the gears shall be checked on completion of the run in each direction. This shall demonstrate that the wear pattern is forming in a correct manner.

The machine shall also be run under no load and at test load conditions at full speed in each direction for a sufficient period to record the maximum vibration amplitudes at: -

- i) Mounting points
- ii) Bearings

c) Verification of Efficiency

The overall efficiency of the machine shall be verified by calculation from the results of the tests.

## 10.8.2

### **Motor**

#### Frequency of Tests

One unit selected by the "Engineer" for each range of motors supplied for this Contract.

If the quantity of the same range of motor exceeds forty, an additional motor shall be selected from the second batch by the "Engineer" to repeat the same tests described below.

If a separate motor is used for achieving maintenance speed, the same requirements shall also apply to the maintenance motors.

In general, all tests shall be conducted in accordance with the relevant parts of BS 4999.

#### Scope of Tests

- a) Insulation Test
  - i) Insulation resistance of windings using 1000V Megger shall not to be less than 200 M ohm.
  - ii) Insulation resistance of thermistors subject to 1000V for 5 seconds shall not be less than 200 M ohm. Windings shall be earthed.
  - iii) Main and slow speed winding shall each be pressure tested to 2000V r.m.s. for 60 seconds. During this test, thermistor wires shall be grounded to earth.
  - iv) Cold resistance of both high and low speed windings shall be recorded.
- b) Dynamic Tests
  - i) No load current and speed shall be recorded at rated voltage and frequency for both high and low speed windings.

- ii) Full load, 75%, 50% and 25% load tests shall be carried out on both high and low speeds at rated voltage and frequency. Current and speed shall be recorded for each. Input power, efficiency, slip and power factor shall be established and recorded for each. For Load Test (as per EN 115) the Escalator shall be started at No Load and subsequently the Load will be increased incrementally to test the Motor for different loads
- iii) Temperature rise test on full load shall be carried out on high speed windings only. Voltage shall be 415V. Frequency shall be as rated.
- iv) Ambient, air outlet, casing, output power and temperatures shall be recorded at 15 minute intervals for the first two hours and 30 minute intervals subsequently until temperature levels off.
- v) Voltage, current, frequency, output power and temperatures shall be recorded at 15 minute intervals for the first two hours and 30 minute intervals subsequently until temperature levels off.
- vi) When the temperature has levelled off, the motor shall be switched off and the winding temperature rise shall be established using the resistance method as specified in BS 4999 Part 101.
- vii) A momentary overload of 200% full load shall be applied for 15 seconds. The motor shall not stall or abruptly change speed.
- viii) A locked rotor test shall be carried out at rated voltage and frequency for both high and low speed windings. Current and torque shall be recorded in both cases.
- ix) The speed/torque characteristic and the starting current characteristic shall be produced from the results obtained.

## 10.8.3

**Main Drive Shaft**

## Frequency of Tests

Depending on the number of different types of main drive shaft to be provided for this Contract at least one for each of the high and low rise range of main drive shaft shall be selected to undergo the type tests. The "Engineer" will determine if the intermediate range is required for the tests.

## Scope of Tests

## a) Dimensional Checking

Ten main drive shafts selected by the "Engineer" shall undergo a comprehensive checking and testing which includes but is not limited to the following: -

- (i) Dimensional checking of the shaft to verify conformance of the manufacturing tolerances.
- (ii) Check alignment of sprocket position and parallelism of sprockets.

b) Radiographic checks or other approved non-destructive testing on the welds shall be carried out on the shaft after the checking in a) i) above have been completed. A certificate of the welder's qualifications shall accompany the report to be submitted.

## 10.8.4

**Steps**

## Frequency of Test

One step shall be required to undergo the type tests as described below: -

## Scope of Tests

## a) Static Test

The testing procedures shall conform to the requirements as described in EN115 Clause 8.2.2.1 as a minimum.

## b) Dynamic Test

The testing procedures shall conform to the requirements as described in EN115 Clause 8.2.2.2 as a minimum.

## 10.8.5

**Step Chain**

## Frequency of Test

One sample of each range of step chain provided in this Contract shall be required to undergo the type test.

## Scope of Tests

- a) A destructive test to verify the tensile breaking strength of the chains.
- b) Dimensional checks on the test sample to check the link plates, step axles and chain pin, and to verify compliance with the manufacturing tolerance of the components.
- c) Evidence of the heat treatment of the link plate, if applicable, shall either be provided or verified by test.
- d) The method of protecting the chain for shipment shall be inspected for conformity with the correct approved procedures.

## 10.8.6

**Wheels**

## Frequency of Test

Three samples each of the chain wheel and trailer wheel from the first batch of production shall be taken for the test.

## Scope of Tests

## a) Dimensional Checking

The dimensions of the test sample shall be checked to determine compliance with the manufacturing tolerance.

## b) Hardness of the Bonding Material

The same samples as used in (a) above shall be used to determine the hardness of the bonding material.

## c) Bonding Strength

The purpose of this test is to determine the bonding strength between the tyre and aluminum hub under a Tensometer.

- i) A full depth section of tyre of sufficient length shall be removed to insert a cutting tool and detach the bond.
- ii) The wheel shall be held by a pin at the stationary end of the Tensometer and the wheel shall be free to rotate.
- iii) The detached end of the tyre shall be clamped firmly between the jaws of the operating end of the Tensometer.
- iv) The load shall be applied gradually until a load of 1 kN is achieved. The rotation of the wheel shall not be more than 40°.

## d) Dynamic Test

The test sample shall be mounted on test jigs and subject to simulated load conditions to test their working life. Accelerated speed and increased loading to shorten the testing period may be acceptable, but full details of supporting calculations shall be provided.

## 10.8.7

**Controller**

## Frequency of Test

One of each type of controller shall be type tested.

## Scope of Tests

## a) Physical Construction Checking

The construction of the control cubicle shall be checked against the approved drawings. Facilities to padlock incoming fused isolator shall be checked. Verification of the protection classification to IP55 shall be conducted and/or provided.

## b) Pressure Test

i) Earth leakage circuit breakers shall be tested on both poles. The current and time required to trip shall be recorded. Similarly, the dc earth leakage unit shall be tested and values to be recorded.

ii) Pressure testing at 2000V ac r.m.s. for 60 seconds between:  
phase to phase and phase to earth.

iii) Control wiring shall be pressure tested at 1,500V ac r.m.s. for 60 seconds between control/auxiliary wiring and frame. Insulation tests shall be carried out before and after the above tests by a 1000V insulation tester. The insulation resistance thus measured shall not be less than 200M ohm.

iv) All protection on electronic circuits shall be tested.

Wiring to all electronic components shall be megger. Megger setting shall be at the discretion of the "Engineer".

v) Verification of the protection circuit shall be carried out in accordance with the approved procedures.

## c) Functional Tests

Functional testing of the completed control cubicle shall be carried out by simulation of the escalator operation to verify compliance with the Specification.

Temperature rise during the tests shall be recorded and verified.

## 10.8.8

**Tension Carriage**

## Frequency of Test

One sample from each range of tension carriage (if different types are provided), shall be selected to undergo the type tests.

## Scope of Tests

## a) Dimensional Check

The test sample assembly shall be checked thoroughly to ensure that all the dimensions comply with the manufacturing tolerances.

Check alignment of sprocket position and parallelism of sprockets.

## b) Radiographic Check

The welds on the same sample shall be checked by radiographic examination or any other approved non-destructive method. A certificate of the welder's qualifications, who performed the welding of the tension carriage, shall accompany the report to be submitted.

10.8.9 **Driving Chains**

## Frequency of Test

One of each type of driving chains shall be required for the type tests.

## Scope of Tests

Each chain selected shall undergo destructive tests to prove its breaking strength.

10.8.10 **Handrail**

## Frequency of Test

One sample selected from the first batch of production shall be made available for the tests. If the mould for vulcanisation is changed due to any reason during the subsequent manufacturing period, the same test shall be repeated, if so desired by the "Engineer".

## Scope of Tests

## a) Physical Checking

The inner element of the test sample shall be checked against the approved drawings before vulcanisation. The vulcanised sample shall be checked to confirm the dimensions and manufacturing tolerances.

The inner layer shall be tested to confirm its water-repellent property. The rigidity of the lips shall be tested to verify compliance. Two samples of the outer stock shall be taken from the test sample and checked to verify their Shore Hardness.

## b) Breaking Strength

The same sample shall be tested to confirm the minimum breaking strength. A factory prepared joint shall also be tested to verify that its breaking strength is not less than 85% of that of the test sample.

## c) Ozone Aging Test

The rubber sample shall be tested to prove its ozone aging resistance in accordance with the test specification.

10.8.11 **Braking System**

## Frequency of Test

One of each type of brake provided shall be required to undergo type testing.

## Scope of Test

A full dimensional check shall be carried out to verify compliance with the manufacturing drawings and a full functional test shall be carried out. A demonstration of brake adjustment and setting shall be carried out.

**10.9 Not used****10.10 Escalator Routine Tests**

The following are the minimum requirements of the routine tests.



- 10.10.1 Main Drive Shaft
- 100% Check:
- Thorough dimensional checking against the accepted drawings and manufacturing tolerances shall be conducted for every main drive shaft produced. This shall include checking of the alignment of the sprockets on both sides of the shaft.
- Random Check:
- Ten main drive shafts will be selected to conduct the radiographic examination or other approved non-destructive testing on the welds.
- 10.10.2 Driving Machines
- Random Check:
- Each set of worm and gear shall be checked to verify that the backlash and contact area is in conformity with the accepted test specification. Test results shall be recorded for inspection.
- Verification of the insulation resistance of the windings using a 1000 Volts megger test. A high voltage test to 2000 Volts r.m.s. for one minute of the stator winding shall be conducted.
- A dynamic test for every driving machine shall be conducted for a period of 4 hours continuously without stopping, except for changing of direction, 2 hours in each direction, at contract speed and 25% load conditions. The test is to ensure no undue vibration or abnormal temperature rise occurs in any component.
- 10.10.3 Step Chain
- 100% Check:
- The assembled chain shall be checked for its overall dimensions and manufacturing tolerance, in accordance with the accepted test specification.
- Random Check:
- The link plates, chain pins and step axles shall be checked at random by using a “go” or “no go” gauge. Evidence of checking shall be verified on the checklist, if required by the “Engineer”.
- 10.10.4 Wheels
- Random Check:
- All wheels and bearings shall be checked at random in accordance with the accepted test specification, to confirm the dimensions and manufacturing tolerances.
- Up to two percent of the total wheels for this Contract, if required by the “Engineer”, shall be tested to prove their bonding strength in accordance with the same procedures as for type tests mentioned above.
- A failure from the first two percent samples shall necessitate a further two percent sample to be tested. A failure during further test shall render the complete batch to be unacceptable.
- 10.10.5 Tension Carriage
- Random Check:
- The carriage shaft shall be checked against the accepted shop drawings to verify the dimensions and manufacturing tolerances. The alignment of the sprockets on both sides of the shaft shall be checked at the same time.
- 10.10.6 Handrail

100% Check:

All factory prepared joints shall be checked before vulcanization, in accordance with the accepted drawings.

Random Check:

The physical dimensions after vulcanization shall be checked three times a day for, at the beginning, mid-day and before closing of work. The lip strength shall be checked to confirm its rigidity.

10.10.7 Floor Plates

Random Check:

Selected Floor plates shall be checked to confirm their dimensions and manufacturing tolerances, in accordance with the accepted drawings.

10.10.8 Comb Sections

Random Check:

The comb sections shall be checked to confirm their dimensions and manufacturing tolerances, in accordance with the accepted drawings. The accuracy of the holes for the fixing screws shall be checked with a gauge.

If required by the "Engineer", a destructive test shall be conducted to verify the breaking strength of the comb teeth, in accordance with the accepted test specifications.

10.10.9 Steps

Random Check:

The tread and cleated riser dimensions shall be checked against the accepted drawings.

10.10.10 Handrail Drive

Random Check:

The alignment of the sprockets on both sides of the shaft shall be checked against the accepted drawings.

10.10.11 Control Cubicle

100% Check:

Verification of the insulation resistance of the control wiring and electronic components shall be conducted in accordance with the accepted test specifications.

Each control cubicle shall be checked with a simulator to test for correct wiring and termination, and the correct function of the electrical switches/relays.

10.10.12 Truss

100% Check

All trusswork welding shall be subjected to a visual examination to ensure there is no surface porosity, undercuts or any other defects. Non Destructive Testing shall be carried out on structural welds and on 10% of the remaining welds.

10.10.13 Escalator Assembly

The Contractor shall develop his own inspection checklist for the manufacturing process and for the checking of the assembled escalator. The results shall be properly recorded for the inspection by the "Engineer" or his designated representative during factory visits.

All the components inside the truss, such as the main drive shaft, tension carriage, tracks, wiring, safety switches, steps, and skirt panels shall be installed in position prior to the tests.

100% Check:

All items shall be checked for correct positioning and any measurements taken shall be recorded in the checklist. In particular the following shall be checked to ensure conformity with the Specification.

- (i) Step to skirting
- (ii) Riser to skirting
- (iii) Step to guide at comb
- (iv) Comb to tread cleat
- (v) Step to step
- (vi) Skirt to step
- (vii) Carriage tension setting
- (viii) Carriage scale plate reading
- (ix) Alignment of the truss joints shall be checked in accordance with the accepted test specifications. Through bolts shall be fitted after correct alignment and any shims used shall be marked and identified.
- (x) All track joints shall be checked for alignment and smoothness. Sliding tracks shall be fitted correctly, in accordance with accepted shop drawings.
- (xi) After checking of alignment and correct squareness to the centre line, the housing of the main drive shaft bearings and the tension carriage bearings shall be drilled and fitted with through bolts.
- (xii) The partially assembled escalator shall be run under power to check for proper clearance throughout the entire escalator.
- (xiii) Wiring of the in-truss switches shall be completed and properly terminated.
- (xiv) For low rise escalators, the handrail may be coiled in the upper landing and properly secured.
- (xv) When the assembled escalator is ready for dismantling and packing, the step chains and steps shall be anchored to prevent them from movement during transit.
- (xvi) A list shall be prepared for parts dismantled and will be shipped together with the escalator sections. Those parts to follow shall be clearly shown on a separate list.
- (xvii) Before shipment can be effective, the "Engineer" shall sign and issue a clearance certificate after he is satisfied with the packing procedures.

## **10.11 Not used**

## **10.12 Escalator Site Checking and Inspection**

A test and inspection specification shall be prepared for each of the following critical phases of work. Forty eight hours notice is required prior to completing these phases to enable the "Engineer" to carry out any checks he deems necessary. The following are the minimum requirements:

- a) Definition of datum and installation of bearing plate

- b) Alignment of truss and end supports
- c) Alignment of drive and reverse station
- d) Alignment of track brackets
- e) Alignment of incline tracks
- f) Installation and alignment of upper and lower newel wheels
- g) Alignment of skirting brackets and panels
- h) Installation of step chain and steps
- i) Installation of balustrade steelworks
- j) Alignment of handrail tracks
- k) Installation of top decking panels, inner panels, skirting returns and kick plates.
- l) Installation of upper and lower comb plates and access floor covers.
- m) Alignment of “over speed” / “under speed” detection unit drive chain, handrail and countershaft drive chains.
- n) Installation of switches and wiring.
- o) Installation of lubrication system
- p) Installation of wiring and cabling
- q) Earthing and bonding checks
- r) Installation of controller
- s) Installation of escalator cladding and decking extension.

### **10.13 Not used**

### **10.14 Escalator Commissioning and Acceptance Tests**

After installation, each escalator shall be tested by the Contractor in the presence of the “Engineer”.. The tests shall include but not limited to the following: -

#### **10.14.1 Final Electrical**

Each escalator shall be subject to a rigorous electrical testing which will prove the functionality of the escalator control, safety and support systems.

- a) The overspeed protection devices shall be tested by operating the escalator at rated speeds and tripping the overspeed device. The device shall have been separately tested and set in the factory to operate at escalator speeds called for in this Specification.
- b) The handrail tension malfunction devices shall be tested manually.
- c) The broken chain protection shall be tested by operating the escalator at rated speed and tripping the broken chain device by hand.
- d) The device providing against sudden and unusual strains on the step chains shall be tested by operating the device by hand.
- e) All push buttons, starting switches, relays, interlocking, controls and features required in connection with the work shall be inspected and tested to prove that the complete escalator functions properly under any and all conditions of operation within the limits specified.

- f) All conductors shall withstand a 1000V megger test with the voltage being applied between each conductor and ground. Each conductor shall show an insulation resistance to earth of not less than 3 Mohms.

#### 10.14.2 Weight Test

The weight test for each escalator including verification of braking distances shall be conducted when the site testing of the escalator has been substantially completed. Details of the requirements shall be as follow:

- a) The escalator shall be run under a series of test load conditions.
- b) In line with EN 115, the Escalator will be started at No Load and its Starting Current measurement. Thereafter, the following readings shall be taken under no load, 25%, 50%, 75% and full test load, and no load after adjustment at full test load;
  - (i) Running current
  - (ii) Supply voltage
  - (iii) Motor speed
  - (iv) Braking deceleration measured as slip through the brake
  - (v) Escalator and handrail speed
- c) A tripping switch shall be provided to enable accurate measurements of braking distances to be made.
- d) The stopping distance versus the operation brake spring settings diagram shall be obtained by determining the following points.
  - (i) Brake spring setting at lower limit of stopping distance at no load.
  - (ii) Stopping distance at full load at brake spring at d) (i).
  - (iii) Brake spring setting at upper limit of stopping distance at full load.
  - (iv) Stopping distance at no load at brake spring setting at d) (iii).
- e) It shall be demonstrated that the brakes can be adjusted to meet the requirements of the Specification under all conditions of load and the brake torque checked and recorded.
- f) Testing weights shall be supplied, placed in position and removed from site after use, by the Contractor

#### 10.14.3 Final Mechanical

The purpose of this test is to ensure that all site test specifications are complete, all "snagging" faults have been rectified and accepted and there is no damage to any part of the step band following the Weight Test. In addition to the verification that all barriers, signs and notices are provided.

#### 10.14.4 Twenty Four Hour Run

Each escalator shall be subjected to a 24-hour continuous running test, 12 hours in each direction, without stopping except to change direction. This test is to ensure that there shall be no undue noise, vibration or abnormal temperatures arising from any component during the testing period. If any of these occur, the escalator shall be shut down for checking and/or repair and the same tests shall be repeated.

#### 10.14.5 To ensure proper commissioning of escalators, testing shall be done using EVA meter.

**10.15 Not used****10.16 Interface and Integrated Tests**

The Contractor shall co-ordinate and carry out interfacing and integrated testing together with other System-wide Contractors to ensure that the all integrated systems function as desired.

**10.17 Certificate of Taking Over**

The final acceptance tests of each item of equipment shall be undertaken in the presence of the "Engineer", in accordance with the test specification. Any defects and/or deviations discovered without prior written approval during the tests shall be rectified at the Contractor's own expenses. These shall be entered into a defects list agreed between the Contractor and the "Engineer". The Certificate of Taking Over will not be issued until these tests have been completed and the defect list substantially reduced to such an extent that the "Engineer" considers that the equipment is safe for operation.

**10.18 Certification**

Upon completion of each escalator the Contractor shall submit to the Employer, a Certificate of Supervision issued by the Contractor's Professional Engineer, in a format acceptable to the "Engineer".

**END OF CHAPTER**

# CHAPTER 11

## ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS

## 11 ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS (EMC)

### 11.1 General

The requirements stated below must be read in conjunction with the other EMC requirements mentioned in GS.

The EMC plan shall include measures to reduce conducted, induced, and radiated emissions, especially the levels of harmonics, to acceptable values as specified by the relevant international standards or by the concerned statutory authority.

### 11.2 Not Used

### 11.3 Inter-System EMC

11.3.1 The various electrical systems installed on the Railway under Construction will after installation interact with each other by mutual coupling and all plant and systems shall be designed so that there is no malfunction due to interference.

11.3.2 The Contractor shall ensure that all equipment supplied shall have minimum Radio Frequency Interference introduced onto the main network and comply with the Electromagnetic Compatibility (EMC) requirements of the following standards:

EN 50081-1	:	EMC Generic Emission Standard
EN 50082-2	:	EMC Generic Immunity Standard
BS EN 12015	:	Electromagnetic compatibility- Product family standard for lifts, escalators and passengers conveyors- Emission
BS EN 12016	:	Electromagnetic compatibility- Product family standard for lifts, escalators and passenger conveyors- Immunity

### 11.4 Harmonic distortion

The total harmonic distortion (THD) caused by the escalator equipment to the supply mains at the power supply input terminals of the escalator shall not exceed the following values when the escalator is in no load:

Rated load Current ( $I_L$ )	THD (%)
$200A < I_L < 400 A$	< 12.0
$20A < I_L < 200A$	< 15.0
$I_L < 20A$	< 20.0



## 11.5 Installation and Mitigation Guidelines

IEC1000-5 series of guidelines must be observed wherever applicable.

### 11.5.1 Earthing

An earthing system should be designed to assure personnel safety and protection of installations against damage. It should also serve as a common voltage reference and to contribute to the mitigation of disturbances.

To achieve the primary goal of assuring personnel safety and damage control, a low impedance path must be made available to large currents generated due to lightning or power system fault. The potential differences (touch and step voltages) between any two points must be as low as possible. Safety considerations also require the chassis or enclosure to be earthed to minimise shock hazards to passengers and the maintenance staff.

To achieve the secondary goal of providing protection for sensitive and interconnected electronic and electrical systems, earthing should be designed to minimise the noise voltage generated by currents from two or more circuits flowing through common earth impedance and to avoid creating earth loops susceptible to magnetic fields and differences in earth potentials.

Earthing shall also be designed to accomplish the following minimum requirements:

- (i) Protect personnel and equipment from electrical hazards, including lightning, where practical.
- (ii) Reduce potential to system neutrals.
- (iii) Reduce or eliminate the effects of electrostatic interference and electromagnetic interference arising from within the system.
- (iv) Provide a single-point earthing method for all equipment enclosures, cabinets, drawers, assemblies and sub-assemblies.
- (v) Provide a clean zero-volt reference point for signals in computer and related equipment.

### 11.5.2 Bonding

Bonding all exposed metallic parts of all equipment and connecting them to the earthing network is a way for meeting safety requirements and minimise noise voltages due to potential differences.

Direct bonding should be used wherever practical. Where indirect bonding via bonding strap is used to connect two isolated items, the bond must satisfy the following minimum requirements and prevailing international standards, for example, IEC1000-5-2.

- (i) Low bonding resistance from DC to at least 2 GHz.
- (ii) Low bonding inductance from DC to at least 2 GHz.

- (iii) Proper bonding procedure, including appropriate surface treatment before and after the bonding process is adopted.
- (iv) Proper use of bond material to reduce electrolytic corrosion.

## **11.6 Reliability, Availability and Maintainability**

All escalators shall be subject to the reliability assessment as described in Sub-section 4.9 of this Particular Specification. The Contractor shall ensure that the equipments supplied shall achieve the availability standard as laid down in Sub-section 4.10 and shall always be under good repair within the environmental conditions prevailing in the General Specification, where the escalators will be installed.

**END OF CHAPTER**

# CHAPTER 12

## MATERIALS AND WORKMANSHIP

## **12. MATERIALS AND WORKMANSHIP REQUIREMENTS**

### **12.1 General**

#### **12.1.1 General Requirements**

This Section covers general standards of workmanship, material requirement and construction methods which are required for the execution of the Work. Any reference to any specific material or plant does not necessarily imply that such is included in the Works.

The names of the manufacturers of materials and equipment proposed for incorporation in the Works together with performance, capacities, certified test reports, Approval letters and other significant information pertaining to the same, shall be furnished when requested by the “Engineer”, who shall have the power to reject any parts which in his opinion are unsatisfactory or not in compliance with the Specification and such parts shall be replaced by the Contractor with neither cost nor programme implications to the Employer.

Samples of equipment submitted for the Approval by “Engineer” shall not be incorporated into the Works without getting the permission in writing from the “Engineer”.

The “Engineer” will examine and confirm as Approved or Rejected the quality and workmanship of the first installation for each configuration of the Works. The installation, if approved, will establish the minimum acceptable standards for the Contractor's Works.

#### **12.1.2 Plant Design**

The whole of the Works shall be designed to conform to the best Engineering practice. Manufacturer's standard designs shall be used for all items of Plant for which standard designs are available provided that they conform to the Specification.

The Plant shall be designed for simplicity and reliability to give economy, long continuous service and minimum maintenance.

The whole of the Works shall be designed for neat appearance and tidy arrangement. The style and finish shall be consistent throughout the Works. The “Engineer” shall decide the final colours for all paintwork and other finishes to be applied to any part of the Works.

All parts shall be designed to withstand the maximum stresses under the most severe conditions of service after loss of any corrosion allowance and for lifetime of not less than 30 years.

The Plant shall be designed to minimize fire risk and of damage in the event fire.

The Plant shall be designed to prevent the entry of vermin and to minimize the entry of dust and dirt. Adequate safe-guards shall be provided to prevent accidental contact with rotating machinery, hot surfaces, electrically live parts and any other hazardous components or content of the Plant.

#### **12.1.3 Compliance with Standards and Local Ordinances**

All materials and components to be used, whether incorporated in the Works, Plant and Equipment at the manufacturer's Works or used for installation on Site, shall comply with the requirements of this Section and applicable Standards. These requirements shall be minimum requirements for general purposes and they shall not relieve the Contractor from ensuring that all his materials and components incorporated in the Works are suitable for their intended purposes and environments.

Where no alternative Standards are stated or agreed in the Contract, all details, materials, equipment and workmanship for which Standards have been issued by the Bureau of Indian Standards shall be in accordance with such Standards, even though no specific Standard may be mentioned in the Contract.

Alternatively, internationally recognized Standards such as IEC, DIN, ASME, ASTM, BS, NEMA, JIS may be Approved by the "Engineer" for manufacture of equipment provided that all parameters specified can be met.

The Works shall conform to all Statutory Ordinances, Orders or Regulations having the force of law.

Where the choice of plant, materials or equipment is affected by Indian Government Regulations or local Ordinances, the plant materials or equipment supplied shall comply with all relevant sections of such regulations even though no particular reference may be mentioned in this Specification. The order of precedence in the event of conflict is stated in this PS.

The Contractor may comply with any equivalent alternative Indian code or standards in lieu of those mentioned in this chapter. However unless satisfactory documentary evidence and test certificates of compliance with the relevant clauses of this Specification, Standards, Ordinance, Regulation, UP Lift & Escalators Act and the like, issued by competent, independent and internationally reputable testing authority (ies) are submitted for "local made" materials, including all components of locally assembled equipment and fixtures, Approval for the use of such materials may not be considered.

#### 12. 1.4

##### Materials- General

All materials incorporated in the Works shall be suitable for the duty concerned and shall be new and of best commercial quality, free from imperfections, and selected for long life and minimum maintenance under the conditions specified.

All material used shall be of current production and well-proven application for the design and intended usage.

As far as practicable the use of electrically dissimilar metals in contact shall be avoided, but, where unavoidable, these metals shall be so selected that the Electro-chemical potential difference between them does not exceed 250 millivolts. If this is not possible, the contact surfaces of one or both of the metals shall be electroplated or otherwise finished in such a manner that the potential difference is reduced to within the required limits or the two metals shall be insulated from each other by an Approved method.

Where different components of equipment are interconnected to form a complete system, their characteristics of performance and capacities shall be matched in order to ensure efficient, economical, safe and sound operation of the complete system.

The use of asbestos and asbestos-based materials is not permitted.

#### 12.1.5 Workmanship- General

Workmanship and general finishes shall be of best quality and in accordance with best workshop practice.

All similar items of Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as used for the originals and shall fit all similar items or plant. Where machining may be needed before fitting renewable parts, the machining fits with their tolerances shall be shown on the drawings accompanying the instruction manuals.

All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds and at any load up to the maximum there shall be no significant vibration due to out-of-balance forces.

All parts and equipment, which are subject to, wear or damage by dust or moisture in the environment they are installed shall be totally enclosed in housings of the appropriate degree of protection.

All equipment shall operate without excessive vibration and with a minimum of noise.

The standard of workmanship shall be consistent throughout the Works. Unless otherwise specified, the “Engineer” shall decide the final colours for all paintwork and other finishes to be applied to any parts of the Works.

#### 12.1.6 Tropicalisation

All items of plant shall be tropicalised to suit the conditions prevailing in Lucknow in general and within the station and location where the escalator is installed in particular. Clause 1.12 in the Chapter 1 of General Specification gives the climatic conditions prevailing in Lucknow above and below ground and the Works shall be suitably designed, manufactured and installed to meet these conditions.

In particular, the following points for tropicalisation of electrical components shall apply:

- (i) All components of electrical systems shall be housed in suitable cubicles or enclosures, which provide the degree of protection as specified.
- (ii) Operating coils shall be vacuum impregnated with waterproof insulating varnish or epoxy-resin encapsulated.
- (iii) Wire-wound resistors shall be on ceramic formers and embedded in fireproof and damp-proof material.

- (iv) Current and voltage transformer windings shall be epoxy-resin encapsulated against the ingress of moisture.
- (v) Equipment provided with anti-condensation heaters shall be capable of operating without damage should the heaters be left on continuously.

#### 12.1.7 Welding- General

Pull details of proposed procedures for factory and site welding of important components shall be provided by the Contractor. Welding of important structural components shall be subject to non-destructive testing as may be stipulated in this Particular Specification.

The design and specification of welded joints and connections, and the fabrication of welded steel parts shall conform to the requirements of BS 5135 structural steelwork and BS 7475 for stainless steel and, unless otherwise agreed by the “Engineer”, shall also be stress relieved to an Approved code.

Members to be joined by welding shall be accurately cut to size and, where required, shall be rolled or pressed to proper curvature in accordance with Shop/Fabrication Drawings. Edges of members shall be suitably machined for the required type of welding and to permit thorough penetration.

Surfaces prepared for welding shall exhibit sound metal without laminations and other injurious defects. Surfaces of plates to be welded shall be free from rust, grease, mill scale and other foreign matter over a distance of at least 25mm back from weld edges.

All welding operatives assigned to the Works for the manufacture, assembly or erection on Site of pressure-tight or highly stressed components shall be qualified in accordance with an Approved code and shall satisfy the “Engineer” in this respect prior to commencement of work.

If at any time, in the opinion of the “Engineer”, the work of any welder appears questionable, such a welder shall be required to undergo, in the presence of the Employer or his representative, tests to determine the welder's ability to undertake satisfactorily the type of work upon which he is engaged. Tests upon the welded specimens shall be undertaken by an Approved examiner.

For such qualification tests and welding techniques shall be identical with those for the work in question and the Contractor shall: -

- i. Furnish to the “Engineer” all test plates and welding electrodes
- ii. Furnish to the “Engineer” certified copies of reports of results of physic tests

#### 12.1.8 Materials and Ancillaries

a. Structural Steel Sections: -

- (i) Hot rolled structural steel section shall comply with BS 4: Part 1.
- (ii) Corrosion protection shall be by hot dip galvanized or heavy protective finished as specified in the Specification.

- b. Mild Steel: -
  - (i) Mild steel for general purposes shall conform with the requirement of BS 4360.
  - (ii) Unpainted steel parts shall be zinc sprayed, or zinc coated, zinc plated, passivated cadmium plate galvanized as appropriate to Approved standards and as specified in the Specification.
  - (iii) Unpainted, uncoated or non-corrosion resistant steel parts shall not be used unless otherwise approved by the "Engineer".
- c. Steel Castings and Forgings: -
  - (i) All steel castings shall conform with the requirements of BS 3100. Forgings shall be to BS 29.
  - (ii) Before proceeding with foundry and forging work, the Contractor shall submit drawings to the "Engineer" of all steel castings and forgings and all other important components, showing the proposed locations for taking specimens for tensile, impact, fatigue, bend and any other appropriate tests.
  - (iii) Castings shall be true to drawings and any casting in which any dimension is sufficiently reduced to impair its strength by more than 10% or to increase the stresses above specified limits, shall be liable to rejection by the "Engineer". Excessive segregation of impurities or alloys at critical points in a casting shall be sufficient cause for its rejection.
  - (iv) Cracks or other defects disclosed during cleaning or machining operations shall be chipped or grooved out by carbon-arc air process to sound clean metal, and then inspected by appropriate non-destructive method(s) to be agreed between the Contractor and the "Engineer". Should removal of metal, to uncover or remove a crack or defect, result in a reduction in stress bearing cross-section of a component or increase the stresses above specified limits by more than 10%, the component may, at the option of the "Engineer", either be rejected or repaired.
  - (v) In such special cases as may be decided by the "Engineer", steel castings and forgings shall be subject to x-ray, gamma-ray or other Approved form of non-destructive testing to appropriate British Standard or such other Standards as may be Approved by the "Engineer". When required by the "Engineer" to do so, the Contractor shall furnish stress calculations and full details of proposed repair procedures before receiving Approval to proceed with remedial works.
  - (vi) No repair shall be undertaken without prior Approval by the "Engineer". Such Approval shall also refer to the procedure for repair. Repairs by welding to steel castings and forgings shall be undertaken only by properly qualified welders and in full accordance with an Approved procedure. All such repairs shall be subject to stress relief.



- d. Corrosion Resistant Steel: -
- (i) Unless otherwise specified or Approved by the “Engineer”, stainless steel tubes, sheets and plates used in this Contract shall be in accordance with the following Standards: -  
Austenitic stainless steel tubes shall comply with BS 6323: Part 1 and Stainless and heat-resisting steel plate, sheet and strip shall comply with BS 1449: Part 2, grade 304 unless otherwise specified.
  - (ii) Stainless steel shall have good arc-welding properties and low carbon content. Stainless steels adversely affected by welding shall not be used. There shall be no visible welding mark on the exterior surface. All stainless steels shall be subject to Approval by the “Engineer”.
  - (iii) Where cladding with stainless steel is proposed, the method of application shall be submitted to the “Engineer” for Approval.
  - (iv) Stainless steel protective cover shall be applied on the external surface and retained until installation is completed. Covering materials between seams or panel joints shall be removed before assemble. The protective cover shall be removed by the Contractor as instructed by the “Engineer”, there shall be no residual covering materials left on the surface or in between seams or panel joints after removal.
- e. Cast Iron: -
- (i) Cast iron shall not be used for systems containing high-pressure air, oil or water or for any components subject to tension or impact stresses.
  - (ii) Where cast iron is used, grades shall not be inferior to BS 1452 Grade 150.
- f. Aluminium and Aluminium Alloys: -
- (i) Any aluminium used for electrical purposes shall be of the highest purity commercially available, and the Contractor shall substantiate this by submitting certificates of analysis stating the percentages and nature of any impurities. Wrought aluminium and aluminium alloys for electrical purposes shall comply with BS 2898.
  - (ii) Unless otherwise specified, aluminium or aluminium alloy when used for components shall either be painted or be anodised to give a deposit of not less than 50 g/mm and 25 micron thickness. Aluminium and aluminium alloys shall not be in direct contact with dissimilar metals. The treatment of any such paints shall be agreed with the “Engineer”.
  - (iii) All die-cast aluminium components in large quantities shall bear a marking clearly indicating the month and the year of manufacture.
  - (iv) Aluminium die-casting shall conform to BS 1490.

## g. Bronze: -

Bronze castings for bearings, packing boxes, and similar applications shall be of the phosphor bronze type to BS 1400.

## h. Copper: -

(i) Copper tubing shall be of the seamless type to BS 2871.

(ii) Copper for electrical purposes shall conform to the requirements of BS1432-4 and BS 1977 as appropriate for the duty.

## i. Brass: -

Brass tubing shall be of the heavy gauge seamless type and shall comprise 70% copper, 29% zinc and 1% tin.

## j. Wood: -

The use of wood shall be avoided as far as possible. When its use is specified or unavoidable, then it shall be fire retardant to BS 476: Part 20 to 22, thoroughly seasoned teak or other Approved hard-wood, tantalised, free from knots and blemishes and naturally resistant to decay. Joints shall be dove-tailed or tongued and pinned where possible. All metal fittings shall be of non-ferrous or stainless steel.

## k. Fabrics, Cork, Paper, and Similar Materials: -

Fabrics, cork, paper and all similar materials shall not be used unless such use is unavoidable. If used, and where not subsequently protected by impregnation, all such materials shall be adequately treated with an Approved fungicide and shall meet the minimum performance requirements with respect to fire safety. Sleevings and fabrics treated with linseed oil or linseed-oil varnishes shall not be used.

## l. Insulating Materials:-

Non-impregnated paper, fabric, wood or press- palm shall not be used for insulating purposes. Where synthetic resin bonded insulating boards are used, they shall be fire resistant to the minimum requirements for fire safety and all cut edges shall be sealed with an Approved varnish.

## m. Adhesives: -

Adhesives shall be specially selected to ensure use of types, which are impervious to moisture, resistant to mould growth and other forms of attack or deterioration. Synthetic resin cement only shall be used for joining wood.

## 12.1.9 Finishes

## a. General Requirements

Exposed metal surfaces shall, after inspection and witnessed testing in the factory, be thoroughly cleaned of all dust, oil, grease, dirt, scale and rust by grit or shot-blasting in accordance with relevant Part of BS 7079 and then ground smooth where necessary, immediately after which they shall be treated.

Surfaces of castings, steel work, piping and plant which are to be in direct and permanent contact with concrete shall be properly painted and covered, prior to dispatch from the factory, with a substantial coating of cement wash or other Approved proprietary coating plus a lapping of an Approved weatherproof tape.

Except where otherwise specified, all non-embedded pipes and fittings located in inaccessible positions (e.g. in pipe trenches, pits and similar locations) shall be externally coated by dipping in acid-free hot bituminous compound. The coating thickness shall be Approved by the "Engineer". The pipe or fitting shall then be overlapped with a layer of anti-corrosion tape, which shall be Approved by the "Engineer".

The internal surfaces of all oil service ferrous pipes and fittings shall be carefully inspected to ensure that all scale and other particles or contaminants have been removed and shall then be protected in an Approved manner to prevent deterioration during transport and subsequent erection.

The external surface of accessible ferrous pipes and fittings shall be treated with two coats of Approved primer paint prior to dispatch from the place of manufacture.

The external surfaces of all plant or items in damp environments shall, unless made of non-ferrous metal, be similarly coated with an Approved bituminous compound. All access ladders and platforms and associate supporting steelwork shall be galvanized.

All other exposed surfaces, except where otherwise specified, shall be thoroughly cleaned of all dust, oil, grease, dirt, scale, rust or other contaminants by power tool operated metal brush, or preferably by shot or grit blasting, and shall then be coated immediately with one coat of an Approved primer paint. Following witnessed factory tests, any rough surfaces shall be filled in and carefully dressed smooth, on completion of which further treatment shall be as detailed hereunder:

- (i) The interior surfaces of oil-filled chambers and tanks, and the external surfaces of piping or fittings included therein, shall receive one undercoat followed by two final coats of oil-resistant enamel paint of a colour and type Approved by the "Engineer".
- (ii) All internal surfaces of cubicles, kiosks, boxes and the like, containing wiring or other apparatus, and the internal compartments of plant components forwarded to Site in assembled or partially assemble condition, shall be paint-finished with three coats of white enamel the last of which shall be an anti-condensation finish.
- (iii) The external surfaces of panel suites, cubicles, kiosks, marshalling and junction boxes, etc. shall be factory finished in stove enamel paint (minimum: 40 Micron DFT Primer + 40 Micron DFT Undercoat + 40 Micron DFT Top Finish, where DFT = Dry Film Thickness),

and with colour in accordance with BS 381C.

- (iv) All surfaces of plant and machinery shall receive protection to suit the duty involved. In particular all surfaces forming an interior accessible compartment shall receive one primer coat and one undercoat to be followed by two final coats of oil-resistant enamel paint, the application of which shall be undertaken only following completion of site erection.
- (v) The external surfaces of all other plant components shall have any damage to priming or undercoats made good by the Contractor on completion of installation and shall then be finally painted in Approved colours.

b. Galvanizing

Unless otherwise specified, all galvanized coatings shall be applied by hot dip process to BS729 forming a smooth, clean, dull grey zinc coating free from bare spots or other defects, and of uniform thickness complying with BS729. Sheradising, Parkerising, or other alternative processes shall not be used without the Approval of "Engineer".

All drilling, punching, tapping and bending of parts shall be completed and all burrs removed before galvanizing is done.

The preparation for galvanizing and the galvanizing itself shall not adversely affect the mechanical properties of the wire or coated material.

Unless otherwise specified, semi-finished products such as zinc sprayed, zinc coated, zinc plated or hot dip galvanized steel sheet suitable for subsequent fabrication shall have the following coating weights: -

- (i) Where no paint finish is required the coating weight shall be not less than 300g/m<sup>2</sup> per surface, i.e. 600g/m<sup>2</sup> on both sides.
- (ii) Where paint finish is required the coating weight shall be not less than 60g/m<sup>2</sup> per surface i.e. 120g/m<sup>2</sup> on both sides.

In the case of steel wire, the coating shall be of such thickness as to comply with the tests of BS 443.

c. Paint Finishes for E&M Elements of the Works

- (i) Unless otherwise specified, the Contractor shall apply paint finish to all exposed metal works including supporting rods and brackets, cable trays, trunkings, lighting fittings, pipe works, ductworks, surface conduits and accessories and other equipment, as supplied and installed under this Contract.

- (ii) Method of Application

The paint finish shall be regarded as an additional finish applied over hot dip galvanized steel sheet or extruded aluminum surface, or other coatings already defined elsewhere in

the Contract. Details shall be submitted to the “Engineer” for Approval prior to application.

As far as possible, paint finish shall be applied at manufacturer's Works prior to delivery to Site for installation.

iii. Electrostatic Painting of E&M Equipment at Manufacturer's Works

The process shall be applicable to escalator steps and other equipment which are fabricated and pre-finished/painted at manufacturer's Works and shall include the following steps: -

- (1) Degreasing with alkaline liquid
- (2) Washing with water
- (3) Drying
- (4) Applying primer coats of 1-2 micron thick
- (5) Applying undercoats of 10-15 micron thick
- (6) Applying finish coats of 10 micron thick
- (7) Baking

iv. Painting of E&M Installations

The process shall be applicable to supporting rods and brackets, pipe works, duct works and other E&M equipment which tailor-fabricated on and shall include the following steps:-

(1) Preparation

Galvanized surface shall be washed with white spirit to remove dirt and grease. Following cleansing the surface shall be washed with a Mordant solution such as British Rail 'T wash'. If metal coating is defective, instructions shall be obtained from the “Engineer” before proceeding.

Mild steel or ductile iron surfaces shall be scraped or wire-brushed to remove rust and loose scale and welding slag or splatter. Crevices shall be cleaned out. Oil, grease and dirt shall be removed using white spirit.

All preparation materials shall be fully cleansed from surface before proceeding.

(2) General

Colours as Approved by the “Engineer” shall be agreed prior to painting. For each finish colour, the colour of undercoat recommended by the paint manufacturer shall be used.

Control Samples: Approval of representative sample areas of each paint type shall be obtained from the “Engineer” before carrying out the remainder.

## (3) Cleanliness

All brushes, tools and equipment shall be kept in a clean condition.

All surfaces shall be kept clean and free from dust during painting and drying.

A suitable receptacle for liquids, slops, washings etc. shall be provided. Disposal shall be in accordance with the Environmental Protection Department procedure.

## (4) Preparation of materials

Paints shall be prepared as recommended by the manufacturer.

Any paint showing impurities, lumps, skin or uneven consistency shall be strained through fine gauze prior to application.

Different paints shall not be intermixed.

Paints shall be stirred to attain an even consistency before use.

## (5) Protection

Freshly applied paints shall be adequately protected from damage.

"Wet Paint" signs shall be exhibited, and protective barriers shall be provided on Site where necessary.

Surfaces adjacent to those being painted shall be adequately protected.

## (6) Application

Paints shall be applied in accordance with the manufacturer's recommendations to clean, dry surfaces in dry atmospheric conditions and after any previous coats have hardened.

## (7) Priming

Priming coats shall be applied by brush unless other methods are specifically permitted and Approved by the "Engineer".

Priming coats shall be to manufacturer's recommended thickness.

Any primed surfaces that have deteriorated on Site or in transit shall be touched-up or re-primed.

Metal surfaces shall be painted on the same day they have been cleaned.

Undercoats shall be applied by brush in a wet, even film all over surfaces, avoiding uneven thickness at edges and angles.

All priming and undercoats shall be rubbed down to a smooth surface with abrasive paper and all dust shall be removed before applying the next coat of paint.

Unless otherwise specified, finish coats shall be applied by brush in a wet, even

film all over surfaces, avoiding brush marks, sags, runs and other defects. Second coats shall be applied within 48 hours of first coats.

Surface shall be cut in neatly and clearly. Adjacent surfaces shall not be splashed or marked.

d. Materials for Painting of E&M Elements of the Works

All coating materials for use shall be obtained only from the ISI approved manufacturers, unless otherwise specified. Any of the other listed suppliers' equivalent products can be substituted provided that all compatible coating materials come from the same supplier.

Coating materials shall be delivered in manufacturers sealed containers, clearly labeled with the following information.

- (1) Type of material
- (2) Brand Name, if any
- (3) Intended Use
- (4) Manufacturer's batch numbers.

e. Paints for E&M Finishes

(i) For hot-dip galvanized finish:

- (1) Primer shall be zinc chromate primer ICI Dulux F500-388 or equivalent
- (2) Undercoat shall be ICI Dulux speed undercoat A543-101 or equivalent
- (3) Finish coat shall be ICI Dulux gloss finish A365-line or equivalent
- (4) 1 primer, 1 undercoat and 2 finish coats shall be applied

(ii) For extruded aluminium surface:

- (1) Etch primer shall be IMP Unilite 220 or equivalent
- (2) Finish coat shall be polyurethane, IMP Imperite 330 or equivalent
- (3) 2 primers and 2 finish coats shall be applied

(iii) For other finish/surface:

- (1) Undercoat shall be ICI Dulux speed undercoat A543-101 or equivalent
- (2) Finish coat shall be ICI Dulux gloss finish A365-line or equivalent
- (3) 1 primer, 1 undercoat and 2 finish coats shall be applied

Paint samples and manufacturers shall be approved by the "Engineer" prior to commencement of painting.

Touch-up proposals to make good any areas/surfaces that have been damaged on Site or in transit

shall be submitted for the Approval of “Engineer”.

f. Paint for Conduit and Duct Systems

Bituminous paint for steel conduits and steel cable ducts shall comply with BS 3416, type 1.

Zinc chromate primer for cable duct systems shall comply with BS 4652.

Galvanizing paint for cable duct systems shall be a proprietary type Approved by the “Engineer”.

12.1.10 Nameplates and Labels

a. Nameplates

The Contractor shall provide and attach to each major piece of equipment a metal name and rating plate to be approved by the “Engineer”. All nameplates shall be mechanically attached (not adhered) in a manner Approved by the “Engineer”.

Each plate shall quote the name and address of the manufacturer, serial number, full rating data and the date of manufacture.

b. Labels

Descriptive labels shall be provided for all instruments, gauges, devices, fuses, links, valves, strainers, motors, cables control cubicles and panels and the main apparatus contained therein.

Labels for normal situations shall be of Approved material, suitable for Site conditions and resistant to mechanical shock. Unless otherwise specified, they shall have lettering not less than 6 mm high.

The designation on these labels shall be clear and shall, where practicable, incorporate the appropriate device number along with concise descriptive wording both in English and Hindi. The Hindi wordings will be supplied to the Contractor by the “Engineer”.

Labels shall be of engraved type, with durable markings, and, unless otherwise Approved by the “Engineer”, samples of all labels shall be submitted for the “Engineer’s” Approval.

Electrical warning signs shall have graphic symbols and wording in red on a white background. All such signs shall be submitted for the “Engineer’s” Approval.

All labels shall be mechanically attached to the Approval of the “Engineer”.

12.1.11 Lubrication

- a. The Contractor shall submit a schedule providing details of quantities and recommended alternative manufacturers and grades for all oil and grease necessary for the lubrication of plant equipment and components provided under the Contract. From this schedule the “Engineer” will select a supplier from whom the Contractor shall be required to purchase and provide, sufficient oil and grease, plus an excess of ten per cent, for the flushing and initial charging of all lubrication systems occurring in the Works. Procedures for system flushing and charging shall be subject to Approval by the “Engineer”.



- b. Unless otherwise specified, each grease lubrication point shall be served by an individual line and nipple. Grease nipples and their location shall be Approved by the “Engineer”. For each type of grease an agreed type of nipple shall be used to prevent mixing of non-compatible lubricants.
- c. Lubricating points shall be positioned so as to be fully accessible and instructions regarding the type of lubricant to be used shall be affixed immediately adjacent to the lubricant point and shall be plainly visible. Oil level indicators shall be easily visible.
- d. All equipment shall be charged with the initial supply of lubricant before running the equipment, and, where such charging is carried out at a manufacturer’s premises or elsewhere, the Contractor shall ensure that this has been done.

#### 12.1.12 Protection of Works for Electrical and Mechanical Installation

- a. Structures in which electrical and mechanical installations are being carried out shall be maintained in a clean, dry condition, free from dust, during the installation, testing and commissioning phases.
- b. The dust level in all escalator “well – way” and EMRs shall be kept to a minimum by using industrial dust extractors of a type permitted by the “Engineer” during and after installation. Temporary screens shall be installed to separate dust-affected areas from the installations or temporary covers shall be installed around the installation as necessary.

#### 12.1.13 General Samples

- a. Unless instructed otherwise by the “Engineer” the Contractor shall submit in accordance with the Approved Programmes, samples of all materials and components specified and obtain the “Engineer’s” Approval prior to confirming orders, and: -
  - i. Submit samples in sufficient time to allow inspection, examination and checking by the “Engineer” and not less than 4 weeks prior to the time of required Approval.
  - ii. Submit samples in duplicate unless otherwise instructed by the “Engineer”.
  - iii. Label or mark clearly submitted samples with the following information:
    - (1) General Description : item and use.
    - (2) Relevant References : as appropriate, to Drawings, Specification clauses and Bill of Quantities.
    - (3) Date of Submission.
    - (4) Date of required Approval.
- b. Minimum size of sample board shall be 1500mmx1500mm unless agreed otherwise.
- c. The sample submitted shall have markings on it showing the name of the manufacturer or product brand name and where applicable the BS or other recognized international standard the item is manufactured to.

- d. Upon completion of the Contract and with an instruction from the “Engineer”, the Contractor shall handover the required samples to the designated storage areas for the “Engineer’s” future use.
- e. The Contractor shall liaise with the “Engineer” to allow suitable space to accommodate samples, mock-ups and prototypes as may be required by the Particular Specification.

#### 12.1.14 **Assessment of Materials and Substances**

Before being brought onto Site any materials proposed by the Contractor shall be assessed by the Contractor for their human and environmental compatibility. Any material that is toxic, explosive or flammable or may otherwise create a hazard shall wherever possible be replaced by a less hazardous product. Where this cannot be done, the Contractor shall conduct a risk analysis and produce a method statement specifying the safe method of use and all associated precautions including personal protective equipment.

### 12.2 **Mechanical Works**

#### 12.2.1 **Screws, Springs and Pivots**

The use of iron and steel for screws, springs and pivots in instrument and electrical relays shall be avoided wherever possible. Steel screws when used shall be plated with zinc, chromium or cadmium or, when tolerance limitations preclude plating, shall be of corrosion-resistant steel. All visible fixing screws shall be of stainless steel. All non-ferrous screws to be electro-tinned, or nickel or chromium plated finish.

Wood screws shall be of dull nickel-plated or other Approved finish. Instrument screws, except where forming part of a magnetic circuit, shall be of brass or bronze.

Springs shall be of non-rusting material (e.g. phosphor bronze or nickel silver) where possible. Pivots or other parts for which non-ferrous material is unsuitable shall be of an Approved corrosion-resistant material.

#### 12.2.2 **Bolts, Studs, Nuts and Washers**

All bolts, studs and nuts shall be to an Approved Standard and to metric dimensions and shall generally be of bright steel. Those subject to vibration, high temperature or pressure shall be of high tensile material to the Approval of the “Engineer”. The use of black grade bolts shall be permitted only Approved locations of minor importance.

Bolts, studs, nuts and washers shall be made of free machining quality stainless steel when: -

- (i) Subject to frequent adjustment or removal, such as adjusting bolts, removable screws or bolts, and adjustable bearings.
- (ii) Used for any application subject to corrosion.

Bolts, studs and nuts shall be suitably machined. Rolled threads will be considered acceptable if conforming to an Approved standard. Washers shall be provided under all nuts and also bolt heads

where appropriate. Bolts and studs shall protrude by at least one thread pitch beyond the outside face of nuts.

Jacking and connection screws shall all be of high tensile steel with fine threads of an Approved form.

Nuts, bolts, tap-bolts, set pins and any other item subject to vibration shall be secured with Approved locking devices

### 12.2.3 Bedplates, Alignment and Leveling

All bedplates of fabricated construction shall, prior to final machining, be fully stress-relieved.

To facilitate the alignment and leveling of larger components, all bedplates shall incorporate jacking screws suitably arranged to provide for movement of driving motors in both axial and transverse directions. Motor seating pads shall be so arranged that single piece machined packers can be inserted in place of shims of required thickness under each foot, or pair of feet, on completion of alignment.

After final alignment checks have been completed, and the unit run at full output for not less than six hours, the alignment shall be rechecked and the unit securely dowelled to the bedplates.

## 12.3 Electrical Works

### 12.3.1 General

- a. These requirements of this Section shall be taken to be generally applicable in accordance with good practice, and they shall not relieve the Contractor from ensuring that all plant, equipment and installations incorporated in the Works are suitable for their intended purposes and environments.
- b. Where detailed requirements are expressed in Chapter 5 of this specification they shall take precedence over the general requirements hereunder.
- c. Polarity

The polarity of all apparatus shall be arranged as follows when viewed from the front of the units:-

- (1) for two pole apparatus the phase pole at the top (or left hand side) and the neutral pole at the bottom (or right hand side);
- (2) for three or four pole apparatus-the phases in order, red, yellow, blue and neutral reading from top to bottom or left to right in the case of vertical and horizontal layouts respectively.

All cables shall be so connected between main switches, distribution boards, plant, machinery and accessories such that the correct sequence or phase colours are preserved throughout the system.

- d. Enclosures for Electrical Apparatus

Cubicles shall be symmetrically arranged as far as possible with projections kept to a minimum and extendable from either end.

The arrangements of the equipment within each cubicle shall be such that all normal maintenance can be carried out through hinged access doors or removable covers, from the front.

Where two or more cubicles are fitted together they shall form a flush-fronted continuous suite of uniform height when viewed from the front.

Each suite of panels or cubicles shall be fitted with a designation label giving plant identification number, voltage rating and duty. Such labels shall be fitted on the front of the cubicle, and on the sides and/or rear where appropriate.

Where a number of different plant items are in close proximity, the enclosure shall be grouped to form a single suite or a composite enclosure shall be provided.

e. Cubicle Construction

Panels shall be made of sheet steel with a minimum thickness of 2mm and suitably braced to form a rigid structure. Exterior corners and edges shall be rounded to give a smooth overall appearance. Interior edges shall be smooth.

An Approved method of construction shall be employed and the use of externally visible assembly bolts and screws will not be accepted.

Enclosures shall provide a degree of protection not less than that defined by characteristic IP 55 in accordance with BS EN 60529.

Individual sections of the enclosures shall be fully segregated to comply with the safety requirements of relevant Indian or British Standard specifications.

The design of cubicles shall be such as to ensure adequate ventilation and air circulation without permitting the entry of vermin. The operation of the ventilation fans in the controller should have temperature control, based on temperature inside the controller. Dust penetration shall be kept to a minimum by the fitting of recessed rubber seals around doors and removable panels.

The cable entries to cubicles shall be closed and made vermin proof by Approved means such as non-magnetic, fireproof barrier plates cut away where required to fit the cables.

All cubicle switchboards shall be in compliance with BS EN 60439-1 FORM 3 in respect of fault segregation.

The height of the cubicles shall, not exceed 2130mm The size of the Cubicles shall be sufficient for enclosing the Control Panel considering the ventilation & light arrangement and easy access to work in the panel. All cubicles shall be suitable for floor mounting unless otherwise approved by the "Engineer". The design of the Cubicles is subject to the approval of Employer at design stage.

Cubicles shall be provided with flush front access doors fitted with lockable handles and lift-off type hinges so arranged that one shank engages before the other to permit ease of fitting. No instruments or relays shall be mounted on the doors unless otherwise specified. The key of lock shall be similar for all Cubicles.

## f. Switchboards and Motor Control Cubicles

Switchboards and motor control cubicles shall be fitted with lockable hinged front doors and bolted removable panels at the rear where the removable panels give access to primary conductors, busbars or terminals. Where the voltage exceeds 110V d.c. or a.c., danger plates with suitable labels shall be fitted to give warning of the potentials contained therein. Where applicable, labels shall be fixed adjacent to the warning label advising isolation and earthing of conductors before removal of the panel. The wording of the labels shall be subject to the approval of the "Engineer".

Cubicles for multi-circuit switchboards shall be subdivided into single circuit sections, each provided with individual access door and rear cover. All dividing screens shall be of sheet metal, rigidly secured and arranged to segregate individual circuits and comply with the specified safety requirements.

Control wiring within the cubicles shall be neatly loomed or contained in purpose designed trunking unless every cable is insulated for the highest voltage present in accordance with the requirements of BS 7671.

The front door of all cubicles shall only be opened when the functional unit is locked off.

Live panel wiring terminations shall have a protective cover and warning labels.

## g. Assembly of Panels

Component layout within panels shall provide a logical arrangement of equipment with the maximum feasible segregation between mains voltage/high current and low voltage/low current components and wiring.

A space allowance across the whole width of panels of a minimum of 100 mm shall be provided between the outgoing (plant) side of the terminal rail and the panel side of the gland plate for all control and monitoring cables.

For incoming and outgoing power cabling this space shall be increased as necessary to ensure that the bending radius of the conductors is not compromised and segregation between power cabling and control cabling is preserved.

All components within control panels shall be either directly mounted on the back plate by means of screws in tapped holes or onto a "DIN" type mounting rail itself directly mounted on the back plate by means of screws in tapped holes.

## h. Small Wiring and Terminations

Wiring shall be carried out in a neat and systematic manner and securely fixed by insulated cleats or other Approved methods, and arranged so that access to any apparatus or connection point is not impeded.

Where inter-panel wiring passes through panel side sheets the access hole shall be fitted with a suitable rubber grommet.

Identification ferrules shall be fitted on all wires at both ends; numbers and letters used shall correspond with the appropriate wiring diagram and shall read from the terminals outwards. They shall be legible and durably marked and shall not be affected by oil or moisture. All cables connected to any nodal point shall be allocated with a discrete number which must not be used elsewhere in the associated circuits.

The wires shall not be jointed or broken in between terminal points.

Terminations for screw or stud terminals shall be of the crimped-on ring type. Termination of standard conductors to clamp type terminals shall be of the crimped-on solid rod type.

Not more than one core of either internal or external wiring shall terminate on any outgoing terminal. Where duplication of terminal blocks is necessary, suitable solid bonding links shall be incorporated in the design of block selected.

Wiring for all known future equipment shall be provided and all wires shall be terminated.

Wires of different voltages, AC or DC shall be completely separated.

Control and mains cabling shall be enclosed in slotted cable trunking with clip-on covers. No more than 50% of the internal cross-sectional area of the trunking shall be used in any length of trunking. Wiring outside the trunking shall be neatly set for connection to terminals or equipment.

All equipment and terminals associated with voltages in excess of 110 shall be fully shrouded.

i. Cubicle Electrical Safety Arrangements

All terminals, connections, relays and other components which may be "live" when access doors are open shall be adequately screened. It shall not be possible to obtain access to any adjacent cubicle when any door is open.

Components within each cubicle shall be fully labeled.

Where several outgoing circuits occupy a common termination chamber all copper work, cable lugs, terminations and terminal boards shall be fully screened or insulated to enable work on any one circuit to be carried out with other circuits live.

Isolators, clearly labeled, shall be provided in such positions and connections so that maintenance can be carried out with maximum safety. This shall particularly apply to control circuits fed from a remote position. Where it is necessary to maintain the isolator in the "off" position, such apparatus shall be so screened and labeled as to eliminate the possibility of accidents. Additionally, a system of removable, insulated links isolating-type terminal blocks shall be provided to enable particular components to be isolated for maintenance purposes whilst retaining other essential circuits energized.

j. Cubicle Control Components

All individual components of control equipment associated with any item of plant shall be contained

in a single control cubicle. Where a similar number of items of plant are specified a composite cubicle shall be provided.

Details of electrical connectors between the control cubicles and the items of plant shall be identified to facilitate cabling.

All instruments, relays, switches, lamps, push buttons and the like shall be arranged on the cubicle in a neat, functional and logic manner.

Similar items shall be of the same type, style, pattern or appearance throughout. Control and changeover selection switches for various functions shall be of the same type of appearance but with a handle of different shape for each specific function. They shall be fitted with facilities for locking to prevent unauthorised operations.

Instruments, controls and relays mounted on different panel sections but having similar functions shall be located in a physically similar position.

k. Labeling and Marking

Warning labels shall be fitted in all situations where the removal of covers or access panels may expose live equipment operating at voltages above 50V between circuits or to earth and shall bear the inscription 'Danger - Live Parts' in red letter on a white background. Minimum height of letters is 10 mm.

If the cubicle contains items of equipment which may retain electrical charges after they have been switched off, a warning label shall be provided.

All labels shall be of Formica engraving laminate or similar and Approved, of ample size and engraved in English and Hindi characters. A permanent mechanical means of fixing these labels shall be provided, other than by adhesives.

All equipment and apparatus, both inside and outside the switchboard, including instruments, meters, and relays, which is not clearly identified by integral labeling, shall be adequately labeled by means of an engraved label bearing, in black letters on a white background.

12.3.2 Electrical Distribution Equipment

a. Moulded Case and Miniature Circuit-breakers

Miniature circuit – breakers (MCB's) and Moulded case circuit – breakers (MCCB's) shall comply with BS EN 60898 and BS EN 60947-2 respectively. They shall be fitted with thermal overload and instantaneous magnetic short-circuit protection.

The instantaneous magnetic short-circuit protection shall be adjustable in MCCB's in frame sizes above 60 amperes.

Earth leakage protection shall be of the current operated type.

Unless otherwise specified, the A.C. rated short-circuit capacity for MCB shall not be less than 6kA,

and that for MCCB shall not be less than 25kA

The maximum rating of MCB's shall be 80 amperes.

Triple pole MCB's shall be integral units and interlocked internally so that an overload on any one phase shall trip and all three phase of the breaker simultaneously. An assembly of three single-phase units mechanically strapped together is not acceptable.

b. Residual Current Circuit Breakers with Integral Overload Protection

Residual current circuit breakers with integral overload protection shall be current-operated, housed in a totally enclosed moulded/metal case or distribution board, manufactured and tested in compliance with BS EN 61009.

The rated earth-leakage tripping current and time shall comply fully with the requirements of the latest edition of IEE Wiring Regulations.

Provision shall be made for testing the automatic residual current tripping by an integral test device.

Manually operated ON/OFF facilities shall be provided.

The rated tripping currents for various applications shall be 30mA, 100 mA, 300 mA or 500mA and be Approved by the "Engineer".

c. Auxiliary Switches and Contacts

Auxiliary switches supplied for indication, protection, metering, control interlocking and supervisory purposes shall be readily accessible and enclosed in a transparent dust-proof cover. Adequate secondary disconnects shall be included to enable the auxiliary switch to be wired to the fixed portion of the equipment.

Spare auxiliary contacts shall be provided (the number being to the nearest manufacturer's standard design with a minimum of two normally open and five normally closed) and shall be wired to suitably identified spare terminals.

Contacts for all applications shall be rated at 6 amperes 240V 50Hz and 110 V de operating current (0.4 power factor inductive load) for one million on-load operations.

d. Volt-Free Contacts

Where volt-free contacts are specified or supplied on any equipment e.g. a circuit-breaker or contact starter, they shall comprise of a pair of contacts operated directly by the equipment but electrically separated such that no potential derived from the equipment appears at the contacts. Volt-free contacts will be used to complete external control, alarms or indication circuits, the supplies for these circuits being obtained from an external source. Unless otherwise stated, these supplies shall be low voltage ac or dc sources and auxiliary isolating poles, e.g. on starter isolators need not be provided.

Volt-free contacts shall be readily convertible from N/O. to N/C, and vice versa by simple field adjustment. Contacts shall be rated adequately to make and break and carry continuously not less



than 6 amps at 240V ac or 6 amps. at 110V dc, unless specified otherwise.

e. Operating Coils

All fine wire operating coils and wire wound resistors shall be vacuum impregnated with an approved insulating varnish.

f. Terminal Blocks

Terminal blocks shall be of the type which clamps the wire securely and without damage between two plates by means of a captive screw and permits removal of a terminal without disturbing any adjacent terminals. Pinch screw type terminal blocks where the screw is in direct contact with the conductor shall not be acceptable. The minimum size of terminal shall be suitable for 4mm<sup>2</sup> conductors. Terminal blocks at different voltages shall be segregated into voltage groups and terminal board layouts shall correspond with the wiring diagrams. Where Approved barrier pattern screws or stud-type terminal boards are used, covers of transparent, insulating material, which do not sustain combustion shall be provided

Terminals for voltages higher than 110V or which may be alive when the main equipment is isolated from the main supply shall be suitably labeled to reduce the risk of accidental contact. All terminals shall bear permanent identification number or letter.

Terminal blocks shall be located adjacent to the point of cable entry adequate space being allowed for terminating the cable tails on Site.

After terminating all cores (including spares) there shall be not less than 10% spare terminals still available for use.

g. Insulated Terminal Blocks

The rated voltage of terminal blocks shall be 415V between terminals, 240V to earth.

Terminal blocks shall comprise brass tubular connectors with screw connections contained within moulded block suitable for working temperature up to 100 deg.C.

Terminals shall be designed to clamp the conductor between metal surfaces with sufficient contact pressure but without causing damage to the conductor. With the largest recommended conductor in position, and tightly clamped, there shall be at least two full threads of the screw engaging in the connector.

h. Fuses and Links

Fuses and links shall be provided to enable any circuit to be isolated as necessary for maintenance and test purposes without isolating the whole panel. All fuses shall be of the HRC cartridge type. Fuse carriers and solid link carriers and bases shall be made of plastic moulded insulating material of an approved make. Other type of materials may be used subject to the "Engineer's" Approval. All accessible live connections shall be efficiently shrouded and it shall be possible to change fuses with the circuit alive without danger of contact with live metal. The fuses shall be rated to give

maximum protection to the apparatus in circuit and the rating shall be inscribed on the fuse label.

Earthing and neutral links in main supply circuits shall be of the solid copper bolted pattern.

Fuses and links functionally associated with the same circuit shall be mounted side by side. At least 10% spare fuses and links shall be provided.

An adequate number of spare fuse cartridges for each rating shall be supplied and fitted in clips inside the panel.

Descriptive circuit/function labels shall be mounted adjacent to all fuses and links, the layout of which shall correspond with the wiring diagrams.

i.

#### Push Buttons

Push Buttons shall be coloured as follows:

- (1) "Start" - Green;
- (2) "Stop" Red;

All other push buttons shall be black.

"Start" push buttons shall be effective when the selected switch is in the "local" position. They shall not be effective when the selector switch is in the "off" or "remote" position.

Emergency stop push buttons shall be provided and positioned in the immediate vicinity of the associated motor drive in all cases where:-

- (1) There is no direct line of sight between the motor and the controlling starter;
- (2) The distance between the motor and the controlling starter exceeds 5 metres; or
- (3) The level difference between the motor and the controlling starter exceeds 600mm.

Emergency stop push buttons shall be connected in the control circuits such that they are effective under all conditions, and shall have red mushroom headed pushes of the stay put pattern. A deliberate reset action shall be required before the drive can be put back into service, but resetting of the push button shall not restart the drive.

In addition to the contacts connected in the control circuits of the circuit-breaker of starter, all emergency stop push buttons shall be provided with an additional contact for remote indication purposes. This additional contact shall close when the emergency stop push button is activated.

j.

#### Instruments, Gauges and Meters

All instruments, gauges and meters shall be approved by the "Engineer" and those which perform similar duties shall be of uniform type and manufacture. They shall be flush pattern, dust and moisture proof suitable for the environment in which they are installed. Where hinged covers are necessary they shall be provided with locks. Indicating instruments shall be of the dial type fitted with zero adjuster externally accessible from the front, have no parallax error and have the normal

maximum reading at approximately 600/6 full scale. Dials shall be white with black scales and black lettering not subject to fading. Scales shall be of such material that no peeling or discolouration will take place with age under any conditions.

Motor ammeters shall be capable of withstanding and indicating the starting current and shall have a compressed overload scales.

k. Control Transformers

All control circuit supplies for contactor starting shall be obtained from a 110V 50Hz internal control transformer contained in the cubicle.

Each control transformer shall be bus bar connected and be provided with isolation facilities and primary and secondary HRC fuses.

Transformers shall be of the double wound pattern and be provided with earth screw button primary and secondary windings. One end of the secondary winding shall be earthed.

l. Indication Lamps

Unless otherwise approved by the "Engineer", indicating lamps on panels shall be suitable for operation on voltage below 50V and rated to withstand not less than 20% continuous over-voltage.

Lamps shall be well ventilated and the design shall readily permit removal of lamp glasses and bulbs from the front of the unit.

m. Control Switches

Switches for control selection, motor control and other purposes shall have spade type handles and with key locking facilities. Contacts shall be non-welding.

Control switches shall comply with the requirements of BS EN 60947-5-1.

n. Current Transformers

Current transformers shall comply with BS 7626 and shall be of the bar primary pattern where practicable. All current transformers shall have a short-time current rating of not less than that of the switch panel in which it is incorporated. For bar primary current transformers this rating shall be for a period of 3 seconds and for wound primary designs the rating shall preferably be for a period of 3 seconds but may be reduced to not less than 0.5 seconds subject to Approval.

Current transformers shall have identification labels giving type, ratio rating, output and serial numbers.

In balance circuits, the spill current with maximum stability conditions shall not exceed one quarter of the operating current of the relay.

All protective current transformers shall be of Class '10P15' accuracy. Other metering current transformers shall be of Class "3" accuracy.

Measuring current transformers shall be connected to test terminal blocks. The test blocks shall be provided with easily removable links, and designed to facilitate connection of test instruments to load without open-circuiting the current transformers.

o. Isolating Transformers

Isolating transformers shall be of the double wound air-cooled pattern to BS3535: Pt.I Class II transformer. Separate windings shall be provided for the primary and secondary. The transformers shall be housed in double insulated enclosures.

p. Contactors

Contactors shall generally be of the air-break type fitted with arc shields and rolling self-cleaning double-break silver face contacts contained in a dust-tight metal case. The units shall be complete with 240V operating coils, neutral links and HRC control fuses.

Contactors shall be electrically held in when in the closed position and fitted with a latch-in facility for test purposes. Each unit shall be fitted with a direct-coupled mechanically-operated indicator to show the contactor position.

q. Contactor Type Motor Starters

All contactor type motor starters shall incorporate air break contactors, triple pole HRC fuses, over current and earth leakage protection relays, necessary auxiliary relays, contactors, timers, auxiliary fuses, necessary wiring, main power cables and terminals which shall be properly interconnected. Control and indication facilities shall be provided on each starter as specified.

All low-voltage contactors shall comply with the requirements of BS EN 60947-4-1 and shall have a Utilization Category AC3 and Mechanical Endurance Class III.

Main drive motor starters shall be suitable for their required frequency duty in line with this Particular Specification. Other motor starters shall also be suitable for their required frequency duty but in no circumstance shall the frequency duty be less than 40 operations per hour. Their performance shall be in accordance with BS EN 60947-4-1.

All medium voltage starters shall incorporate a triple-pole, fully interlocked, load-breaking, isolating switch capable of breaking the installed motor current. Starters may be of the fixed or withdrawable pattern to the manufacturer's standard. If they are withdrawable, facilities shall be provided for testing started control circuits and operation when withdrawn without the necessary for complete removal of the starter chassis. Where control circuit supplies and interlock circuits are broken via plugs on withdrawal of the starter at least one jumper lead and plug assembly of each size and type shall be provided to facilitate testing in the withdrawn (isolated) position.

All three phase motor starters shall be completed with three HRC fuses suitable for the starting duty of the circuit for short circuit protection and a triple pole hand reset thermal overload device with single phasing protection unless otherwise specified. Auxiliary contacts which close on the

occurrence of overload/single phasing and remain closed until reset shall be provided for fault indications.

Where starters incorporate a number of contactors for reversing and/or assisted starting, these shall be both electrically and mechanically interlocked.

r. Relays

Protective, control, interlock and alarm relays shall be placed in positions readily accessible during operation of the plant. Unless otherwise Approved, these relays shall satisfy the general requirements of BS 14:

Relays shall be contained in dust-proof cases suitable for flush mounting on panels or cubicles, and shall not be fixed to doors without prior Approval.

All metal bases and frames of relays shall be earthed except where they must be insulated for special requirements.

The relays shall be of an Approved type, construction and flush relay equipment shall be of the flush withdrawable pattern and shall have protective means for retention in the service position.

The contacts of all relays shall be adequate for the maximum current that can occur in the circuit they control. They shall also be capable of breaking such currents, unless provision is made for automatically breaking the current on contacts elsewhere in the circuits. The contact shall be of Approved material and shall be capable of repeated operation without deterioration. Contacts for remote alarms and indication shall be volt-free hand reset.

Relays shall not be adversely affected by mechanical shock or vibration, or by external magnetic fields, consistent with the place or method of mounting.

Operation indicators shall be fitted to trip relays and such other relays or relay equipment to enable the type of fault condition to be identified. The indicator shall be capable of being reset without the relay case being opened.

Except when the requirements of auto-control circuits do not permit, all protection relays which initiate tripping (excluding tripping relays) shall have not less than two independent pairs of contacts, of which one shall operate the tripping relay directly without the interposition of auxiliary contactors, and preferably, without the use of reinforcing contactors.

All de relays shall operate satisfactorily when the supply voltage is between 50% and 120% of the rated voltage.

All relays shall be marked for purposes of identification with the following information:

- (1) Function of relay
- (2) Device number (BS EN 60617)
- (3) Voltage and phase colour of the supply (where applicable).

All contacts for control and auxiliary equipment shall be adequately rated for their duty and subject to the Approval of the “Engineer”.

s. Earthing Arrangement of All Plant & Equipment

A continuous copper earth terminal shall be provided for all cubicles for connections to the metal cladding or armouring of all incoming and outgoing cables and, where specified, to the station earthing system. The cross-sectional area of the earth bar(s) shall not be less than the recommendations of BS 7430.

Earth bar for main earthing system shall be 300mm<sup>2</sup> tinned copper bar. No earth terminal shall have a cross-sectional area of less than 25mm<sup>2</sup>. All metal parts of the Plant and equipment, other than those forming part of any electrical circuit, shall be effectively connected in an approved manner on to the main earthing system.

The entire conduit and trunking installation shall be electrically continuous throughout, forming a completely bonded system. All apparatus or parts thereof not directly connected to the conduit or trunking system, shall be connected thereto by substantial bonding clamps. The earth pin of all switch sockets and the exposed conductive parts of all lighting fitting and all other fittings and equipment shall be effectively earthed.

The Contractor shall test every complete earth loop circuit comprising conduits, cable sheaths, core conductors and transformer windings. The impedance values of the loop circuits for each section of the installation shall not exceed 0.5 ohm.

12.3.3 Cable Trunking , Conducts & Fittings

- a. Trunking and fittings shall comply with BS 4678, part 1. Factory fabricated bends and tee's shall be used.
- b. Trunking shall be manufactured in mild-steel sheet and shall be hot- dip galvanized. Trunking shall have a removable cover throughout its length with centre- screw latch fixing, or quick-fixing device reviewed without objection by the “Engineer”. The thickness of the sheet metal shall be 1.6mm for trunking size up to 100mm x 100mm and 1.8mm for trunking size of 150mm x 75 mm to 150mm x 150mm. Bonding link shall be fixed on external surfaces unless otherwise specified.
- c. Unless otherwise reviewed without objection by the “Engineer”, the minimum size shall be 50mm x 50mm.
- d. All bend, tee pieces, stop ends, outlets, intersections and adapters will be of the same manufacture as the trunking. All inside edges of trunking shall be smooth and provision shall be made to prevent abrasion at bends.
- e. All conduits, except flexible conduit, shall be heavy gauge, hot-dipped galvanized welded steel complying with BS 4568: Part 1 Class 4. All conduit fittings and components shall be

in accordance with BS 4568: Part 2.

- f. Flexible conduit and fittings shall comply with BS 731 Part 1 and in addition shall be of a metallic watertight pattern, oversheathed with a low smoke halogen free material and with a separate earth wire enclosed within the conduit.
- g. The minimum size of conduit used in the installation shall be 20mm diameter.
- h. Separate conduits shall be provided for extra low voltage circuits.
- i. Inspection-type conduit bends, elbows and tees shall not be permitted.
- j. Standard conduit and draw-in boxes and covers shall comply with the appropriate British Standard and in addition shall be galvanized malleable cast-iron or steel. Draw-in conduit and cables entering the boxes shall be installed in accessible positions.
- k. All boxes and conduit accessories shall be fully weatherproof when used in outdoor locations. Weatherproof boxes and conduit accessories shall also be used in locations other than outdoors when so specified or as directed by the "Engineer".
- l. All draw boxes and junction boxes shall be of ample size to permit the cables to be drawn in and out. They shall be made of galvanized malleable iron with jointing surfaces machined to ensure a dust-tight joint. All circular boxes shall be provided with long spouts, internally threaded, incorporating a shoulder for proper butting of the conduit and a tapped 5mm hole in the base to accept a solid brass earth terminal.
- m. The ends of all conduits shall be reamed to remove all burrs or sharp edges after the screw threads have been cut. All dirt, paint or oil on the screwed threads of the conduit, sockets and accessories shall be removed before installation.
- n. The ends of the conduit shall butt solidly in all couplings. Where they terminate in fuse-switches, fuse boards, adaptor boxes, non-spouted switch boxes etc., they shall be connected thereto by means of smooth bore male brass bushes, compression washers and sockets. All exposed threads and all bends shall be painted with an aluminium spirit paint after installation. Exposed metal shall be similarly treated.
- o. All conduits shall be kept 80mm clear of water, gas and other services. All necessary equipotential bonding shall be installed including that for piped services, in accordance with the IEE Wiring Regulations.
- p. Particular care shall be taken to ensure that no water is allowed to enter the conduit at any time and all conduits shall be arranged with adequate ventilation and drainage. Inaccessible junction boxes will not be allowed.
- q. The ends of conduits laid or set in formwork prior to concreting shall be temporarily sealed off with a coupler and a solid brass plug.
- r. All bends are to be made on Site to suit site conditions. An adequate number of suitably

sized hot-dip galvanized cast iron draw-in boxes shall be provided in conduit runs to enable cables to be drawn in easily and without damage. Draw-in boxes shall be fitted after every two bends, or after a maximum straight run of 15m. Tees, elbows and sleeves when used, shall be of type reviewed without objection by the "Engineer".

- s. All conduits shall be swabbed through before wiring is commenced and cables shall not be drawn into any section of the system until all conduits and draw boxes for that particular section are fixed in position.
- t. Where conduit crosses expansion joints, the Contractor shall allow for the installation of expansion couplers at the position of the expansion joint and at right angles to it. Allowance shall be made for running an earth wire between each terminal fitted in the nearest conduit boxes at each side of the coupler. All flexible metallic tubing shall be galvanized water-tight pattern fitted with sweated brass adaptors. Typical details are given in the drawings for surface mounted conduit installation.
- u. Wiring shall be carried out on the looping-in system and no joints other than at looping-in points will be allowed.
- v. No cables installed in conduit shall be laced.

## END OF CHAPTER





## CHAPTER 13

## INTERFACES

## **13. INTERFACES**

### **13.1 Interfaces**

The Contractor shall interface the design and construction of the Works with that of other contractors, principally the Contractors for the Designated Contracts as defined in the General Conditions of Contract. The Contractor shall keep the “Engineer” fully informed in respect of such interfaces, such information being given to the “Engineer” in a manner and form and at such intervals as stated in the Contract or as required by the “Engineer”.

#### **Contract Packages for**

##### **Signaling, Communications and Train Control**

This contract provides for signalling and automatic train control systems including equipment in the station control rooms and the Operation Control Centre (OCC) such as train mounted control equipment, relay room equipment, independent telephone networks including automatic switching centres and exchanges, main trunk cables, direct telephone lines, communication equipment, emergency telephones, closed circuit television, radio communication and BMS System.

##### **Automatic Fare Collection**

This contract provides for the revenue control system at stations, including automatic ticket vending machines, barriers, manual control and checking equipment and electronic linkages to station control rooms and the Central Control room.

##### **Rolling Stock**

This contract provides for air-conditioned rolling stock in rakes of up to 3 coaches.

##### **Civil, E&M and VAC**

The Contract provides for Civil and E&M works including the stations & tunneling. The E&M and VAC works include stations lighting, 415V AC distribution, tunnel ventilation, station air-conditioning, fire protection system etc.

The Contractor shall co-ordinate with these Contractors for design as well as installation related issues as part of his interface responsibilities. The relevant Contractors shall be referred to as Designated Contractors in this specification.

##### **Building Management System (BMS)**

This contract provides for the Building Services Management System for the Stations.

##### **NP- SCADA Contract**

This contract provides for non-power SCADA systems from stations to OCC.

### **Escalators**

This contract provides for escalators at stations. The Contractor shall co-ordinate with the escalator contractor for requirements related to remote monitoring and control system etc. to be provided in Station Control Room.

## **13.2 Interface Responsibilities**

The responsibility for specification and provision of the requirements for the works which interface with Designated Contractor's equipment are tabulated below.

The Appendix "A" describes the interface requirements between Designated Contractors, which include Civil Contract & E&M Contract and this Contract.

This Appendix shall be read in conjunction with the relevant clauses of the Employer's Requirements. The Contractor shall be responsible for ensuring that all requirements of the specifications pertaining to interfaces are properly satisfied.

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 (IMP) after the commencement of the Works and throughout the execution of the Works to ensure that:

- a) All interface issues between the contractor and the Designated Contractors are satisfactorily identified and resolved; and
- b) All the construction tolerances at the interface shall meet the requirements of the respective specifications relating to the interface points.

Where details of the design of this contract 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 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 works.

The Contractor shall take a lead in developing the Interface Management Plan. The IMP will be prepared in conjunction with the Designated Contractors to cover all aspects of the implementation of the interface works required. The IMP will define the interface works necessary to complete all the works in this contract and is not limited to those listed in the summary table attached.

Should it appear to the "Engineer" 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 the progress of the Works, are mutually consistent and conform to other provisions of the Contract.

The Contractor shall review the details of interface works and notify the "Engineer" of any amendments to the summary table required in the process of his works. Unless such requests are reviewed without objection by the "Engineer", the Contractor shall design and construct the works in accordance with the provisions outlined in the Appendix "A".

### **13.3 Scope of Work of Interface Management Plan (IMP)**

The information and scope of works to be provided by the Contractor include but are not limited to those outlined in the Appendix A. The Appendix A only defines those tasks at the interface point and is not a complete itemization of the Scope of Work

The Designated Contractors shall liaise with the Contractor in the design, installation, testing and acceptance of works.

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.

Where the Contractor's 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 "Engineer" for review and shall copy the same to the Designated Contractors.

**END OF CHAPTER**

# CHAPTER 14

## SITE ARRANGEMENTS

## **14. SITE ARRANGEMENTS**

### **14.1 General**

- 14.1.1 In addition to the general conditions and provisions of the Site as described in the General Specification, this Section of the Specification sets out the site arrangements, conditions and requirements for the delivery and installation of the escalators supplied under this Contract.
- 14.1.2 Methods and procedures may vary depending upon site conditions which shall be discussed and agreed with the “Engineer” during the planning and installation stage but the Contractor shall make provision for alternatives in the methods and procedures provided that the basic criteria for delivery and installation as described below remain unchanged. Method Statement shall be submitted to Employer for approval 30 days before starting the work.
- 14.1.3 The conditions and requirements set out in this Section of the Specification shall not relieve the Contractor of his responsibility to deliver the equipment in time to meet the Approved programme as defined in Chapter 21 of this Particular Specification and to install the Plant in accordance with the Specification.

### **14.2 Access and Power on Dates**

- 14.2.1 The Contractor shall note that no exclusive possession of the Site will be granted. The Contractor will be required to work with the Designated Contractors, the Interfacing Contractors and other contractors.
- 14.2.2 The Contractor shall take note of the access and power on dates shown in the “Engineer’s” Preliminary Programme and Project Calendar. Except approved by the “Engineer”, the Contractor shall not have exclusive access to the designated areas.

### **14.3 Works Areas**

- 14.3.1 The Contractor shall coordinate with the Designator Contractor for the works areas allocated within the site in which he may erect offices, workshops and stores. The area allocated for the Contractor and the period of availability are shown in Appendix 'C'.
- 14.3.2 The Contractor shall allow for transportation of all materials and equipment to the Works Areas and from the Works Areas to the Site.
- 14.3.3 The Contractor shall note that works trains are not intended for transportation of material and equipment except to those locations where road access would not normally be available. The Contractor shall coordinate with the relevant Designated Civil Contractors for delivery of major equipment by road access.
- 14.3.4 General attendance and other services will be made available at the Works Areas in accordance with the General Specification.
- 14.3.5 The Contractor shall be responsible for the cleanliness and tidiness of the Site after each period of

work.

- 14.3.6 The period within which the area will be available to the Contractor is shown in Appendix 'C'. The Works Area shall be returned to the Employer no later than the date specified for the completion of the Works. The Contractor shall remove all facilities erected by the Contractor at the Works Areas before returning the Works Area to the Employer.

#### **14.4 Delivery**

##### **14.4.1 General**

Each escalator shall consist of truss, track, drive unit, steps, step chains, comb plates, handrails, driving machine, control cubicle, safety devices, balustrades, special tool kit for operation and maintenance and all other parts required to provide a complete escalator.

Each escalator shall be partially assembled, tested without handrail and balustrade decking at the Contractor's Works, and then dismantled and delivered in sections to site, unless otherwise agreed by the "Engineer". Provision shall be made to properly secure the in-truss equipment during transportation, and during access into the Works Area. Allowance shall be made for the truss being tilted at an angle of 45° to the horizontal when being delivered into the Works Area.

##### **14.4.2 Methods of Delivery**

The method of delivery of escalator sections to site shall be by road, and access to the Works Areas through a station entrance, and/or temporary access openings if provided, and via a route within the Site. The Contractor shall be responsible for arranging access into the Site with the Designated Contractors for the stations works. The Contractor shall co-ordinate the routes and time of entry into the stations with the Designated Contractors. The delivery route within the stations shall be agreed between the Contractor and the Designated Contractors. The access plan of each station shall be submitted for the "Engineer's" Approval 30 days before starting the work.

The locations and size of the access openings and the size of working area around each opening will depend on site and local traffic conditions and shall be agreed by the "Engineer". The method of delivery for each station shall be governed by the overall installation Programme of Lucknow Metro and be subject to the "Engineer's" Approval, whose decision shall be final.

##### **14.4.3 Delivery, Access to and Through the Site**

The Contractor shall make provisions to deliver his equipment by vehicles into the working area around the access opening. In the event that the working area is not large enough or the local traffic conditions cannot permit any container vehicle to gain access into a particular working area during normal working hours, the Contractor shall make arrangements to deliver the equipment by trucks and unload the equipment within a limited working area allocated by the "Engineer".

When it is unlikely that a mobile power crane can be used within the vicinity of the access opening due to restricted site conditions, the Contractor shall arrange to maneuver his Plant by smaller traction equipment from the unloading working area into the access opening and Works Areas.



Transportation, unloading and delivery equipment such as hoisting frames, gantries, lifting tackles, chain blocks, trolleys etc., required for delivery, shifting and equipment access to the Works Areas shall be provided by the Contractor, unless otherwise specified herein or as Approved by the "Engineer".

The Contractor shall provide a Schedule of major deliveries of Plant for each station to the "Engineer" at least 2 months prior to the first delivery.

Each escalator section shall preferably be hoisted into position in the well way immediately after delivery to Site. Long period of storage inside the station will not be allowed, unless written permission has been received from the "Engineer".

The Contractor shall provide adequate means to protect completed architectural finishes during delivery and shall make good any damage caused by delivery of the equipment.

#### **14.5 Installation**

14.5.1 It is desirable that the installation time of Escalators on Site shall be kept to a minimum and the proposed design shall take due account of this requirement.

14.5.2 The Contractor's attention is drawn to the restrictions on working area available on Site and shall make his own arrangements to store materials and equipment off-site or at the Depots until such time as they can either be incorporated into the Works or stored within the working area assigned to him.

14.5.3 The Contractor shall co-ordinate with the Designated Civil Contractor for the hoisting points and confirm acceptability before commencing installation. When it is not possible to provide such hoisting points due to its particular location. In such case, the Contractor shall provide suitable hoisting frame, gantries or the like for hoisting. Safe working load of such equipment shall be stated and relevant testing certificates shall be submitted for the "Engineer's" Approval.

14.5.4 All other lifting equipment such as lifting tackles, chain blocks etc., required for installation purposes shall be provided and installed by the Contractor.

#### **14.6 Care of Works**

14.6.1 The Contractor shall protect the equipment within his own reasonable control, particularly in normal construction site conditions such as dust, dirt, plastering and small particles which may possibly damage the equipment, stainless steel decking and panels, if they are not properly protected. Such damage, if occurring, shall not relieve the Contractor of his responsibility to repair and/or replace these parts, depending on individual conditions, to the satisfaction of the "Engineer".

14.6.2 The contractor shall provide adequate protection to the Escalators during the Stop Work Period and before handing over of the complete installation to the Employer. The protection shall not be removed unless instructed by the "Engineer".

**14.7 Material Recovery**

- 14.7.1 The Contractor shall remove all redundant materials and cables from Site. The Contractor shall handle all redundant equipment with care and deliver to a location designated by the “Engineer” where it shall be stored in a neat and orderly fashion.
- 14.7.2 Recovery work shall occur after the completion of every stage of the above mentioned Works and as directed by the “Engineer”.

**END OF CHAPTER**

## CHAPTER 15

### PACKAGING, SHIPPING AND DELIVERY

## **15 PACKAGING, SHIPPING AND DELIVERY**

### **15.1 General**

15.1.1 All the stipulations laid down in the GS shall apply.

### **15.2 Packaging and Shipping**

15.2.1 All equipment Goods and materials shall be properly inspected to ensure that there are no defects before shipment. An inspection tag bearing the words "INSPECTION PASSED" giving reference number to the inspection date and details to permit verification of inspection details shall be attached to those items inspected satisfactorily.

15.2.2 The four adjacent sides of each package shall be marked with permanent paint with the following information:

CONSIGNEE

COMMODITY

CONTRACT No

SHIPPING MARK

15.2.3 Appropriate caution notices such as "FRAGILE", "HANDLE WITH CARE", "KEEP DRY", "KEEP UPRIGHT" along with visual display symbols internationally accepted shall be conspicuously displayed on the outside surfaces of boxes, crates and packages.

### **15.3 Delivery**

15.3.1 The Contractor shall be responsible for transportation and delivery of materials to site or to the storage space and shall continue to be responsible for its safe storage, handling, erection and commissioning.

END OF CHAPTER

## CHAPTER 16

NOT USED

## CHAPTER 17

### MAINTENANCE REQUIREMENTS

## **17. MAINTENANCE REQUIREMENTS**

### **17.1 Maintenance**

In addition to his obligations under the Conditions of Contract, the Contractor shall provide maintenance services throughout the Defects Liability Period (DLP) and also for the specified period for all the escalators supplied under the Contract. Maintenance work shall include attendance to all service calls, work described in approved Maintenance Schedule, and the followings:

- 17.1.1 All defects shall be remedied either when observed on the weekly service call or on an attendance to a service call. Service shall include all work necessary to maintain the entire escalator system in good working order at all times.
- 17.1.2 The Contractor shall supply adequate quantity of consumable and contingent spare parts in order to minimize the shut down time due to repairs and maintenance. All parts rendered defective, including replacement of indicator lamps and programmable circuit board, shall be replaced by the Contractor. The list of these consumable & contingent spares (DLP spares), tools and test equipments are enlisted in appendix "E". Any additional spares, tools and test equipment are required the same may be indicated by the Firm in their Technical Offer. The employer may revise the list of spares at the time of submission of the Preventive Maintenance Schedule (PM) & Corrective Maintenance (CM) procedure, as mentioned in 17.1.10. Bidder is advised to follow the Spare Policy given in the Tender Document.
- 17.1.3 The Contractor shall mobilize competent personnel to rectify stoppages at any time during the day or night when being called on by the Employer. Repairs shall be carried out on a 24 hours per day, 7 days per week basis until the faulty unit is put back in service.
- 17.1.4 The Contractor shall carry out periodic testing and examination of equipment safety devices as may be required by the provisions of any enactment in force relating thereto or of any enactment, regulations or by-laws of any local or other duly constituted authority which may be applicable to such tests and to provide such copies of the test certificates, duly signed by a Registered Escalator "Engineer" and Registered Escalator Contractor, as may be required. A master schedule of such planned tests shall be submitted to the Employer at least two months before commencement of the DLP.
- 17.1.5 The Contractor shall provide quarterly and half-yearly reports on the condition of the equipment in an agreed format. (format will be finalized during design stage). If a defect appears or damage occurs during the relevant DLP, the contractor and the Employer's representative shall jointly inspect the Escalator. Such reports shall include event logs and performance data collected from the associated indicative panel stored on diskettes or other agreed medium, over the reporting period. Such data shall enable off-line individual and fleet statistical analysis to be performed on the lap-top Personal Computer supplied by the Contractor.
- 17.1.6 A report in duplicate shall be sent to the Employer immediately following every call out, indicating the time of call out visit, cause, remedial action taken and the time that the service was restored.

The monthly summary of failure report along with the analysis given details of nature of fault, remedial action taken etc. in the approved format shall be provided.

- 17.1.7 Reports on routine visits are not required except where necessary to draw attention to defects of a minor nature which could not be rectified during the routine visit. Records of each routine visit and call-out visit, together with details of the work done or action taken, shall be entered on a log book which shall be provided by the Contractor and retained in the escalator machine room or other location as decided by the "Engineer".
- 17.1.8 Before the expiry of the Defects Liability Period, the Contractor shall perform a loading test for each escalator to re-confirm that the function of the system is being met and shall undertake corrective adjustment if necessary. This test may be incorporated into the half-yearly equipment survey maintenance works.
- 17.1.9 The Contractor shall provide a maintenance plan and a major component replacement programme for review and acceptance by the "Engineer" 90 days before the programmed commencement of the Defects Liability Period.
- 17.1.10 The Maintenance service shall include all Preventive/Scheduled & Corrective Maintenance. In this context, the Contractor shall submit a PM Schedule and CM procedure for Approval, 3 months before the commencement of the DLP.
- 17.1.11 In order to ensure that the system will meet the RAM targets and Customer Service requirements using the minimum resources, the Contractor shall conduct a detailed Maintenance Requirement Analysis to derive a complete list of preventive maintenance schedules and procedures under the Contract. The Maintenance Requirement Analysis shall identify for each system function the potential functional failures, the failure consequences and the appropriate maintenance approach. RAM analysis shall be submitted quarterly during 2 years DLP.
- Based on the Maintenance Requirement Analysis, the Contractor shall indicate in the Maintenance Plan, the final preventive maintenance programme, the proposed skill and manning level, spares level and special tools require. The proposal shall be fully traceable to the maintenance Requirement Analysis output.
- The Maintenance Requirement Analysis shall be submitted as part of the maintenance plan, under the main contract tender submission. However, tenderers will be allowed to defer submission of this Analysis, latest 12 months before the commencement of the Defect Liability Period, by presenting formal written request for such deferral.
- 17.1.12 Accommodation for Emergency Service Report Centre
- An Office of approximately 10sq.m will be provided by the Employer as the emergency service report centre. The Premise will be located at 4-5 Places in the Lucknow MRTS network as determined by the Employer.



## **17.2 Employer's Maintenance Strategy**

### **17.2.1 Maintenance Strategy**

The Contractor shall ensure that the system designed, installed and commissioned is supportable throughout the service life of the System to address, as a minimum, the following:

Design errors in the System;

Operational changes;

Environment changes; and

Changes in infrastructure.

According to the maintenance strategy, all equipment and infrastructure supplied for the 'Project' must be designed for minimum or no maintenance. Maintenance activities required must be capable of being performed with little or no impact on the train service. In addition, the maintenance work systems shall ensure safety of personnel and equipment.

**17.2.2** The Contractor, upon noticing any defects, deficiency in quality and quantity of spares and materials shall without delay, arrange for alternative source of supply and submit his proposal to the "Engineer" for review.

## **17.3 Maintenance during DLP**

During the 2 years' DLP period, the contractor shall carry out all type of preventive and breakdown maintenance. The preventive maintenance would be done during non-traffic hours whereas breakdown maintenance would be done whenever breakdown occurs. The contractor should post his supervisor and maintenance staff at a key places (4-5 Places in the Lucknow Metro network) on the stations as determined by the Employer.

The acceptable response & attention time also needs to be mentioned for minor & major breakdowns.

### **17.3.1 Maintenance Management System (MMS) and Maintenance Arrangement**

During non-operation time, sections of line will be closed for maintenance work. The minimum time for possession periods is 4 hours. Ideally, this time shall be the free time available for maintenance.

### **17.3.2 Competency of Personnel**

During the DLP the Contractor shall depute sufficient trained and competent personnel for maintenance purpose.

Such persons shall have their generic competence established and must demonstrate their specific competence and knowledge in the particular systems, environment and procedures.

The Contractor shall provide evidence of specific competence and knowledge, which shall include:

- assessment and certified training in particular applications and operations;

- recording of competence and work in the license holders logbook; and
- receiving or in receipt of sufficient and current exposure to the area of work that the holder is licensed for.

Routine spot checks on licensing may be carried out from time to time by the “Engineer’s” qualified personnel on the proficiency of the Contractor staff.

In the event of a failure, the Contractor shall undertake the management and investigation necessary to identify and rectify the cause.

#### 17.3.3 Testing and Re-commissioning of System and Equipment

In the event of a failure requiring modifications to the System, the Contractor shall undertake any testing and re-commissioning required. Any such modification shall be submitted for review by the “Engineer”.

#### 17.3.4 Temporary Alterations to Restore Service

The Contractor shall undertake any temporary modifications necessary to maintain service. Any such modification shall be submitted for review and acceptance by the “Engineer”.

#### 17.3.5 Discrepancies between Installation and Design Records

Should the Contractor discover inconsistencies between the maintenance drawings and documentation and the installed equipment, the Contractor shall correct all such errors within two weeks.

#### 17.3.6 Communications

The Contractor shall ensure that adequate communication facilities are provided to its staff during the DLP.

#### 17.3.7 Location of Staff

The Contractor shall be responsible for locating staff such that the Contractor meets its obligations.

#### 17.3.8 Storage of Equipment and Materials During the Maintenance Period

The Contractor shall ensure that no equipment is stored along the trackside.

The Employer will provide defined storage locations for the support of the different levels of Maintenance.

The Contractor shall satisfy itself and the “Engineer” that the storage locations for equipment and materials will meet the performance requirements of this PS.

#### 17.3.9 Maintenance Regimes

The Contractor shall produce a maintenance regime for the equipment that shall comprise two constituent parts, corrective and routine/preventative maintenance.

Corrective maintenance shall be available 24 hours per day, able to respond to all foreseeable circumstances.

The maintenance regime shall cover all parts and equipment of the system designed, installed and commissioned by the Contractor.

The Contractor shall take into account the requirements of the operations and maintenance when determining and proposing its maintenance regime.

#### 17.3.10 Scope and Hours of Coverage

The regime and structure of corrective maintenance shall be robust in design.

The Contractor shall provide a full 24 hour On-Call coverage and shall be such that initial response and rectification of failure are in accordance with the following:

- assistance for first line corrective maintenance within 30 minutes, upon request of first line maintainer;
- 24 hour from notification for second line maintenance where spare parts replacement is involved; and
- within 2 weeks including transportation time for third line maintenance where replacement or repair of component from factory is involved. Any extension to this time shall be agreed with the "Engineer" and a replacement provided.

All elements of First Line preventative maintenance/ Second Line and Third Line maintenances shall be carried out and completed during non-traffic hours without interrupting train services.

If the equipment is kept non – functional for more than a week then the DLP may be enhanced proportionately in the multiple of month.

#### 17.3.11 Failure Investigations

The Contractor shall conduct failure investigations.

Disputes between the Contractor and other Contractors will be resolved by the "Engineer".

The Contractor shall make available to the Employer all test and failure data as required.

### 17.4 Software Support

#### 17.4.1 General

The Contractor shall submit to the "Engineer" for review, the software support plan at least 90 days before commencement of software installation.

Employer will have the right, for multiple use of the Software. Employer at his discretion may download the software on multiple PCs as per the requirement. For this purpose, no specific password, Key Number etc. should be required from the Contractor / Software firm.

All changes, bug fixes, updates, modifications, amendments, new versions shall not result in any non-conformance with this Specification.

The Contractor shall submit all new versions to the “Engineer” for review at least 2 weeks prior to their installation.

The new versions of software shall not degrade the operation of the System.

#### 17.4.2 Security Obligations

Within 14 days of the installation of any software into the Permanent Works by the Contractor, the Contractor shall submit to the “Engineer” for retention by the Employer two back up copies of the software, which shall include any specified development tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers.

Any software item delivered by the Contractor to the “Engineer” pursuant to the above Paragraph shall not be translated or modified by the Employer without the prior consent of the Contractor unless:

- the owner of the software becomes insolvent or has a receiving order made against it or makes an arrangement or assignment or composition with or in favor of its creditors (including the appointment of a committee of inspection) or goes into liquidation or commences to be wound up or has a receiver, liquidator, trustee or similar officer appointed over all or any part of its undertaking or assets or if distress, execution or attachment is levied on, or if an encumberancer takes possession of, any of its assets or any proceeding or step is taken which has an effect comparable to the foregoing in any relevant jurisdiction; or
- the owner of the software ceases to trade; or
- the owner of the software assigns copyright in the software and the Contractor fails within 60 days of such assignment to procure in favor of the Employer, a license from the new owner in the same terms as that required by the Contract; or
- The Contractor is in breach of any of his obligations under the Contract.

#### 17.4.3 Error Correction

The Contractor shall inform the “Engineer” immediately when a fault is discovered within delivered software or documentation.

On receipt of a request from the “Engineer” for identification or further diagnosis of a failure or fault, the Contractor shall provide appropriate resources.

The Contractor shall provide written details as to the nature of the proposed correction to the “Engineer”.

#### 17.4.4 Training

The Contractor shall provide training for Employer's staff to enable the Employer to make proper use of any new versions.

17.4.5 Fixes or Patches

The Contractor shall notify the Employer promptly of any fixes or patches that are available to correct or patch faults.

The Contractor shall detail any effect such fixes or patches are expected to have, upon the System.

17.4.6 New Versions

The Contractor shall ensure that all new versions are fully tested and validated on the simulation and development system prior to installation.

The Contractor shall ensure that all new versions are fully tested and commissioned once installed on the Site.

The Contractor shall deliver to the Employer any new version, together with the updated Operation and Maintenance Manuals.

The Employer shall not be obliged to use any new version and that shall not relieve the Contractor of any of its obligations.

Any effect upon the performance or operation of System that may be caused by a new version shall be brought to the Employer's attention.

17.4.7 Routine and Corrective Maintenance Procedures

Routine and corrective maintenance procedures shall be supplied for all equipment. The format shall be as follows:

- Uniform format and layout irrespective of equipment supplier;
- Colour coding for each activity;
- Cross referenced to the Operation and Maintenance Manuals; and
- Document control information.

17.4.8 Operation Activities

All operational activities shall comply with the Employer's safety rules, and requirements of the Operation and Maintenance Manuals.

The Contractor shall recommend in detail the frequencies for preventive and corrective maintenance, and what items of work are to be carried, including but not limited to the following.

- Step-by-Step procedure to carry out the task;
- Diagrams and flow charts for illustration, if applicable;
- Precautions for the maintenance personnel to follow; and
- Estimated duration and manpower required.

17.5 Not used

17.6 **Not Used**

**17.7. Service Performance Requirements.**

The Contractor shall mobilize competent personnel to rectify stoppages at any time during the day or night when being called on by the Employer's representatives within a time of thirty Minutes. Repairs shall be carried out on a 24 hours per day, 7 days per week basis until the faulty unit / escalator is put back in service. The contractor shall ensure to achieve following Service Performance during DLP: -

S.N.	Service Performance Requirements during DLP	
1	Reliability (MTBF) Mean Time between Failure	≥ 7 days
2	Availability	≥ 99.9%
3	Maintainability (MTTR: Mean Time to Repair)	≤ 4 hrs
4	Call out Ratio (per Escalator per Year)	≤ 2 calls
5	Response Time	≤ 30 Minutes

**1. Reliability:**

Reliability measure for the Escalators is Mean Time Between Maintenance Action (MTBMA). MTBMA shall be calculated for each calendar month separately and MTBMA calculation shall be done based on the total number of Escalator operational on 01st day of that applicable month. The Preventive Maintenance Action is also included in this for Calculation of MTBMA. If contractor fails to comply above conditions of MTBMA (i.e. MTBMA less than 7days) then Penalty of INR 15,000/- shall be imposed.

**2. Availability:** Availability will be calculated as under: -

$$= \frac{(Availability\ Hour - unavailability\ Hours)}{(Availability\ Hours)}$$

$$Availability = \frac{\{(365 \times 20\ hrs.) \times \text{No of escalator population in section}\} - \{\text{Total Unavailability hrs. in one year}\}}{\{(365 \times 20\ hrs.) \times \text{No of escalator population in section}\}}$$

If contractor fails to comply above conditions of Availability (i.e. Availability less than 99.8%) then Penalty of INR 15,000/- shall be imposed. For the purposes of calculation of "Availability Hours", the Contractor shall assume that the service operating hours are 20 hours per day (06:00 hours of morning to 23:00 hours of midnight or as decided by Employer). For the purposes of calculation of "Unavailability Hours", breakdown time in above said service operating 20 hours shall be considered. For Example, if Escalator gets breakdown (not available for operation) at 18:00 Hr (in the evening) and Contractor put back in operation in next morning at 06:00 Hr then only 5 hours (23:00 Hr -18:00 Hrs) will be considered as unavailable Hours, Means non-operation time will not be considered as unavailable hours for calculation.

**3. Mean Time To Repair (MTTR)**

MTTR time measurement shall include response time, on site diagnostics and rectification of the failure up to point that the system is restored to full functionality. In the event that the failure cannot be rectified, the measurement shall include the time necessary to remove the failed piece of equipment from the system and replaced it with a functioning module. The maintainability shall measure by fault rectification time, which should not exceed 4 hours since its reporting to contractor's call center and/or to his authorized person by NCRTC or/and its representative(s). If contractor fails to comply above conditions of MTTR (i.e. MTTR more than 4 hours) then Penalty of INR 15,000/- shall be imposed.

**4. Call Out Ratio:**

There should not be more than 02 (two) service engineer visits per year for any particular Escalator per Escalator for the failures. The period of one year will commence from date of Revenue Operation / Taking over whichever is later. If the visit of service engineer for break-down maintenance exceeds 2 per Escalators per year, then a penalty

of Rs. 15,000/- (Rs Fifteen Thousand Only) shall be imposed for each such visit which is as per Jurisdiction of Employer.

**Note:** The Contractor shall submit a Quarterly Performance Report along with the Payment Invoice, giving the details actual performance achieved on monthly basis in an approved format with specific reasons if any of above mentioned target does not met, duly signed by Employer representative(s). If contractor fails to comply with anyone above performance targets of Reliability, Availability, MTTR and Call out Ratio, then penalty of Rs 15,000/- for each non- compliance target Per month shall be imposed.

In addition to above, if anyone of Escalator is kept out of service for more than 24 hrs due to non – availability of spares or due to lack of proper attention, then Employer shall impose an additional penalty of INR. 15,000/- (INR. Fifteen Thousand Only) per day, for each such case. The Employer will assess the reasons for the equipment not being in service, accordingly, the penalty will be imposed. The Employer decision is final.

Please note that for a period of First Three months from date of Revenue Operation, the values of Reliability, availability, Maintainability, call out Ratio will be calculated and monitored, but No Penalty will not be admissible. After, three months from the date of Revenue Operation, Penalties as specified above in the respective paras above will be applicable.

**END OF CHAPTER**





## CHAPTER 18

### SPARES, SPECIAL TOOLS AND TEST EQUIPMENT

**18. SPARES, SPECIAL TOOLS AND TEST EQUIPMENT****18.1 General**

- 18.1.1 The Contractor shall note the requirements stipulated in the General Specification and Spare Policy as provided at Appendix-E of this PS.
- 18.1.2 The Contractor shall supply all spares, special tools and test equipment to facilitate the maintenance, repair and overhaul of the escalators effectively and efficiently while ensuring their performance to a high standard of safety and reliability consistent with the requirements as detailed in this Specification. The details and Policy for various Spares, tools and test equipment required has been provided in Appendix – E. Any additional spares, tools and test equipment are required the same may be indicated by the Firm in their Technical Offer.
- 18.1.3 All spare parts shall be identical to the equivalent installed items and strictly interchangeable, be suitable for use in place of the original parts fitted and comply with this Particular Specification and the tests specified therein.
- 18.1.4 They shall be suitably marked and numbered for easy identification and shall be packed for long storage in wooden boxes in suitable groups for easy maintenance. While necessary parts shall be coated in protective material to prevent deterioration.
- 18.1.5 In the event that rectification and/or modifications are introduced to any part of the equipment which are deemed necessary by the “Engineer” in order to comply with the Specification requirement, the Contractor shall modify and replace all spare parts and/or special tools whether delivered or otherwise.
- 18.1.6 The Contractor shall guarantee that the test equipment supplied shall be well calibrated in accordance with manufacturer's instruction. Appropriate calibration certificates shall be required by the “Engineer” for checking prior to carry out testing and commissioning.

**18.2 Spares**

- 18.2.1 DLP Spares  
The Contractor shall recommend and provide a list of commissioning and DLP spares with sufficient quantities to ensure the successful completion of the testing and commissioning activities and covering of DLP. Details are provided in Spare Policy at Appendix-E of this PS.
- 18.2.2 Unit exchange Spares  
Details are provided in Spare Policy at Appendix-E of this PS.

**18.3 Test Equipment**

18.3.1 NOT USED.

18.3.2 Portable Test Equipment

Portable lap top computer shall be provided to allow rapid verification of satisfactory operation of system, assist in trouble shooting and isolating sub-system failures. Use of Portable lap top computer shall not require any mechanical or electrical disconnection to or within the sub-system under tests.

Two sets of portable lap top computer with desired software (software of downloading the reading of EVA meter also) for the escalator contract specified at clauses 18.3.2 shall be provided by the Contractor. The detailed specifications for Laptop or palmtop to be got approved from the "Engineer". Latest Specification of Laptop shall be as per Employer requirement compatible to the downloading facilities of Fault codes from the Elevators Control Panel with necessary software including of Software of EVA Meter.

**18.4 Special Tools**

18.4.1 The Contractor shall provide all necessary tools for normal as well as emergency rescue operation and for maintenance purpose including tools such as brake releasing devices and hand winding devices, all other keys for the key operated switches such as the key to open the Auxiliary Switch Cabinet. 3 set of keys for each escalator shall be provided by the Contractor at the time of hand over to Employer for trial Operations.

18.4.2 The Provision of the special tools under this part of the Particular Specification shall be deemed to have been included in the Contract and shall be handed over to the "Engineer" when the escalator installations are completed.

18.4.3 Certain items of these special tools shall be fixed on to a shadow board or housed in a container mounted at an approved location inside the escalator machine rooms. Details of the arrangement will be given to the Contractor by the "Engineer" during the installation stage.

18.4.4 The Contractor shall supply one complete set of any special tools for each type of escalator that are necessary for routine maintenance to be carried out. These tools shall be supplied in a suitable hard wood or steel tool box

**18.5 Availability of Consumable Spares during Defect Liability Period**

18.5.1 Consumable Spares shall be provided as per Spare Policy given at Appendix-E of this PS.

**18.6 Not Used****18.7 Second Sourcing for Non-Proprietary Items**

- 18.7.1 The Contractor shall identify principal source suppliers that can supply the Mandatory Spares. The Contractor will furnish the list of proprietary items. For non – proprietary items the contractor shall submit the list of alternate / second source of suppliers.
- 18.7.2 The Contractor shall ensure that second-source supplier information is maintained up to date up to a period of 10 years after taking over of whole works. The Contractor will provide support to the Employer to a reasonable extent regarding the second-source supplier information throughout the service life of the system.
- 18.7.3 The Contractor shall make the second-source supplier information available to the “Engineer” at the time of submission of the final design and taking over of the works.

## **18.8 Long Lead Times**

- 18.8.1 The Contractor shall identify the lead times for all spare parts. Parts with long lead times shall be identified in the spares list.

## **18.9 Routine Change**

- 18.9.1 In the event that any item of the supply requires to be routinely changed or calibrated, regardless of whether it appears in the spares list or not, it shall be identified to the “Engineer” together with the routine change interval.

## **18.10 Shelf Life**

- 18.10.1 In the event that any of the spares identified have a particular life or storage requirement, this shall be made known to the “Engineer” with the submission of the spares list, including the necessary action for disposal or storage.

## **18.11 Price of AMC Charges**

The Contractor shall furnish price for 1 year AMC rates beyond the DLP. The details shall be provided in statement 8 of BOQ (Pricing Document-Vol-7). For This AMC period, the contractor shall furnish a separate performance Bank Guarantee from a scheduled commercial Bank in India for a value of 5% of total contract value (Including one year AMC cost), in the format of Performance BG, Schedule-2 of SCC). The Bank guarantee shall be submitted one month before completion of DLP and valid upto 28 days beyond completion of one year AMC period.

## **18.12 Vendor Approval Policy**

Refer Appendix-F of this PS for vendor approval Policy.

**END OF CHAPTER**

# CHAPTER 19

## TRAINING

## **19 TRAINING**

### **19.1 General Requirements**

19.1 This section of the specification covers the requirements for a Training Program to train the Employer's maintenance, operations and training personnel. The training Program shall enable the staff to operate, service, enhance, maintain, and interact with, the hardware, software, and firmware, such that the escalator systems and associated equipment will perform in accordance with the specifications of this contract.

The Contractor shall provide comprehensive training to the Employer's staff, including Employer's training Instructors. The Employer's staff basically consist of Executives, senior supervisors, junior supervisors and maintainers. Some of the senior supervisors would be nominated as Employer's Training instructors. The Contractor shall provide competent training instructors, training manuals, all necessary aids and materials in support of all training courses. The training manuals shall be submitted in original plus five hard copies and in electronic format.

The training instructors shall be qualified, competent, with sufficient years of practical experience in the relevant fields and possesses good communication skills.

The training instructors shall be competent staff of the Contractor, or the subcontractors or the equipment manufacturers.

19.1.2 The training shall be carried out at such locations where the greatest benefit for trainees may be gained. This may be in India, abroad, at place of manufacture, assembly or testing, or at such other locations as may be necessary. All places of training shall be subject to review by "Engineer".

19.1.3 The training courses and/or sessions shall include system performance requirements and all major equipment and works designed, by the Contractor.

19.1.4 The Contractor shall provide full-time on-Site management and co-ordination of the entire training programme to ensure the continuity of classes, and proper distribution of training materials, and be responsible for interfacing with the instructors.

19.1.5 The training courses shall be delivered to all relevant Employer's staff, including instructors, operation and maintenance engineering staff.

19.1.6 The training shall cover a holistic view of operation & maintenance of complete Escalator system. It should also cover, man-power requirement, job description, maintenance infrastructure requirements including tools, test-instruments, spares etc.

19.1.7 Audio-visual aids, class room training, site visits, on the job training and Trainer's kit for training on trouble shooting to be used.

### **19.2 Scope of Training**

The training shall be provided by the Contractor to the Employer's personnel in design, manufacturing, testing, system architecture and installation practices related to Escalators. This will cover training in India and abroad including training at manufacturing facilities.

### 19.3 Training Programme

Contractor shall submit a training programme for imparting training to Employer Staff with batches of approximately 10 persons for Escalator systems in following areas.

S.N	Description	Total Period (Trainer Working days)	Remarks
1	Design of Escalators	05	During the Design Stage
2	Manufacturing facilities, Testing methods and procedures, Working MRTS installations. Short Module course on System description, architecture, etc. for Escalators. Training in O&M in operational MRTS where similar system functions.	05	During manufacturing at factory premises and other locations.
3.	Installation and site testing practices for Escalators	10	During installation and commissioning phase
4.	Escalator control & monitoring system, troubleshooting, fault diagnosis, emergency handling, etc.	15	At existing installation in other MRTS or similar sites.
5.	Overall view of Escalator system, Operation and maintenance practices for Escalators, Maintenance infrastructure, PM & CM , CBM (vibration etc.)	30	At suitable locations

### 19.4 Training Plan

The Training Program shall be prepared and submitted by the Contractor as per requirements of GS.

### 19.5 Training Courses

The Contractor shall provide Training Courses on all facilities, systems, equipment, hardware, and firmware, software. Each Course shall be specific, and shall consist of classroom, hands-on, or field training as necessary to accomplish the Course Objectives specified in the Training Program Plan. The Contractor shall provide training courses for each of the sub-systems, including, but not be limited to:

- (i) Escalator structure and support
- (ii) Escalator drive and braking system

(iii) Escalator Control & monitoring system

Different types of training courses of each subsystem shall be provided for staff from different disciplines. Operations training courses shall be provided for the operations staff. Maintenance courses shall be provided for maintenance staff. The Employer's Training Instructors shall attend all types of training courses such that the Employer's Training Instructors shall be able to subsequently train the Employer's additional staff in future in all aspects of operation and maintenance of the System.

Training is also required to be given to all station operating staff in emergency operations & small recoveries and to identify the defects so that maintenance teams can be called.

## 19.6 Operations Training Courses

The operations training courses shall be developed to provide all necessary knowledge and skills for operations staff of the Employer to operate the system under normal and emergency situations and recovery from minor or simple faults. In particular, the training course shall include the following as minimum:

- Overview of the Escalator Systems;
- Brief description of the operation principle each of the Subsystems;
- Operational features and functions;
- Familiarisation and use of all man-machine interfaces involved;
- Reading and interpretation of system status and alarm messages or indications;
- Normal operating procedures;
- Operating procedures under emergency situations;
- Procedures for recovery from minor or simple faults; and
- Use of Operation and Maintenance Manuals and documentation.

Particular exercises shall be included in the operations training course for each trainee to operate and manage the system under normal and emergency operating conditions and simple fault recovery.

## 19.7 Maintenance Courses

The maintenance courses shall be developed to provide all necessary knowledge and skills:

- 1) To perform full maintenance, including preventive/corrective maintenance and condition based maintenance on the Escalator Systems and use of CM techniques like vibrations.
- 2) To perform system Engineering management including system parameter configuration, enhancement, adjustments and provision of new equipment and components.
- 3) Man-Power requirement.
- 4) Maintenance infra-structure requirement.



The Contractor shall determine the content of the courses and the courses shall include the following as minimum:

- Overview of the Escalator Systems;
- System features and functions;
- Operation principles;
- Description of system components;
- Test and commissioning procedures;
- Use of test equipment and special tools;
- Reading and interpretation of alarm indications, messages and print-outs;
- Preventive maintenance procedures;
- Fault diagnosis, troubleshooting and corrective maintenance procedures;
- Equipment settings and parameters configuration;
- Use of equipment manuals, Operation and Maintenance manuals, circuit diagrams and wiring schematics;
- Methods and procedures to provide new circuits, system expansion and enhancement;
- Data, software backup and loading; and
- Use of software such as peripheral control and configuration, utility, database structure, generation and modification.
- Practical exercises shall be provided for each trainee to practise the following as minimum:
- Use of test equipment and special tools;
- Preventive maintenance;
- Fault diagnosis and troubleshooting with induced faults set by the Contractor to simulate real-life situation; and
- Faulty modules or cards replacement and restore the system to normal operation.
- CM techniques.
- CM based maintenance (CBM), Maintenance Requirement Analysis (MRA), Reliability centred maintenance, FMECA, RAMs etc.

## 19.8 Training Materials

Audio-visual Training Aids, Interactive Training Video CD, Training Materials, and Training Devices (like Trainer's kit) shall become the property of the Employer on approval of the Training Demonstration, or on approval of the Final Deliverables, as applicable. For every lecture, training manual is to be given well in advance before commencement of training.

The Contractor shall provide all Training Aids, Interactive Training Video CD, along with the Training Materials, Training Devices, Special Tools, fixtures, models, or other equipment required to train Course participants.

Training Manuals are a convenient source document for use in the field. However for every lecture handouts with Interactive Training Video CD, will also be required to be given.

Training Manuals shall be separate from Operation and Maintenance Manuals.

The Contractor shall prepare Training Manuals bi-lingual (i.e. in Malayalam or any other Indian Language as approved by employer and English both) as per requirement of the project, and submit them to the Employer for review and approval at least 60 days prior to the start of the Training Demonstration.

Throughout the Contract and DLP, it shall be the responsibility of the Contractor to supply the Employer with all changes and revisions to the Training Manuals.

Training Manuals shall become the property of the Employer.

The Contractor shall provide the master and five hard copies of the Training Manual for each course/subject.

The Employer reserves the right to copy all Training Manuals for use in Training Courses.

The Contractor shall, for each course, distribute two sets of trainer's guides for the trainers, one set of training handout for each trainee, two sets of trainer's guides and three additional sets of training handout to the Employer before the commencement of the training course. Electronic copy of Trainer's guide & Training manual will required to be provided.

All the training materials shall be accurate and match with the actual design of the System.

## **19.9 Training Records**

The Contractor shall keep records on the attendance of trainees.

The Contractor shall devise a system, standards in assessing the level of knowledge, understanding of the course content and proficiency of the trainees. The system and standards shall be submitted to the Employer for review four weeks before the commencement of the training course.

The Contractor shall issue appropriate training certificate to the trainees who pass the assessment and have over 80-90% attendance. At the end of successful training, contractor shall issue competency certificates to O & M staff of various levels.

## **19.10 Training of Employer's Training Instructors (ETI)**

19.10.1 The objective of this training is to enable the Employer's Training Instructors to be competent to deliver future courses for other employees of the Employer.

19.10.2 The Contractor shall provide training to the Employer's Training Instructors on the various Systems. Aspects covered shall include, but not be limited to, the following:

Basic Operating & Features and functional principles of the Escalator Systems

System design aspects including but not limited to design standards, design criteria and parameters, short-circuit and other calculations, insulation and protection co-ordination;

Details of major equipment and components used in the System;

System operation and maintenance management procedures;

Control and monitoring systems for Escalators;

Trouble shooting, faults, failure analysis & remedial action, PM, CM & CBM, first level, second level & third level maintenance.

### **19.11 Transfer of Technology (TOT)**

Tenderer shall submit the detailed plan of transfer of technology along with MOU with suitable Indian companies or company having proven track record and are working in related areas for all major systems/subsystems. TOT shall be essential and shall include system assembly, installation, maintenance and software modification/customization and training of Indian Company's personnel to cover; All configuration/application programmes for Escalator system for:

Engineering of extensions and up gradations of stations

Re-engineering to suit changed traffic conditions.

Incorporation of additional features

Incorporation of optional facilities

Addition /Modifications to equipment and components

Maintenance of Escalators

Change in parameters of any of the Escalator equipment in stations.

The Transfer of Technology may require involvement of Indian Company's personnel in design, manufacturing, testing and installation of Escalator Sub- Systems during the Contract period. The Contractor shall undertake to supply or make arrangement with the original manufacturer to supply additional equipment required for replacement or up gradation of the Escalator systems in future. The Contractor shall undertake to provide to the above Indian Company, during the life of the equipment ordered technical assistance in the form of additional drawings, maintenance practices and technical advice.

**END OF CHAPTER**

## CHAPTER 20

# OPERATION AND MAINTENANCE DOCUMENTATION

## **20 OPERATION AND MAINTENANCE DOCUMENTATION**

### **20.1 General**

- 20.1.1 The Contractor shall provide Interactive Training and Operation and Maintenance manuals, bi – lingual (i.e. in Malayalam or any other Indian Language as approved by employer and English both) and Interactive Video CD, for use by supervisory, operating and technical staff of Employer.

#### **Requirements of Interactive Manual**

The contractor shall submit in English language Interactive Electronic Technical Manuals (IETMs) to manage technical documentation. IETMs shall compress volumes of text into Hard-disks which may include sound and video and shall allow readers to locate needed information rapidly than in paper manuals.

This IETM shall follow the structure and format of a printed book, with indexes and table of contents that are hyperlinked into the content of the document. All figures, tables and section references shall be linked.

The data to be stored in a relational database, obtaining benefits of data integrity and removal of data redundancy. Relationships in the content that are presented as hyperlinks, are mapped directly to relations in the database scheme. The IETM shall be able to change the content dynamically based on users navigation and input through the content; the content may now be user specific.

- 20.1.2 Requirements of submission have been furnished in Chapter 11 of GS.
- 20.1.3 Each and every manual shall be divided into indexed sections explaining the subject matter in logical steps. Most manuals shall consist of A4-size printed sheets bound in stiff-cover wear-resistant binders clearly and uniformly marked with the subject matter and reference number. Where alternative sizes are proposed, (e.g. A5/A6 pocket books of schematic wiring diagrams) these shall be submitted for review of “Engineer”. The binding shall allow for all subsequent changes and additions to be readily effected.
- 20.1.4 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.
- 20.1.5 The Contractor shall provide clarifications and amendments to the Operation and Maintenance manuals as necessary during the Defects Liability Period. Updates shall be provided for the originals and all copies.

20.1.6 The first draft of operation & maintenance manuals are to be provided at least 60 days before the installation commences. These should be corrected as per employer's comments and finally be submitted during installation and commissioning.

20.1.7 Hard copy as well as electronic copy should incorporate colour photos, colour sketches and drawings in pictorial form wherever possible.

## **20.2 Operation Manuals**

20.2.1 The Contractor shall provide operation manuals explaining the purpose and operation of the complete system together with its component subsidiary systems and individual item of equipment. The characteristics, ratings and any necessary operating limits of the Equipment and Sub-systems shall be provided. The Operation Manuals shall focus on operation aspects under normal and emergency conditions.

## **20.3 Maintenance Manuals**

20.3.1 The Contractor shall provide 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.

20.3.2 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 by the "Engineer".

20.3.3 The maintenance manual shall also include an illustrated parts catalogue of all plant supplied and shall contain sufficient information to identify and requisition the appropriate part by maintenance staff. The catalogue shall comprise 2 sub-sections.

20.3.4 The first shall be an alphanumeric parts list, which shall include the following information:

- (i) Part number
- (ii) Description
- (iii) Name of manufacturer
- (iv) Quantity and Unit
- (v) Part number of next higher assembly (usually a line replaceable unit).
- (vi) Cross-reference to figure number.
- (vii) Category: e.g. consumable, line replaceable unit, repairable.
- (viii) Life-expected life, Mean time between failure or mean distance between failure where available, Mean time between repair, Mean time between maintenance, Reliability.
- (ix) General or specific purpose

20.3.5 The second is 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.

20.3.6 Maintenance manual should cover the following ;

- Maintenance planning, Maintenance management, Maintenance Requirement Analysis like Reliability centred maintenance, FMCEA etc.
- PM, CM, CBM & condition monitoring techniques i.e. during installation, vibration levels are required to be noted down which becomes reference for vibration limits.
- Maintenance infrastructure
- Maintenance Checksheets
- Illustration of of escalator's components assemblies, sub-assemblies, etc. with sketch.
- Detailed explanation of safety items,
- Detailed coverage of troubleshooting,
- Manpower requirement
- Job description, Comprehensive annual maintenance.

#### 20.3.7 Routine and Corrective Service Procedures:

Routine and corrective Maintenance procedures shall be supplied for all equipment. The format shall be as follows:

Uniform format and layout irrespective of equipment supplier;

Colour coding for each activity;

Cross referenced to the Operation and Maintenance Manuals; and

Document control information.

#### 20.3.8 Operation Activities:

All operational activities shall comply with the Employer's safety rules, and requirements of the Operation and Maintenance Manuals.

The Contractor shall recommend in detail the frequencies for preventive and corrective maintenance, and what items of work are to be carried, including but not limited to the following:

Step-by-Step procedure to carry out the task;

Diagrams and flow charts for illustration, if applicable;

Precautions for the maintenance personnel to follow; and

Estimated duration and manpower required.

#### 20.3.9 Maintenance Service Plan

The Contractor shall provide the employer with a maintenance service plan and a Predictive Replacement Plan for the components which are likely to result in failure of Escalators. Reference Plan shall be finalized during design approval stage. Maintenance service plan shall include all Preventive / Scheduled & Corrective Maintenance, and must be submitted for Approval, 3 months before the commencement of the DNP. The Employer shall reserve the right to review the "Predictive Replacement Plan" based on actual performance of equipment during 2 Years Defects Notification Period (DNP) Nothing extra shall be payable

**END OF CHAPTER**





## CHAPTER 21

### PROGRAMME REQUIREMENTS

## **21 PROGRAMME REQUIREMENTS**

### **21.1 General**

The expected dates of commissioning of various section of Lucknow Metro Project are defined in Clause 2.2 of Chapter 2.

In addition to the requirements specified in the General Specification, the Contractor shall programme the Works in accordance with a pre-determined sequence to meet various Key Dates and Access Dates so as to meet the Target Dates of commercial opening:

### **21.2 Key Dates**

The work includes a number of stages. These stages are inter-related and essential to the completion of the Escalator works to be achieved within the Key Dates.

The Key Dates indicated in the schedule of Key Dates are mentioned in terms of the time period reckoned from the commencement of the works, and the deliverables for each Key Date shall be achieved by the midnight of the last day of the week mentioned.

If the identified work is not achieved by the stated Key Dates, liquidated damages may become applicable as set out in the Contract.

Each Key Date and its description is given in the Appendix "B".

### **21.3 Access Dates**

The contractor shall require Access to information as well as to various locations at stations / depots / guide-ways etc. , in stages, in order to plan his activities for time- bound completion of his obligations under the Contract.

The dates on which such Access becomes available are indicated in terms of the time period reckoned from the commencement of works, and shall mean guaranteed access by the mid-night of the last day of the week mentioned.

These sequence, timings and extent access within any location will be further refined and reflected in the Master Programme developed by the "Engineer", based on the Installation Programme from the Contractor and Project Contractors.

The exact timing to access a specific location (or any part of the location) shall then be confirmed by the "Engineer" in the weekly Works Meeting during the construction stage.

Major installation works in the stations and ancillary buildings which require co-ordination with the Civil Project and Electrical Project Contractors, shall be followed as per the Co-ordinated Installation Programme to be prepared by the Civil Project Contractors.

The Access dates for this contract in connection with various stages are also given in the Appendix "B".

**END OF CHAPTER**

## CHAPTER 22

NOT USED



## APPENDIX A

### INTERFACE MATRIX OF ESCALATOR CONTRACT (LKE (02)-02)

- 1) All System Contractors to display interface issues on boards at site in suitable format, so that concerned contractor / department and inspecting officials are aware of the interface requirements.
- 2) Architect / DDC to ensure that interface requirements are met with while issuing GFC drawings. All system contractors are to ensure it & sign off. Interface with concerned contractor is the responsibility of the system contractor. Engineer will provide the contact detail of concerned contractors to system contractor to facilitate timely interface.

If they fail to timely ensure, it will be contractors responsibility to get it done. Not getting it done will attract imposition of penalty.

#### Part-I

Civil contractor responsibilities	Electrical Contractor responsibility	Escalator Contractor responsibilities
<b>Design:</b> <ul style="list-style-type: none"> <li>Identify escalator locations and sizes of escalators.</li> <li>Define mounting and structural provisions for escalator assemblies, Co-ordinate access and delivery space provisions.</li> </ul>	<b>Design:</b> <ul style="list-style-type: none"> <li>Electrical power, Control Interfaces and system shall be developed.</li> </ul>	<b>Design:</b> <ul style="list-style-type: none"> <li>Co-ordinate details of mounting provisions, power supply, electric load and control requirements.</li> <li>Define requirements and provide design details to Civil and E&amp;M contractor for escalator's various requirements.</li> <li>Furnish sizes for escalator controller enclosures, pit, support details and well way dimensions.</li> <li>Co-ordinate fire safety requirement with firefighting systems.</li> <li>Interface with Civil Contractor and Architect for location of suitable hoisting hooks and stray water drainage arrangements.</li> </ul>
<b>Construction:</b> <ul style="list-style-type: none"> <li>Provide escalator structure including upper and bottom pits with the notches. The pits shall have gravitational drainage system.</li> <li>Cut outs for fixing traffic bollards and for laying of cables.</li> </ul>	<b>Construction:</b> <ul style="list-style-type: none"> <li>Provide three phase power with dual earth duly terminated on a suitable MCCB in the escalator control room / enclosure.</li> <li>Provide water connection to escalator sprinkler system.</li> <li>Provide Connection to Fire detector installed in the Escalators Pits from</li> </ul>	<b>Construction:</b> <ul style="list-style-type: none"> <li>Provide Isolating Switch (suitable capacity MCCB and ELCB) before the Escalator controller where the main power supply cable will be terminated.</li> <li>Provide and install escalator units complete with claddings, finishes and operating mechanisms.</li> <li>Provide lighting, ventilation and power socket in the escalator Controller / Enclosure.</li> </ul>

Civil contractor responsibilities	Electrical Contractor responsibility	Escalator Contractor responsibilities
<ul style="list-style-type: none"> <li>Providing and fixing of hoisting hooks.</li> <li>Drainage Pit from the escalator should be away from the escalator pit for ease of cleaning.</li> <li>The depth of the sump / drain pit should be more than the depth of Escalator pit for effective drainage.</li> <li>Wall should not be provided beside the escalator pit, to avoid obstruction in opening of covers of escalator pit for maintenance purpose.</li> </ul>	<p>the Main Station Fire detection system.</p> <ul style="list-style-type: none"> <li>If separate Escalator Control room is constructed, then Provide lighting, ventilation and power socket in the escalator control room.</li> <li>Provide cast in conduits/race ways from escalator control room to escalator's nearest pit.</li> <li>Provide cable tray / conduit / trunking from escalator control room to SCR for escalator data cable.</li> </ul>	<ul style="list-style-type: none"> <li>Plan escalator section / sizes considering local site conditions to facilitate easy transportation to installation location.</li> <li>The gap between escalators and the sides of escalator and the adjoining walls/ parapet walls /Stairs shall be provided with decking extensions upto 300 mm. The Contractor shall allow a gap of approximately 15mm between the decking and the adjacent walls/ parapet walls. The gap shall be filled up by the Escalator Contractor with flexible sealant.</li> <li>Provide and install Fire detectors in the Escalators Pits and Escalator Control Room / Escalator Controller Cabinet.</li> </ul>

**Part-II**

Architect / DDC Responsibility	Civil Contractor Responsibility	Electrical Contractor Responsibility	Escalator Contractor Responsibility
<p><b>Before erection</b></p> <ul style="list-style-type: none"> <li>To issue structural drawings for present and future escalator at stations as per vertical rise of escalators and details of the same.</li> <li>Identification of proper (naturally ventilated and protected from rain shower) escalator control panel location for each escalator in consultation with escalator contractor.</li> <li>Identification of ECP Room (if ECP panel is not placed in open) in consultation with escalator contractor.</li> </ul>	<p><b>Before erection</b></p> <ul style="list-style-type: none"> <li>Adequate storage area at station / depot / storage yard including proper access to storage area from near by road for carrying escalators by cranes / trailers.</li> <li>To protect and cover future escalator shafts suitably.</li> <li>Marking for finished floor level at top support, intermediate supports and bottom support of escalator.</li> <li>Slope of finished floor in the vicinity top and bottom pits of escalator should be away from escalator to prevent entry of mopping water to top and bottom pit of escalators.</li> <li>Adequate extension of roof sheet above the entrance escalator on both sides of escalator for protection of escalator from rain showers.</li> <li>Installation of foldable gate and SS grill with locking arrangement for entrance escalators to prevent theft and sabotage.</li> <li>Load testing of hooks.</li> <li>Pit cleaning, PCC work and construction of slope in pit towards drainage hole.</li> </ul>	<p><b>Before erection</b></p> <ul style="list-style-type: none"> <li>Single phase power supply for Computer based RMS System in Customer Care Centre / Station Control Room.</li> <li>Adequate lighting fixtures above the escalator for proper illumination.</li> <li>UPS supply at Escalator Control Panel as per requirement of escalator contractor.</li> </ul> <p><b>Testing</b></p> <ul style="list-style-type: none"> <li>Fire detectors testing</li> </ul>	<p><b>After erection</b></p> <ul style="list-style-type: none"> <li>RMS cable laying</li> <li>Installation of Computer based RMS System in SCR and other designated room.</li> <li>Installation of escalator safety instructions in chrome plated stainless steel pipe frame both in Hindi and English language at both landings.</li> </ul> <p><b>Testing</b></p> <ul style="list-style-type: none"> <li>Load testing.</li> <li>Escalator safety testing</li> </ul>

<ul style="list-style-type: none"> <li>• Identification of location for installation of Computer based RMS in CCC / SCR</li> </ul>	<ul style="list-style-type: none"> <li>• Hole in Slab / Wall for cable entry from escalator control panel (ECP) to escalator pit, from Escalator Switching Room (ESR) to ECP.</li> <li>• Finishing of roof ceiling, painting etc. above escalator.</li> </ul> <p><b>After erection</b></p> <ul style="list-style-type: none"> <li>• Stone Flaming for making it rough surface.</li> <li>• Filling of Gap (between stone and floor plate).</li> <li>• Filling of gap around escalator pit on all side.</li> <li>• Storage area for maintenance purpose.</li> <li>• SS Handrail near top floor plate and bottom floor on both side of escalator as per requirement of escalator contractor.</li> </ul> <p><b>Testing</b></p> <ul style="list-style-type: none"> <li>• Drainage Hole connectivity to Sump Checking.</li> </ul>		
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**Part-III** (Escalator RMS Data Centralization (via Dark Fiber))

Item No.	Subject	Civil Contractor Responsibilities	Electrical Contractor Responsibilities	Escalator Contractor Responsibilities	S&T Contractor Responsibilities
2	<b>Escalator RMS Data Centralization to OCC (via Dark Fiber)</b>	Provide containment from Escalator controller area to SCR for RMS communication cable. Ensure environmental protection and clear routing.	Provide 230V auxiliary power for RMS PC in SCR (if required). Provide earthing up to entry in Escalator shaft.	<p>Provide RMS Board in Escalator Controller, RMS software, RMS PC/Interface at SCR, and all hardware required for data generation and handover at SCR Ethernet Port. Ensure compatibility with OCC RMS Server.</p> <p>Transport all RMS data from SCR → TER</p> <p>Required Bandwidth shall be informed during design stage.</p> <p>Provide required configuration, IP addressing, VLAN, bandwidth reservation, and interface with</p>	<p>Transport all RMS from TER → OCC over Telecom dark fiber network.</p> <p>Provide required bandwidth reservation as informed by Escalator Contractor during design stage.</p>

				OCC RMS Server. Maintain uptime of transport network and workstation	
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**Part IV** (*Escalator RMS Data Centralization (via Dark Fiber) at Underground Stations*)

Item No.	Subject	Civil Contractor Responsibilities	Electrical Contractor Responsibilities	Escalator Contractor Responsibilities	S&T Contractor Responsibilities
2	<b>Escalator RMS Data Centralization to OCC (via Dark Fiber)</b>	Provide fire-rated cable containment, risers, and shaft routing for RMS communication cable up to SCR.	Provide power (UPS-backed as applicable) for SCR RMS PC/interface.	<p>Provide RMS Board in Escalator Controller, RMS software, RMS PC/Interface at SCR, and all hardware required for data generation and handover at SCR Ethernet Port. Ensure compatibility with OCC RMS Server.</p> <p>Transport all RMS data from SCR → TER</p> <p>Required Bandwidth shall be informed during design stage.</p> <p>Provide required configuration, IP addressing, VLAN, bandwidth reservation, and interface with OCC RMS Server. Maintain uptime of transport network and workstation</p>	<p>Transport all RMS from TER → OCC over Telecom dark fiber network.</p> <p>Provide required bandwidth reservation as informed by Escalator Contractor during design stage.</p>

If they fail to timely ensure, it will be contractors responsibility to get it done. Not getting it done will attract imposition of penalty.

**End of Appendix**





## APPENDIX B

### KEY DATES AND ACCESS DATES

#### 1.0 Key Dates

The following key dates have been stipulated in this Contract:

##### 1.1 Key Date 1 (KD1): Preliminary Design submission

**Achievement** - The following activities shall have been completed prior to the Key Date:

Submission to the “Engineer” of the Preliminary Design which consists of general equipment layouts including machine room sizes, major cabling routings, proposed architectural materials for public areas, preliminary drawings, escalator equipment details and proposed arrangement, preliminary delivery routes, preliminary design and construction specifications, preliminary installation and testing procedures etc. Submission to “Engineer” of Interface Management Plan.

##### 1.2 Key Date 2 (KD2): Submission of Final Design (Definitive)

**Achievement** - The following activities shall have been completed prior to the Key Date:

Submission to the “Engineer” of the Definitive Design in respect of the whole of the works, the same being in the opinion of the “Engineer”, a complete and comprehensive submission or submissions which complies with the Employer's Requirements.

##### 1.3 Key Date 3 (KD3): Delivery to Site of Escalators

**Achievement** - The following work shall have been executed prior to the Key Date:

Manufacture, acceptance of factory testing, shipping and delivery to site of all major equipment and components of proposed Escalators. The delivered equipment shall be unloaded and stored at storage area, which will be subject to agreement by the “Engineer”.

##### 1.4 Key Date 4 (KD4): Installation at Site, Testing and Commissioning of Escalator Systems.

**Achievement** - The following work shall have been executed prior to the Key Date:

Completion of all installation processes at site for escalators systems. The completion of all testing at site, completion and testing of all remote monitoring and control system, obtaining all licenses and clearances from local authorities and commissioning of escalator systems.

##### 1.5 Key Date 5 (KD5): Completion of whole of the Works and taking over by the Employer.

**Achievement** - The following work shall have been executed prior to the Key Date:

Completion of whole of the works to facilitate taking over of escalator system by the Employer. Completion of all training related activities for the Employer's Staff. Submission of all necessary documents including operation and maintenance manuals etc. Supply and handing over of all mandatory spares as required under the Contract.

**SCHEDULE OF KEY DATES: CONTRACT LKE (02)-02**

**Key Dates for Design of Escalator: Kindly refer Appendix 2B (LKE (02)-02) of General Specification**

**SCHEDULE OF ACCESS DATES**

STATION NAME	ACCESS DATES *
Contractor has to interface with designated civil Contractor	

**END OF APPENDIX**

## APPENDIX C

### WORKS AREA ACCESS DATES

#### 1. WORKS AREAS

The Site is divided into a series of Works Areas, which are divided into Construction Depot and Work Sites that will be made available to the Contractor at different times and for various duration as shown on the Schedule of Works Area availability overleaf.

The descriptions of the Works Areas given below are indicative and the Contractor shall satisfy as to the exact nature of the various Works Areas and the extent of works to be carried out prior to the making use of the area as working space and/or for temporary site facilities.

- (a) The Contractor shall submit to the "Engineer" proposals for the use and occupation of these Works Areas, such submissions being at least sixty (30) days prior to the programmed use of the specific Works Area.
- (b) Prior to the returning of any Works Area, the Contractor shall carry out the following works:
  - (i) reinstate the area to the condition as close as possible to its condition when it was taken over, except where the contract requires construction of Permanent Works,
  - (ii) propose final modifications / changes to the area, at locations where it is not possible or desirable to reinstate the area to its original condition, to the "Engineer" for approval and form the area to the approved lines and levels and carry out such other works as may be required by the "Engineer",
  - (iii) remove all rubbish, debris and other materials.

#### SCHEDULE OF WORKS AREA ACCESS DATES: LKE (02)-02

S.No.	DESCRIPTION	ACCESS DATE	Interfacing Contractor
Contractor has to interface with designated Civil Contractor.			

Notes: -

1. The Contractor is obliged to co-ordinate with the Designated Contractors for the location of area available and provide storage, staging and unloading areas.

**END OF APPENDIX**

## APPENDIX D

### LIST OF ABBREVIATIONS

The abbreviations used in this Specification are as follows: -

AC	Alternating Current
ASTM	American Society for Testing and Materials
BCC	Back-up Control Centre
BIS	Bureau of Indian Standards
BS	British Standards
CPWD	Central Public Works Department
DC	Direct Current
DDC	Detail Design Consultants
DFT	Dry Film Thickness
DLP	Defects Liability Period
E & M	Electrical and Mechanical
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EMU	Electrical Multiple Unit
EMR	Escalator machine room
EN	European Standard
g	Gravitational acceleration
GCC	General Conditions of Contract
GS	General Specification
IEC	International Electro Technical Commission
IEEE	Institute of Electrical and Electronic Engineers
IMP	Interface Management Plan
IS	Indian Standards
ITB	Interface Terminal Board
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LT	Low tension
LMR	Lift machine room
m	metre
mm	milli metre
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MMS	Maintenance Management System
MRT	Mass Rapid Transit
N	Newton

NFPA	National Fire Protection Association, USA
N/m <sup>2</sup>	Newton per square metre
N/C	Contactor or relays with normally close contacts
N/O	Contactor or relays with normally open contacts
OCC	Operations Control Centre
PS	Particular Specification
RAM	Reliability, Availability and Maintainability
SCC / PC	Special Conditions of Contract / Particular Conditions
SCADA	Supervisory Control and Data Acquisition
SCR	Station Control Room
UPS	Un-interruptible Power Supply
VVVF	Variable Voltage Variable Frequency
UPMRC	Uttar Pradesh Metro Rail Corporation

## APPENDIX E

### Spares & Tools Policy for Electrical Contracts

#### 1.1 General

The Contractor shall supply the following spares:-

##### 1.1.1 Consumable Spares

- (i) The '**consumable spares**' shall include items such as lubricants, oils, greases, sealants, filter Medias, gaskets, lamps and wearable parts etc. whose declared life is less than one year. This will not include the consumables like Diesel Salt etc. required for operation of the equipment.
- (ii) The Tenderer shall provide a recommended un-priced list of 'consumable' spares in Annexure-1 of this Appendix E on Employer's Requirements as noted above for maintenance and repairs of equipment in technical package. **Any consumable item if required but not included in the above recommended list by the tenderer will be deemed to have been included and shall be supplied as per the provisions of this contract without any extra financial implication to the Employer.** Contractor will be required to supply the requisite quantity of spares, as required irrespective of the quantities indicated by the contractor in the recommended list. Employer's decision in determining any particular item(s) as consumable in line with above guideline will be final and binding. In case any changes are required in the supply of consumables on account of changes at design stage, the contractor shall have to supply the required consumables also.
- (iii) The price of these spares will be part of tender evaluation while assessing the inter-se position of the bidders.
- (iv) The consumable spares shall be handed over by the contractor 3 months prior to ROD or Handing Over (whichever is earlier) to O&M Department. All the Spares shall be stored in the custody of O&M department at a location approved by Engineer-in-charge. However, the delivery of Consumable Spares that have shelf life of less than 2 years shall be regulated as per the requirement at site and approval of Engineer-in-Charge.
- (v) List of consumable spares furnished in the technical package shall be updated during the execution of Contract and following information as minimum shall be provided.
  - a) Names, addresses, telephone numbers and other particulars of manufacturers and their local representatives;
  - b) Models and part numbers,
  - c) Full description of spares including a note whether it is sealed unit or an assembly or sub-assembly which can be broken down into component parts;
  - d) Quantity installed in the system;
  - e) Expected consumption rates;
  - f) Overall dimensions and weight including minimum packing (if any) for shelf space purposes;
  - g) Inter-changeability or otherwise with similar parts;
  - h) Normal manufacturing and shipment lead times; and
  - i) Shelf life.
- (vi) The consumable spares shall be stored at the location agreed to by the Engineer.
- (vii) It shall be the responsibility of the contractor to maintain sufficient stock of consumable spares till the end of DLP. These spares will be utilized by the Contractor during the maintenance etc. and its consumption to be countersigned with Operation & Maintenance of Employer and the old replaced parts shall be destroyed in the presence of Employer representative. Unused spares, if any, by the end of DLP shall be handed over to Employer and it will become property of employer.

- (viii) There will be joint quarterly audit of available consumable spares by nominated representatives of engineer and contractor and forecast of proportionate balance requirement of consumable spares till the end of DLP will be generated which will be binding on the tenderer to arrange within 3 months of finalization.
- (ix) If due to any Design change, some type of Consumable Spares defined in the list are not required, the same shall be deleted from the scope of contractor by the way of Negative Variation.
- (x) If during the course of Execution of the project certain Non-Schedule Items are approved, then the list, quantity and cost of Consumable spares (if any) related to these non-Schedule items shall be approved along with the approval of that item, as per the discretion and approval of Engineer-in-charge.
- (xi) Recommended list shall be furnished by the contractor as part of design submission / vendor approval for respective systems and subsystems. **(The price of these spares will be part of tender evaluation while assessing the L-1 bidders).**
- (xii) In case of award of Quantity Variation (Positive or Negative) during the execution of the contract, there shall be no variation in the value of Spares till such time the value of variation is within 25% (Positive or Negative) of the Original Contract Value regardless of any variation in Individual item. However, in case of Variation beyond 25% (Positive or Negative) of Original Contract Value, proportionate variation in Consumable Spares rounded to the next higher digit shall be awarded to the contractor.
- (xiii) Payment for spares shall be made on delivery and handing over of Spares to UPMRC O&M Department.

#### 1.1.2 Unit Exchange Spares

The Contractor shall supply the Unit Exchange Spares as listed in the Annexure-2 of this Appendix E on Employer's Requirements. The Unit Exchange Spares shall be supplied in the Store nominated by the Engineer. These shall be delivered as per the key dates defined **(key dates will be informed to the contractor within sixty {60} days of issuing of LOA/NTP)**. Any delay in this regard will make the Contractor liable for liquidated damages as per tender conditions. **This will be part of tender evaluation while assessing the L-1 bidder.**

#### 1.1.3 DLP Spares

- (i) (The Contractor shall submit to the Engineer for review a list of minimum spare parts that that he intends to make available during the installation, erection, commissioning and defect liability periods. **An indicative list is provided at Annexure-3** of this Appendix E on Employer's Requirements.
- (ii) The Contractor shall keep on Site, at his own cost, throughout the installation, erection, commissioning and defect liability periods, stocks of spare parts, as per the list to enable rapid replacement of any item found to be defective or in any way in non-conformance with the Specification.
- (iii) The Contractor shall generally not be entitled to use any of the Employer's spare parts during the installation, erection and commissioning periods or during the Defects Liability Period.
- (iv) Contractor shall not be permitted to remove any working/healthy equipment / components / sub-systems / systems for any reason whatsoever without specific approval in writing from Employer's Engineer or Engineer's authorised representative.
- (v) Spares as per the agreed list shall be supplied at least three months before ROD. Stocks of such spares as available in Contractor stores will be jointly checked with Engineer every three months. Certificate by Engineer confirming availability of the spares in contractor stores / in Depots as per agreed list will be a pre-requisite for release of interim payments of the Contractor. However, this condition will not be applicable for six months before the expected expiry of the DLP period.
- (vi) The Contractor shall include the price of these items in cost of DLP in their Financial bid. the price of DLP shall be part of tender evaluation while assessing the L-1 bidder.

#### 1.1.4 Recommended Spares for 1 year beyond DLP



- (i) The Tenderer shall furnish priced list of the 'recommended spares' not covered under 'Unit Exchange Spares', 'consumables' and 'DLP' spares but the Contractor expects them to be required during three years after expiry of defect liability period, along with the bid as per format enclosed in Annexure-5 of this Chapter of Employer's Requirements. The prices should be proportionate and reasonable. Employer may decide to procure any number of these spares at quoted / negotiated rates before the end of DLP. The Spares shall be supplied at a location nominated by the Engineer.
- (ii) Contractor shall supply all the spares recommended by equipment/sub-system manufacturers within the quoted cost for recommended spares. Contractor shall update list of spares recommended by equipment/sub-system manufacturers at design submission stage.
- (iii) This will not be part of tender evaluation while assessing the L-1 bidder

#### **1.2 Manufacture, Delivery and Warranty**

- (i) The major spare parts ordered under the Contract shall be manufactured, tested and inspected in accordance with the relevant quality system, suitably packed and labeled. All spares shall be subject to inspection by the Engineer. In the event that any item is known to be going out of production, then the Contractor shall give advance notice to the Engineer.
- (ii) The warranty period of 'unit exchange' and 'mandatory spares', delivered shall be:
  - (a) Either 24 months from the date of acceptance or
  - (b) Upto expiry of the defect liability period, whichever is later.

#### **1.3 Purchase of Spares from Vendors**

- (i) The Contractor shall furnish an undertaking that he has no objection whatsoever to and shall not in any way deter or obstruct the Employer, its licensee or its representative from dealing directly with the Contractor's Vendors for the purchase of the spares during the Contract period. The spares purchased shall be subject to inspection by the Engineer.
- (ii) Contractor shall obtain an undertaking from vendors, OEMs etc. at detailed design submission stage that they will deal directly with Employer for supply of spares, equipments and/or sub-systems.

**1.4** The relevant list of the spares mentioned above shall be submitted in the technical bids after blanking the prices, where applicable. The financial bid shall have the price details.

**1.5** Contractor shall submit technical specifications of the items used in this project for the purpose of purchasing. Engineer's views, if any, shall be suitably incorporated.

**Annexure-1 to Appendix-E of PS****List of Recommended Consumable Spares**

Refer Statement of Price- 4A of BOQ

**Annexure-2 to Appendix-E of PS**

The indicative list of Unit Exchange Spares in Lucknow MRTS Project is given in following table.

**Unit Exchange Spares**

Refer Statement of Price 4B of BOQ

**Annexure-3 to Appendix-E of PS**

The indicative list of DLP spares in Lucknow MRTS Project is given in following table.

**List of DLP Spares in Lucknow MRTS Project**

Refer Statement of Price-5B of BOQ

**Annexure-4 to Appendix-E of PS**

The indicative list of mandatory Spares in Lucknow MRTS Project is given in following table.

**List of Mandatory Spares in Lucknow MRTS Project**

Deleted

**List of the Tools**

Refer Statement of Price-5A

**Annexure-5 to Appendix-E of PS****Deleted****Annexure-6 to Appendix-E of PS**

The indicative list of Spares for 10 years beyond DLP in Lucknow MRTS Project is given in following table.

**List of Spares for 10 years beyond the DLP in Lucknow MRTS****Appendix-F****Vendor Approval**

It shall be obligatory for the Contractor to obtain Notice of 'No Objection' from the Engineer for the selection of the vendors for all items of work, even if the name of the vendor is specified in the Contractor's Technical Submission and the works to be done including purchase of materials and equipment is in accordance with the Standards specified in the Contract.

Vendor to be selected who are capable to provide good after sales services available in Kanpur and Agra during DLP and thereafter.

**Vendor Approval and Selection Procedure**

- (1) The contractor can send a proposal for the vendor after ensuring that what he proposes at least meets the specifications both, the quality and safety standard of the stipulated makes, the proposed product should be a proven one. He shall also stand full guarantee to his proposal and if at any stage it is found that the material is not suitable or meeting the tender requirement, the contractor shall replace the material and provide the material from the alternate vendor after approval from Employer without any additional cost to Employer. The alternate makes can be used only after an approval accorded by the Employer, whose decision will be final in the matter.
- (2) The approval of any equipment or product to be used shall be done in two stages:-

**(a) Stage-I**

- Assessment of capability of proposed Vendor to supply a particular equipment or product, with quality and performance requirements, as required by Specifications as well as other contract conditions. The proposed product should be a proven product in service for at least 3 years.

- Assessment of the financial and functional strength of the Vendor to supply the requisite quantity of equipment and product as per delivery schedule acceptable to contractor and engineer to deliver the project in time.

**(b) Stage-II**

Stage-II called as Technical Submission Approval Stage, selection of Equipment or product from the equipment / products manufactured / supplied by the approved vendor will be done. This stage includes thorough technical assessments about the conformance of the offered equipment / product to the Specifications and other requirements.

- (c) To obtain Vendor Approval the Contractor must apply with the four sets of the following documents to the Engineer
- (i) Company Profile and Experience of the Vendor
  - (ii) Clause wise compliance of the relevant Clauses of Specifications.
  - (iii) Details of supplies / orders executed in last ten years for the type of equipment / product offered. Supplies / orders executed for Underground Metro Systems shall be specifically mentioned
  - (iv) Details of the facilities available at the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured.
  - (v) ISO 9000 Certification for the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured (The Works / Manufacturing Unit where the proposed equipment / product shall be manufactured must have ISO 9000 Certification)
  - (vi) Proof regarding compliance to Manufacturer's Qualifications. The offered products must be proven in service.
  - (vii) Audited Financial Statements of the Vendor for the last three years.
  - (viii) Type test certificates/ Performance certificate from accredited laboratories for the proposed type of equipment / products to establish the technical capability of the vendor (In case, specific requirements are mentioned in the relevant sections of Specifications with regard to type testing, same shall also be complied additionally).
  - (ix) The vendor shall not have been blacklisted by any Govt. Agency in India.
  - (x) Any other item as required by Employer / Employer's Representative.
- (d) Contractor must certify the check list provided that vendor Proposal is complete and all the above documents are available in the Vendor Proposal. In addition, the Contractor must check / certify compliance to the Specifications before forwarding the same.
- (e) Incomplete Vendor Proposal will not be treated as a submission and will be returned.
- (f) Engineer will give Approval to the Vendor Proposal (received complete with all the documents mentioned above) expeditiously.
- (g) Technical submission shall be accompanied with the calculations / other technical documents to justify the selection of any particular model of equipment / product, detailed technical features /

parameters of the selected product, type test certificates from the accredited laboratories for the offered products, any other document required by the Engineer.

- (h) Engineer will give Approval to the Technical Proposal (received complete with all the documents mentioned above) expeditiously.
- (3) It may be noted that Approval of Vendors as per Point (3) above shall only be done by Employer / Engineer after the award of the work. Vendor submissions shall not be evaluated during the tender evaluation. Conditional Tender offers received from Tenderers with particular Vendors for supply of equipment/ products will not be evaluated during evaluation and will be dealt with after award of the work.
- (4) It may further be noted that Employer / Engineer shall be under no obligation to accept equipment / products manufactured by the successful Tenderer, unless it meets the entire criterion mentioned above.

### **For Design and Build Contracts**

**In addition to above, in Design and Build Contracts the following shall also be ensured for the Vendor Approval and Selection:-**

#### **1. Proven Design**

The Contractor shall develop the design based on this specification and on sound proven and reliable engineering practices. The broad design details shall be submitted with technical support data in the technical bid. Detailed calculations shall be submitted to the Engineer during the design process stage for review and approval.

#### **1.1 Systems and Sub-Systems**

Manufacturer shall have at least 5 years experience of design and manufacturing of similar system. Proposed systems from the proposed manufacturing unit shall have been in use and have established their satisfactory performance and reliability for 3 years in minimum.

All sub-systems, equipments and major components etc. (hereinafter referred as 'sub-systems') shall be state-of-art and of proven design.

Proposed Systems/ sub-systems shall have been in use and have established their satisfactory performance and reliability on at least Two mass rapid transit systems (including Railway or Airports) in revenue service over a period of three years or more either outside the country of origin at an average in two different countries. Systems/ Sub-systems/ components used in other MRTS in India do not get automatically qualified for use unless specifically approved by the Engineer for this project. If required by the Engineer, Contractor shall provide certificate of satisfactory performance for a period of five years or more from the Metro operators. Where similar System/ Sub-systems of a different rating are already proven in service as per the above criteria then the supply shall be based on such sub-systems.

All 'sub systems' shall be procured from the approved vendors and sourced from only such manufacturing units that have supplied the sub-systems that fulfill the proven design requirements as above.

In case the contractor proposes to use systems or sub-system(s) that do not fulfill the above said criteria then the contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered systems and sub-system(s) for review of the Engineer.

The Engineer's decision on contractor's proposal shall be final and binding.

**For sourcing the equipment from indigenous manufacturing facilities, following conditions shall be complied:-**

- (i) In case the vendor uses his own facilities for indigenization after part supply of equipment from the approved manufacturing unit, no change in design, component type/make, quality standards, manufacture procedure, etc. shall be made without specific approval of the Engineer.
- (ii) In case OEM wants to use manufacturing facilities in India (other than his own) for items for which the OEM has been approved, it shall enter into an agreement with such selected Indian equipment manufacturer and obtain prior approval from Employer. No change in composition, rating, type, model no., manufacturing process, quality standards, design, etc. and make of the components used in assemblies/sub-assemblies of such equipment as manufactured by the approved parent vendor shall be made without specific approval of the Engineer.
- (iii) In case OEM wishes to change/make/type specifications, etc. of any sub-components for supplies to be sourced from Indian facility, specific prior approval of the Engineer shall be obtained for changes made, model, specification, etc. Responsibility for obtaining such prior approval shall rest solely with the contractor.

**Format for submitting the vendor approval request shall be given to the contractor during initial stages and approved format shall be followed throughout the contract.**

**END OF APPENDIX**

**Appendix-G****MAINTENANCE REQUIREMENTS**

**To be Read in conjunction with the chapter-17 Maintenance Requirement of PS**

**1.0 Maintenance**

- 1.1 The Contractor shall provide maintenance services throughout the 2 Years Defects Liability Period (DLP) under the Main Contract and also under the supplementary Comprehensive Annual Maintenance Contract for the Escalators supplied under the contract.
- 1.2 The Maintenance work shall include attendance to all service calls, work described in approved Maintenance Schedule, and the followings:-
  - 1.2.1 Service shall include all work necessary to maintain entire escalator system in good working order at all times through Preventive /Scheduled Maintenance (PM) & Corrective Maintenance (CM). Preventive Maintenance can be carried out only during Non– Revenue Hours. (likely to be 00.00 hrs (Midnight) to 04.00hrs.)
  - 1.2.2 The Contractor shall dispatch competent personnel to rectify stoppages at anytime during the day or night when being called on by the Employer with in a time of Four hours(maximum).
  - 1.2.3 The Contractor shall maintain adequate quantity of consumable and contingent spare parts as per agreed list at mutually agreed location in order to minimize the shutdown time due to repairs and maintenance.
  - 1.2.4 The DLP and Comprehensive AMC includes all spare parts of Escalators including consumables.
  - 1.2.5 Contractor shall carry out periodic testing and examination of Escalators safety devices as required by the provisions of any enactment in force relating thereto or of any enactment, regulations or by-laws of any local or other duly constituted authority which may be applicable to such tests and to provide such copies of the Test certificates, duly signed by a competent “Engineer.”
  - 1.2.6 Contractor shall be fully responsible for obtain & ensure timely renewal of relevant safety certificate(s) or license(s) or any other documents required from statutory authorities for operation & maintenance of Escalators, during 2 Years Defects Liability Period (DLP) and also during the Comprehensive Annual Maintenance Contract. **Nothing extra shall be payable.**
  - 1.2.7 Annual Independent Third Party Safety Check including loading test for each Escalator and corrective adjustment (if necessary) shall be done by the Contractor. The report format shall be approved by Employer.

**1.2.8 Reports**

- 1.2.8.1 The Contractor shall provide monthly, quarterly, half-yearly and yearly reports on the condition of the equipment in a format approved by the Employer.
- 1.2.8.2 A report in duplicate shall be sent to the Employer immediately following every call out, indicating the time of callout visit, cause, remedial action taken and the time that the service was restored. The monthly summary of failure report along with the analysis giving details of nature of fault, remedial action taken etc in the approved Format shall be provided.
- 1.2.8.3 Reports on routine visits are not required except where necessary to draw attention to defects of a minor nature, which could not be rectified during the routine visit. Records of each routine visit and call-out visit, together with details of the work done or action taken, shall be entered on a logbook which shall be provided by the Contractor and retained in the location as decided by the "Engineer".

#### 1.2.9 Maintenance Service Plan

- 1.2.9.1 The Contractor shall provide the employer with a maintenance service plan and a Predictive Replacement Plan for the components which are likely to result in failure Of Escalators. Reference Plan shall be finalized during design approval stage.
- 1.2.9.2 Maintenance service plan shall include all Preventive /Scheduled & Corrective Maintenance, and must be submitted for Approval, 3 months before the commencement of the DLP.
- 1.2.9.3 The Employer shall reserve the right to review the "Predictive Replacement Plan" based on actual performance of equipment during 2 Years Defects Liability Period (DLP) and also during the Comprehensive Annual Maintenance Contract. **Nothing extra shall be payable.**

#### 1.2.10 Failure Investigations

The Contractor shall conduct failure investigations. The Contractor shall make available to the Employer/Owner all test and failure data as required. Disputes (if any) will be resolved by "Engineer".

- 1.2.11 Contractor shall provide Operation and Maintenance Manuals (in Hindi & English).
- 1.2.12 Contractor shall provide training to UPMRC personnel (a batch of 20 person) in operation & maintenance related to Escalators for 15 trainer working days (from 10:00 hrs to 17:30 hrs).

#### 2.0 Maintenance Performance Requirements.

- 2.1 The Contractor shall dispatch competent personnel to rectify stoppages at anytime during the day or night when being called on by the Employer within a time of **Four hours** (maximum). Repairs shall be carried out on a 24 hours per day, 7 days per Week basis until the faulty unit/Escalator is put back in service.
- 2.2 If contractor fails to comply above conditions the penalty of **Rs.1,000/- Per hour** if response time is more than **Four hour** and **Rs.15,000/- per day** if repair is not carried out on a



24hours,7days per week basis, until the faulty unit is put back in service shall be imposed.

**2.3 NOTUSED.**

- 2.4 The contractor shall ensure that the Maintenance Performance requirements as mentioned below are achieved:-

<u>S. No.</u>	<u>MaintenancePerformanceRequirement.</u>	
<u>1</u>	<u>Availability</u>	<u>≥99.5%</u>
<u>2</u>	<u>Maintainability(based on MeanTimeToRepair)</u>	<u>≤4hrs.</u>
<u>3</u>	<u>Call out Ratio(per Escalator perYear)</u>	<u>≤2</u>

**Availability** will be calculated as under:-

Availability=  $\frac{\text{Availability} \{ (365 \times 20 \text{ hrs.}) \times \text{No. of Escalators in a Section} \} - \{ \text{Total Unavailable hrs. in one year} \}}{\{ (365 \times 20 \text{ hrs.}) \times \text{No. of Escalators in a Section} \}}$

**Mean Time to Repair (MTTR)**

The MTTR time measurement shall include on site diagnostics and rectification of the failure up to point that the system is restored to full functionality. In the event that the failure cannot be rectified, the measurement shall include the time necessary to remove the failed piece of equipment from the system and replaced it with a functioning module.

The maintainability shall measure by fault rectification time, which should not exceed 4 hours since its reporting to contractor's call centre or his representative by UPMRC.

- 2.5 The Contractor shall submit a Quarterly Maintenance Performance Report along with the Payment Invoice, giving the details actual performance achieved on Monthly basis in an approved format with specific reasons if any target is not met.
- 2.6 If contractor fails to comply any one of above performance targets, the **penalty of Rs15,000/-Per month** shall be imposed for each Escalator under theSection.

**Indicative List of Spares and tools are provided at Annexure-1 to Annexure-6 of Appendix E of PS.**

## Annexure-1 of AppendixG

### PRICE VARIATION CLAUSE FOR COMPREHENSIVE MAINTENANCE CONTRACT FOR ESCALATORS/ESCALATORS

The price of comprehensive maintenance contracts, if any awarded after completion of 2 years DLP and 1 years AMC for Escalators/escalators, it is to be Revised at the end of one year period on the basis of the following variation formula:

$$P = P_0 / 100 \{ 15 + 50(W/W_0) + 25(MP/MP_0) + 10(FP/FP_0) \}$$

Wherein,

P = Revised price payable in accordance with the above formula.

P<sub>0</sub> = Previous year's confirmed price for the maintenance contract.

W<sub>0</sub> = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt. Of India (Base 1982=100).

This index number is as applicable for the month six months prior to date of commencement of previous year contract.

MP = The final whole sale price index number for metal products as published by the office of the economic advisor, Ministry of Industry, Government of India (refer notes).

FP<sub>0</sub> = The final wholesale price index number for fuel, power, light and lubricants as published by the office of the economic advisor, Ministry of industry, Government of India (refer notes).

This index number is applicable on the 1<sup>st</sup> Saturday of the month, six months prior to the date of commencement of previous year's contract.

For example: For the contract period 1<sup>st</sup> January 2002 to 1<sup>st</sup> December 2002, the applicable (P<sub>0</sub>) should be the contract price for the period 1<sup>st</sup> January 2001 to 31<sup>st</sup> December 2001 (W<sub>0</sub>) should be for the month of July 2000, (MP<sub>0</sub>) and (FP<sub>0</sub>) both should be as on 1<sup>st</sup> Saturday of the month of July 2000 would appear in the circular issued for the month of October 2000.

The above published by IEEMA vide circular reference number IEEMA(PVC)/LLES prevailing as on day of the month.....i.e. one month prior to the date of commencement of previous year's Contract.

W = All India average consumer price index number for industrial workers.  
(base1982=100) is as published by labour bureau, Ministry of labour,  
Govt. of India.

This index number is as applicable for the month ,six months prior to  
The date of commencement of the revised contract.

MP = The final whole sale price index number for metal products as published by the office  
of the economic advisor, Ministry of Industry, Government of India(refer note).  
This index number is as applicable on the 1<sup>st</sup> Saturday of the month, six months  
prior to the date of commencement of the revised contract.

FP = The final whole sale price index number for fuel, power, light and lubricants are  
published by the office of the economic advisor, Ministry of Industry, Government  
of India (refer notes).

This index number is as applicable on the 1<sup>st</sup> Saturday of the month, six months  
prior to the date of commencement of the revised contract.

For example: For the contract period from 1<sup>st</sup> January 2002 to 31<sup>st</sup> December 2002, the applicable  
index numbers (W) should be for the month of July 2001 and applicable whole sale price index  
number (MP) and (FP) both should be for the week ending 1<sup>st</sup> Saturday of July 2001, which would  
appear in the circular issued for the month of October 2001.

Notes:

- a. Whole sale price index number for metal products and for fuel, power, light and lubricant  
are as published by the office of economic adviser, Ministry of Industry, Govt. Of India  
with base 1993-94=100. These whole sale price index numbers are being published  
weekly, on provisional basis. However the same gets finalized after 8 weeks and are  
normally available after two/three months. (Therefore we are considering in our circular  
only this final index published by the economic adviser for the 1<sup>st</sup> Saturday of the month.).
- b. The sole purpose of the above stipulation is to arrive at the amount of the  
entire contract under the various situations. The above stipulations do not indicate any  
intentions to sale material under this contract as movables.
- c. The indices MP, FP and W are regularly published by IEEMA in monthly basic  
price circulars based on information bulletins from the authorities mentioned.

For Indian Electrical & Electronics Manufacturers 'Association

Authorised Signatory

## APPENDIX -H

### REMOTE MONITORING SYSTEM / CENTRAL MONITORING SYSTEM

1. The Contractor shall provide a PC based Remote Monitoring and Control System (RMS) to be run on the computer in the Operation Control Centre to be provided by the contractor. The RMS shall provide continuous monitoring and controlling of the lifts and escalators. In addition to above, the tentatively following data of escalators are to be integrated into the BMS system at Station Control Room in elevated and underground stations (if required by the Engineer). The BMS will be provided by the respective E&M contractor.
2. The following monitoring function shall be provided for RMS of each escalators:
  - a) Power ON/OFF status
  - b) UP & DN direction of travel status
  - c) Escalator Stop Status
  - d) Local/Remote Status
  - e) Speed of the escalator status
  - f) Fault codes of escalator
  - g) Escalator fault status
  - h) Maintenance mode status
  - i) Escalator stop command
  - j) Escalator start (UP & DN) command
  - k) Fault reset command
  - l) Override command

The following monitoring function shall be provided for RMS.

- a) Power On / Off status indicator
  - b) Trip (fault) indicator for all Faults. (Should also include Instructions to
  - c) Local operator / Controller to act in case of fault).
  - d) Up (escalators) direction indicator
  - e) Down (escalators) direction indicator
  - f) Start override indicator
  - g) Speed of the escalator (0.0 m/s, 0.2 m/s, 0.50 m/s, or 0.65 m/s)
  - h) RMS Mode / Local mode.
  - i) Down time log.
  - j) Maintenance support (Maintenance Log, Maintenance Schedule & Non –
  - a) maintenance Alarm).
  - k) Monthly Report.
  - l) Equipment History. (i/c History of Factory Acceptance Test Results, Commissioning Results and Site Test Results).
3. The trip signal shall be activated whenever the escalator is stopped by any fault or emergency stop button during operation and the activation of the control functions in (a) and (b) in Clause 2.0 above. The signal shall be latched on until it is manually re-set by key switches located at the two landings or remotely via the RMS. The escalator shall only be re-started after the "trip" is cleared and the trip" signal has been re-set. Re-starting of escalators shall also be allowed for those fault signals activated by safety devices without the necessities of maintenance personnel to carry out inspection and the safety device is automatically re-set. Detail proposal shall be submitted by the Contractor for review without objection by the "Engineer" prior to manufacture.
4. The following control function shall be provided for RMS:-
  - a) Remote stop control
  - b) Override control switches to prevent unauthorized starting of the escalator for both normal run and inspection run locally. This shall only function when the escalator has been stopped. A by-pass (Local/Remote) switch with illuminated indication which shall by-pass this function shall be provided in the controller.
  - c) Remote re-setting of trip (fault) signal.
  - d) Remote starting comprising of option to select Up / Down direction of movement for escalators.

5. The RMS system shall also be used jointly to operate the functions of the Remote Monitoring and Control Systems of Escalators (Lift). The Contractor shall integrate display requirements of different functions of both elevator and escalators into single software. The choice of size, system of display and background shall be furnished for the consent of the Employer or his representatives. The Contractor shall interface with Telecom Contractor for Communication Network to transfer the signals/information from Station Telecom Equipment Room (TER) to OCC /Central Server. . Escalator contractor shall execute the work as per interface matrix between escalator and TELECOM FIBRE OPTICS TRANSMISSION SYSTEM (FOTS). Contractor for central monitoring of lifts and escalators at OCC provided in Annexure 1 of this PS Further, the Escalator contractor will supply his own computer and provide RMS of escalator and elevator both. It is also the responsibility of escalator Contractor to match open source communication protocol (TCP/IP) of Escalator & Elevator Software, with the software of equipment in OCC for displaying the same in OCC for Central Monitoring System.
6. The Contractor shall be responsible for the provision of all conduits, trunking, cabling and interface terminal board (ITB) in connection with the installation of the RMS except that the conduits and trunking from the Escalator Controller Room to the Station Control Room will be provided by the respective Electrical Contractor. The Contractor shall coordinate and interface with Electrical Contractor and/or his sub-contractor in association with conduits / trunking routing and sizing requirement. The RMS cabling from Elevator to Interface Terminal Block (in Station Control Room) shall be provided by Elevator Contractor.
7. It is preferable that the Contractor proposes to extend signals (Open Source TCP/IP communication protocol) of lifts and escalators from escalator monitoring panel located in SCR, using CAT-6 Cables, to RJ-45 patch panel (Interface point ) on FOTS rack located in station TER. The physical characteristics and data transmission protocol proposed shall conform to an internationally recognized publicly available standard. The Contractor shall also provide serial data link of each escalator, terminated in the interface terminal board (ITB) located in the Station Control Room for connection to OCC by "Telecom Contractor". The information to be carried by serial data link is detailed in Clause 5.10.2 and Clause 5.10.10 above. The Contractor shall interface with "Telecom Contractor" in this regard.
8. Screened cables shall be used for the connection between the communication as described above.
9. If there is a conflict between control functions of RMS as per this requirement and latest edition of EN 115 then requirement of EN 115 shall prevail.

## **10. Online Monitoring of Lift and Escalator Status for Lucknow, Kanpur & Agra Metro Rail Construction Project**

### **10.1 OBJECTIVE**

The objective of the contract is the fixing of agency for Online Monitoring of status and faults of Lift & Escalator of Lucknow, Kanpur & Agra Metro Rail Construction Project as mentioned in Employer Requirement. In full recognition of this objective, and with full acceptance of the obligations, liabilities and risks which may be involved, the Contractor shall undertake the execution of the Works.

### **10.2 GENERAL**

- 10.2.1 Online Monitoring of status and faults of Lift & Escalator of Lucknow, Kanpur & Agra Metro Rail Construction Project shall be done in accordance with Employer's Requirements and the other requirements of the Contract.
- 10.2.2 Online Monitoring of status and faults of Lift & Escalator of Lucknow, Kanpur & Agra Metro Rail Construction Project shall be of highest standards available using proven up- to-date good Engineering practices. The Specification shall in any case not specify standards which, in the Engineer's opinion, are less than or inferior to those described in the Technical Specifications contained in the Tender Documents.

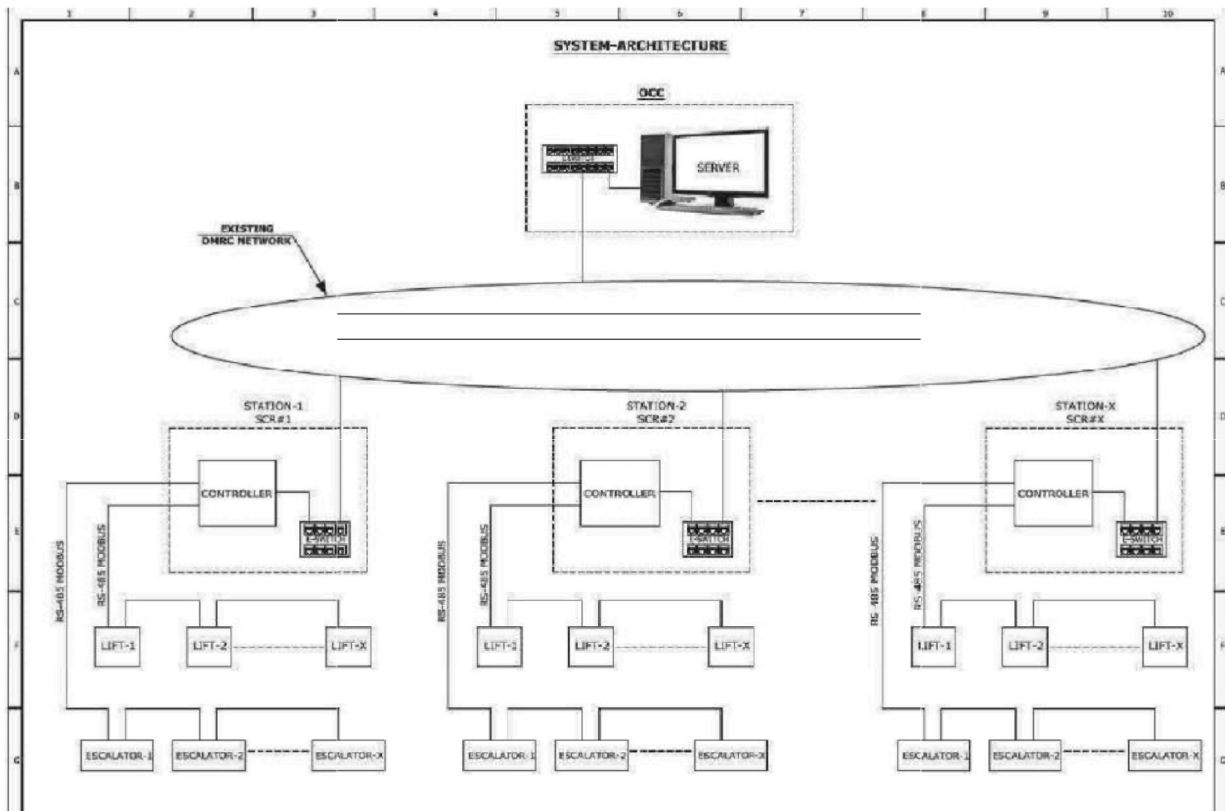
### **10.3 SCOPE OF WORK**

The work shall be executed as per given schedule.

- 10.3.1 The schedule of work includes the following:
  - 10.3.1.1 Online Monitoring of status and faults of Lift & Escalator of Lucknow, Kanpur & Agra Metro Rail Construction Project. The quantity of equipment per station may vary and depend on compatibility of online monitoring equipment with total number of Lift or Escalators at one station. Contractor may also use common one device / equipment for lift & escalator if their device compatible.
  - 10.3.1.2 Not Used.
  - 10.3.1.3 Location of installation of the equipment shall be as decided by the UPMRC engineer in-charge.
  - 10.3.1.4 Work to be executed
    - Development of Software and User Interface as per requirement of Employer. UPMRC reserve the right to seek changes in web based user interface as per requirement and no extra cost will be paid for changes I modification by Contractor.

#### Employer's Requirements: Particular Specification

- Supply and installation of hardware to take the data's of Lift & Escalator from Station Control Room
- UPMRC will provide the signals on MODBUS (Open Protocol) of all Lift & Escalator Station wise at a centralized location, preferably in Station control room (SCR) of that station. The Register Map / Fault Code Mapping of lifts, Escalators and Moving Walkways shall be provided by UPMRC to successful bidder (contractor) only at the time of execution of work as these are confidential. Contractor is advised to do not share the confidential information to any third party without getting approval of UPMRC.
- Data will be transferred from all above mentioned stations to OCC on UPMRC fiber optic network. The Ethernet port will be available either in SCR (Station Control Room) or in TER (Telecom Equipment Room) at each station. If Ethernet not available in TER, Contract has to supply and lay the fiber optic cable from SCR to TER. Fiber optic cable should have two pair extra then required pairs. Any other material i.e. Ethernet switches, LIU (Light interface unit), fiber optic convertor etc, if required, will be supplied by the contractor. To collect the data in OCC (Operation Control Centre) local server will be provided by contractor. Fiber optic cable and other equipment required to connect the server from Ethernet port in OCC will be supplied by contractor. Computer with LED/LCD monitor of latest version (make and specification to be approved by engineer In-charge) will be supplied by contractor for local server. The server at OCC will be web based and could accessed on UPMRC network by other client using Web Browser. For better understanding, the system architecture will be like below picture.



- Necessary arrangement i.e. box for placing of hardware and looping arrangement of signals of all Lift & Escalator wise, etc. to be done by contractor and no extra payment shall be paid by UPMRC.
- The user name and password of user interface website shall be provided by contractor to only authorised persons of UPMRC after getting approval of engineer-in-charge.
- Data Monitoring user interface Access to data shall consist:-
  - Station wise running status of all Lift & Escalator
  - Data viewing
  - Real Time data
  - Historic Data viewing
  - Network tree view
  - User configurable profile
  - Report
  - Download Data reports in excel for further evaluation and analysis
  - Auto e-mail Reports to registered email ID's
  - Auto SMS of faults to registered numbers
  - Pop-up window of current faults with audible alarms
  - Status of Maintenance
  - Alert for Maintenance and predictive replacement of spare parts.

- Access to Authorized Maintenance staff to update maintenance status
  - Predictive replacement of spare parts.
- 10.3.2 The contract for online monitoring will be awarded for one year only. After completion of one year, UPMRC reserves the right to extend the maintenance/DLP/service. The rate and duration of maintenance/DLP/service period will be finalized at that time, but the cost of development / modification of software and user interface will not be applicable. UPMRC reserve the right to ask some modification in user interface as per requirement for which nothing shall be paid extra.
- 10.3.3 All the work associated with finishing such as welding, patching, grinding, complete in all respect shall be carried out by contractor for which nothing shall be paid extra.
- 10.3.4 Manning of site by guard shall be in the scope of contractor if required.
- 10.3.5 While executing work, damage if any to the property/asset of UPMRC/other agency shall be compensated by the contractor.
- 10.3.6 All T&P material including providing of shall be in the scope of Contractor. No T& P support shall be provided by UPMRC.
- 10.3.7 Safety of Man & material shall be ensured by contractor.
- 10.3.8 Manpower for loading and unloading of cable route marker at different locations shall be provided by Contractor.
- 10.3.9 UPMRC is an ISO-14001 & OHSAS 18001 certified Organization for Environment, Health & safety. The work is to be carried out as per International Norms/Standards and in such a manner that all premises always look Neat & Clean. Similarly, the waste disposal is also carried out in totally sealed manner without affecting the Environment.
- 10.3.10 Additional Clause
  - (i) Contractor shall keep close coordination and interface with Operation & Safety department of O&M as well as Project Wing for smooth working and proper execution & completion of work.
  - (ii) The manpower can also be deployed during off days/holidays/night hours as per site requirement for which nothing shall be paid extra.
  - (iii) The work is to be carried out under the guidance / supervision of UPMRC only.
  - (iv) Power block / permit to work shall be arranged by UPMRC on advance request by the contractor.
  - (v) The UPMRC may make minor alterations/additions/substitutions in the specifications/scope of work or issue instructions that may be deemed necessary during the period of contract and contractor shall carry out the work in accordance with the instructions which may be given to him by authorized UPMRC representative. No extra payment shall be payable on this account.
  - (vi) Complete time schedule shall be given by the contractor in advance to concerned engineer-in-charge. However, availability of site shall be informed by engineer-in- charge.

#### **10.4 PROVISION FOR REMOTE MONITORING SYSTEM (RMS) FOR ELEVATORS**

- 10.4.1 The Contractor shall provide a PC based Remote Monitoring and Control System (RMS) to be run on the computer in the Operation Control Centre. The RMS shall provide continuous monitoring and controlling of the lifts and escalators. In addition to above, the tentatively following data of elevators are to be integrated into the BMS system at Station Control Room in elevated and underground stations (if required by the Engineer). The BMS will be provided by the respective E&M contractor. The elevator contractor shall provide / receive the following status monitoring points and control points to the RMS in the form of voltage free contacts: -
  - a. Maintenance mode status- Monitoring
  - b. Run/Stop status- Monitoring
  - c. Power available status- Monitoring
  - d. Emergency Alarm status- Monitoring
  - e. Lift parking status- Monitoring
  - f. Fault status- Monitoring
  - g. Homing command (Parking/un-parking)- Control
- 10.4.2 In addition to above, the Elevator Fault Log Data shall be in the open-source communication Protocol, so that an integrated Remote Monitoring System can be delivered.
- 10.4.3 The elevator fault / trip signal shall be activated whenever there is a fault in the elevator system, which causes a breakdown. The signal shall be latched on for at least 10 seconds. It shall only be reset after the fault is cleared.
- 10.4.4 The alarm signal shall be activated whenever the alarm inside the elevator car is pressed.



## **UTTAR PRADESH METRO RAIL CORPORATION LIMITED**

**Design, manufacture, supply, installation, testing & commissioning of lifts and CCTV installation inside lifts including 01 years DLP and 02 Year Comprehensive Annual Maintenance**

**CONTRACT: LKE (02)-02**

**TENDER DOCUMENTS VOLUME-3**

**Part-C (Agra Staff Quarter Elevator)**

**EMPLOYER'S REQUIREMENTS- TECHNICAL SPECIFICATIONS**

**Uttar Pradesh Metro Rail Corporation Ltd.  
Administrative Building, Vipin Khand, Gomti Nagar,  
Lucknow – 226010, Uttar Pradesh, India**



## TENDER– LKE (02)-02

### EMPLOYER’S REQUIREMENTS – TECHNICAL SPECIFICATIONS

#### AGRA STAFF QUARTERS ELEVATORS

## 1. OVERVIEW OF THE PROJECT

### 1.1 General

This Chapter gives an overview of the Project and the information provided in this Chapter is for reference only.

The UPMRC Staff Quarters at Agra consists of three residential towers—Tower A, Tower B, and Tower C. Each tower consists of pre- build lift shafts. Following is the details of the approximate shaft dimensions.

<b>Tower</b>	<b>Approx. Shaft size (mm X mm)</b>	<b>Type of lift in each tower</b>	<b>Capacity</b>	<b>Stops</b>
A	3000*1810	Passenger cum Service	15 passengers /1020 Kg	Ground +3
B	3010*1815	Passenger cum Service	15 passengers/1020 Kg	Ground +3
C	2550*1890	Passenger cum Service	15 passengers/1020 Kg	Ground +3

### 1.2 Scope

The Contract shall include but not be limited to the following Works: -

- a) Provision of machine-room less 15- Passenger cum Service Elevators in UPMRC Agra Staff Quarters.
- b) CCTV camera installation in lift car with display which is also to be integrated with existing security system (if any) with proper cable laying in cable trays/conduits.
- c) All minor civil works including holes for armored cable entry, louvers and cutouts, load hooks, pit sump, chipping / cutting including Architrave finishing or modifications required for installation of the equipment and restoring to final finishes etc. shall be done by Lift contractor by themselves. All such openings after the completion of works to be closed suitably to avoid any Rodents entry.
- d) Cable laying and Earthing connection from Input power panel to elevator to be done by vendor.
- e) Transportation of materials and equipment for installation purposes.
- f) Interface management as specified in this Specification.
- g) Training for Employer’s staff.
- h) Presentations, reviews and audit support as specified in this Specification
- i) O&M Documentation.
- j) Decommissioning, removal and/or disposal of temporary works;
- k) Obtaining statutory clearances / license for the commissioning of Elevators from regulatory authorities for the period of three years.

- l) 01 years Defect Liability Period (DLP) and 02 Year Comprehensive Annual Maintenance (AMC).
- m) Any other requirements as per lift and escalator Act, 2024.

### 1.3 Key Dates

The following key dates have been stipulated for this Contract:

Sno.	Description of project activity	Timeline in month (within) from the date of LOA
1.	Key Date 1 (KD1): Preliminary Design submission.	4
2.	Key Date 2 (KD2): Submission of Final Design (Definitive).	10
3.	Key Date 3 (KD3): Delivery to Site of major Elevator components/CCTV components.	30
4.	Key Date 4 (KD4): Installation at Site, Testing and Commissioning of Elevator and CCTV Systems.	36
5.	Key Date 5 (KD5): Completion of whole of the Works and taking over by the Employer.	38

#### 1.3.1 Key Date 1 (KD1): Preliminary Design submission

**Achievement** - The following activities shall have been completed prior to the Key Date:

Submission to the “Engineer” of the Preliminary Design which consists of general equipment layouts including major cabling routings, preliminary drawings, elevator equipment details and proposed arrangement, preliminary delivery routes, preliminary design and construction specifications, preliminary installation and testing procedures etc. Submission to “Engineer” of Interface Management Plan.

#### 1.3.2 Key Date 2 (KD2): Submission of Final Design (Definitive)

**Achievement** - The following activities shall have been completed prior to the Key Date:

Submission to the “Engineer” of the Definitive Design in respect of the whole of the works, the same being in the opinion of the “Engineer”, a complete and comprehensive submission or submissions which complies with the Employer's Requirements.

**1.3.3 Key Date 3 (KD3): Delivery to Site of major Elevator components** - The following work shall have been executed prior to the Key Date:

Manufacture, acceptance of factory testing, shipping and delivery to site of all major equipment and components of proposed Elevators. The delivered equipment shall be unloaded and stored at storage area, which will be subject to agreement by the “Engineer”.

**1.3.4 Key Date 4 (KD4): Installation at Site, Testing and Commissioning of Elevator Systems. Achievement** - The following work shall have been executed prior to the Key Date: Completion of all installation processes at site for elevators systems. The completion of all testing at site, completion and testing of all remote monitoring and control system, obtaining all licenses and clearances from local authorities and commissioning of elevator systems.

**1.3.5 Key Date 5 (KD5): Completion of whole of the Works and taking over by the Employer. Achievement** - The following work shall have been executed prior to the Key Date: Completion of whole of the works to facilitate taking over of elevator system by the Employer. Completion of all training related activities for the Employer's Staff. Submission of all necessary documents including operation and maintenance manuals etc. Supply and handing over of all mandatory spares as required under the Contract.

## 2. STANDARDS

The following Standards and Codes of Practice with up-to-date amendments shall apply to the equipment and the work covered by this contract.

### 2.1 Local Codes, Regulations and Standards

Unless otherwise stated herein, the design, installation, testing and commissioning shall comply with the latest edition of all applicable standards issued by the Bureau of Indian Standards and other relevant local regulations applicable.

- IS – 17900: All parts (Latest Version)
- IS – 14665: All parts (Latest Version)
- IS-15785: Installation and Maintenance of lifts without conventional machine rooms
- IS – 15330: Installation and Maintenance of lifts for Handicapped Persons – Code of Practice (Latest Version).
- IS – 7759: Specification for lift doors locking device and controls.
- IS-1860 Code of practice for Installation, Operation and Maintenance of Electric passenger and goods lifts.
- IS 1554 and IS 694 LSHF Cables.
- IS-2147: Degree of Protection.
- National Building Code of India.
- CVC Guidelines.
- BS-476 Part 22:1987-Code requirement for Fire door rating

Additional requirements imposed by statutory or government authorities not listed above shall be complied with. In addition, the relevant clauses of the following, as amended up to date shall apply.

- Central Electricity Authority Regulations, 2010 with latest amendments.
- The Indian Electricity Act, 2003 with latest amendments.
- Uttar Pradesh Lifts & Escalators Act, 2024 Compliance: The Contractor shall ensure full compliance with all the provisions and requirements set forth under UP Lifts and Escalators Act, 2024 (or any subsequent amendments or regulations). This includes (but is not limited to) the AMC of lifts and requisite registrations to be obtained from the Director, Electrical Safety as specified in Act. The Contractor shall provide all necessary documentation and certificates of compliance to the Employer and relevant authorities

as required by the Act and shall be responsible for adhering to any update or modifications to the Act during contract period. Non-compliance with the UP Lifts and Escalators Act, 2024 may result in penalties, suspension of work, or termination of the contract as determined by the Employer.

- The Contractor shall provide adequate signage and graphics as being statutory requirements, for the safe and proper utilization of each equipment, in adequate number exhibited at required locations.
- The tenderers shall also take into account local and State regulations as in vogue for the design and installation of lifts.

Wherever appropriate Indian Standards are not available, relevant EN Standards, British and/or IEC Standards, other National / International standards shall be applicable. BIS certified equipment shall be used as a part of the Contract.

## **2.2 Additional Standards**

Elevators shall comply with the requirements as per latest edition of EN 81 and BS 5655 of the British Standards: Safety rules for the construction and installation of electric lifts. The provisions related to the application for differently abled persons stated in these codes shall also be complied with.

The Contractor shall also comply with the “Guidelines and space standard for Barrier free Built Environment for Disables and Elderly Persons” published by C.P.W.D. (Central Public Works Department), India. The contractor shall comply with the guidelines for safety of elevator circulated vide A. V. series circular no. 822, issued by Ministry of Urban Development and Poverty Alleviation, Govt. of India vide their letter no. C-31011/1/2001-AVII dated 7.12.2001.

## **3. DOCUMENTATION**

The documentation to be delivered by the Contractor shall include, but not be limited to, the following items: -

### **Design Stage**

- Description of General design philosophy;
- System reliability, availability, maintainability and safety evaluation reports;
- Automatic fault identification and isolation arrangement;
- Determination of equipment ratings;
- Design and proving protection devices/ systems and its validation,
- Type test reports for equipment selected;
- Detailed design drawings and reports;
- Hazard identification and control documentation.

### **Manufacturing, Installation Testing & Commissioning Stage**

- Factory Acceptance Test Plan, QAP for equipment;
- Method statement for ITC including site safety plan,
- Installation, operation and maintenance instruction of all equipment;
- Operation and Maintenance Manuals;
- Records and As built drawings of equipment installed;
- Site test report of equipment;
- Other documentation as required, by the Employer.

## **4. TECHNICAL PARAMETERS**

### **4.1 Design Environment**

The Contractor shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information with respect to the viability of his design and execution of Works and to have satisfied himself before submitting the Tender, as to all the relevant matters including without limitation:

- (a) the form and nature of the Site, including the sub-surface conditions;
- (b) the hydrological and climatic conditions;
- (c) the extent and nature of the work, Plant, and Materials necessary for the execution and completion of the Works and the remedying of any defects;
- (d) the applicable laws, procedures and labor practices;
- (e) The Contractor's requirement for access, accommodation, facilities, personnel, power, transport and other services.
- (f) the risk of injury or damage to property adjacent to the Site and to the occupiers of such property or any other risk.

**4.2** The staff quarter area is exposed to extreme weather conditions such as heat, dust, humidity and occasional seepage. The system design shall, take into consideration these conditions and ensure that performance of the system remains unaffected due to such conditions.

### **4.3 Basic Design Philosophy and Requirements**

The Contractor shall develop the design based on this specification and on proven and reliable Engineering Practices. The design details shall be submitted with technical data and calculations to the "Engineer" for review.

The System, including all Sub-systems and Equipment shall be of proven design.

The Elevator Sub-systems and Equipment proposed by the Contractor shall have been in use at minimum two MRTS Projects to and have established their performance reliability over a period of at least two years.

Where similar equipment or Sub-systems of a different rating are already proven in service, then the design shall be based on such equipment. In case these stipulations are not fulfilled, the Contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered Sub-system.

The design philosophy should meet the following criteria:

- Application of state-of-the-art Technology.
- Service proven design.
- Design life 30 years.
- Minimum life cycle cost.
- Low maintenance cost.
- Use of interchangeable, modular components.
- Extensive and prominent labelling of parts, cables and wires.
- Use of unique serial numbers for traceability of components.
- High reliability and ensure Zero passenger trapping.
- Low energy consumption.
- System safety.
- Adequate redundancy and factor of safety.
- Fire and smoke protection.
- Use of fire-retardant materials.

- Environment friendly.
- Adherence to operational performance requirements
- Maximum utilization of indigenous materials and skills, subject to quality conformity.
- Specified values for Reliability, Availability and Maintainability (RAM) for equipment / components in elevator.

Adequate margin shall be built into the design particularly to take care of the higher ambient temperatures, dusty conditions, and high seasonal humidity, etc. prevailing in Agra.

#### 4.4 DRIVING MECHANISM

Each Elevator shall have its own driving machine. The method of drive shall be Electric Traction with Gear less motor having VVVF Control & regenerative braking (supporting detailed calculation of energy saving viz a viz cost saving shall also be submitted during technical detailing stage.).

- The System, including all Sub-systems and Equipment shall be of proven design.
- The Elevator Sub-systems and Equipment proposed by the contractor shall have been in use and have established their performance reliability over a sufficiently long period of time. In support of the performance certificate from the client/ user of the system is to be submitted.

#### 4.5 LIFT MACHINE

The lift machine shall be suitable for 415-volt 3 phase 50 Hz AC supply with a voltage variation of +10% and -15% and shall be placed directly above the hoist way. The lift machine shall have high efficiency and low power consumption and shall be designed to withstand peak currents in lift duties. Resilient anti vibration mountings of suitable design shall be provided to minimize vibration transmission to the building structure.

The gear less drive machine shall be mounted on guide rails/bracket accommodated within the elevator shaft. The power switch gear and main control equipment shall suitably locate inside or near the Elevator shaft. No separate machine-room will be provided for machine room less elevators.

The lift machine shall consist of a motor, electromechanical brake, sheave shaft and sheave all completely mounted on a common bed plate. The sheave shaft will be provided suitable bearings taking into consideration the various loads to ensure proper alignment and long bearing life. The hard alloy cast iron or steel sheave shall have rope grooves to ensure proper traction and minimum rope wear. Adequate means of lubrication shall be provided for all bearings.

Means for manual operation of the lift car shall be made by providing winding wheel suitably marked to indicate the direction of the movement to enable the lift car to be brought to the nearest landing. There shall be a warning display for switching off electrical supply before the manual operations.

The AC self-lubricating motor shall be suitable for lift use with high starting torque and low starting current. Thermistors shall be embedded in the stator windings to indicate the temperature rise in the motor. The AC motor shall **have Class F insulation** and suitable for **180 starts per hour** with a maximum temperature rise of 45 degree Celsius over the ambient.

S	Machine	Compliance to be furnished by the tenderer
1	Acceptable voltage fluctuation	+10 to -15%
2	Gear type	Gearless
3	Motor power in HP/kW and voltage	To be furnished by Tenderer
4	Starting/full load current	To be furnished by Tenderer

5	Running current	To be furnished by Tenderer
6	Starts per hour permissible.	To be furnished by Tenderer
7	Speed in r.p.m.	To be furnished by Tenderer
8	Motor Type & Insulation Class (TEFC & Min. Class F)	To be furnished by Tenderer
9.	Max. starting torque (kg.f.m)	To be furnished by Tenderer
10.	Temperature rise in full load	To be furnished by Tenderer
11.	Rate of acceleration / deceleration (m/sec <sup>2</sup> )	To be furnished by the tenderer
12.	Jerk (m/sec <sup>4</sup> )	To be furnished by the tenderer
13.	Brake (type)	To be furnished by Tenderer
14.	Potential free contacts	To be provided for monitoring through elevator monitoring system.
15.	Motor protection	Trip devices for : <ul style="list-style-type: none"> <li>➤ Over current</li> <li>➤ Under voltage</li> <li>➤ Over voltage</li> <li>➤ Single phasing</li> <li>➤ Earth leakage</li> <li>➤ Phase reversal</li> </ul>

#### 4.6 BRAKE

The electromagnetic brake shall be spring applied and electrically released. It shall come into action after the lift has come to a complete halt to hold the car in position. The brake shall operate automatically with the safety devices and failure of the mains. It shall be released electrically. It shall be possible to release the brake manually - such release requiring the action of manual force to move the lift in short stops.

#### 4.7 CONTROL

The Lifts shall have state of art microprocessor-based AC Variable Voltage Variable Frequency (ACVVVF) drive & regenerative braking. The Controller should use distributed computing power to provide powerful Duplex full collective Group Control features which help meet the Traffic needs for Mid Rise buildings like Waiting time optimization, Dynamic call allocation, Sudden peak detection, Express service, Priority landings, Redundancy, Cancel of false calls, Cancel of calls in opposite direction, Misuse of landing calls, Door open time, Special function floors etc. (as applicable) Complete details of these features shall be furnished along with the tender.

- The controller shall be wall mounted, vertical, totally enclosed cubicle type with hinged doors on the front to provide easy access to all components in the controller. The cubicle shall be with minimum IP20 rating, well-ventilated such that the temperature inside never exceeds the safe limits of the components at ambient room conditions in the machine room. The controller shall operate within the supply voltage variation of plus 10% to minus 15% of the nominal voltage.
- The Controller shall be complete with relay protection against the following:
  - a) Overcurrent
  - b) Under voltage

- c) Overvoltage
- d) Single phasing
- e) Phase reversal
- f) Earth leakage
  - The controller shall be designed to cut off the power supply, apply the brake and bring the car to a rest in the event of any of the above failures occurring.
  - The tenderer shall state clearly the forms of protection provided for each equipment.
  - If any devices of the electro mechanical type are used the same shall be equipped with arc chutes to prolong the life of contacts. Tenderers shall stipulate the type of devices used and the material of the contacts.
  - Tenderers shall support their offers with complete details of experience, number of lifts installed and operational in India, collaboration for equipment design and manufacture etc.

#### 4.8 COUNTER WEIGHT

The counter weight shall be made of cast iron/wrought iron/steel and shall travel between rigid guides and steel frames capable of withstanding buffer impacts. Suitable galvanized metallic counter weight guard of required length shall be provided at the bottom of the hoist-way.

#### 4.9 GUIDES

Car and counterweight guide shall be machined T section as per relevant Indian Standards IS-4666- 1968 revised up to date. The guides shall be capable of withstanding forces resulting from application of the car safety gear, without permanent deformation or bending due to the uneven loading of the car. The guide rail brackets shall be hot-dipped galvanized.

#### 4.10 HOIST ROPES/COATED STEEL BELTS (CSB)

Round standard steel wire ropes/coated steel belts as per Indian Standards shall be used for lift suspension. The number and size of the hoist-way ropes/coated steel belts shall be so selected to ensure proper factor of safety (**minimum 10 for ropes & 12 for CSB**) and adequate traction for the lift. The CSB should pass residual strength test, Hoist-way friction test & Simulated Fire Test and must be provided with a monitoring system for wear & tear of Coated Seat Belts. The governor ropes shall also be wire-ropes.

#### 4.11 DOORS

##### 4.11.1 CAR & HOISTWAY DOOR PROTECTION

A multiple infrared cell electronic door detector shall be provided to regulate the closing motion of the doors for entry of the passengers. When a person is entering the car while the doors are closing the detector shall sense the same and hold the doors to permit entry.

##### 4.11.2 CAR & HOIST-WAY DOOR OPERATION

The equipment shall be with electric door operator for opening and closing of Car & Hoist-way landing door. The equipment shall consist of a motor on the lift car to operate the door when the car is stopping at a landing. The car & Hoist-way doors shall be mechanically connected such that both move simultaneously for opening and closing. The Hoist-way landing door shall be provided with an interlock such that:

- a. It shall not be possible for the car to be started or kept in motion until all the landing doors and the car door are locked in the closed position.
- b. It shall not be possible to open the landing door from the landing unless the lift car is within the particular landing zone.
- c. The car doors & Hoist-way landing doors open automatically as the car is stopping at a



landing. The closing of the car and landing door must occur before the car is set in motion.

### 4.11.3 DOOR HANGERS AND TRACKS

The car and the landing doors shall be provided with two-point suspension sheave type hangers complete with tracks. Sheaves and rollers shall be steel with molded nylon collar and shall include shielded ball bearings. Tracks shall be of suitable steel section with smooth surface and shall be covered to prevent dust ingress. The landing doors shall be complete with headers, sills, frames etc. as required.

### 4.12 CAR ENCLOSURE

- (a) The car enclosure shall be fabricated from galvanized steel of not less than 1.5 mm in thickness or any other material where specified and securely fastened to the car platform and so supported that it cannot be loosened or become displaced in ordinary service or on the application of safety gear or on buffer engagement. The design of the final finishes of the walls, ceiling and floor is subject to the acceptance of the "Engineer".
- (b) No wood or other combustible materials shall be used for any part of the Elevator car including car door and emergency trap door.
- (c) The enclosure shall be insulated to prevent the transmission of noise and vibration from the car frame.
- (d) For elevators of glass door with glass side panels, the car enclosure shall be Scratch Resistant Stainless-steel finish at rear side and framed transparent glass panels on both sides with minimum thickness 10mm.
- (e) Car Interior and Elevator Finishes:- Scratch Resistant Stainless steel. The fire rating of the Stainless-Steel Door shall comply as prescribed in BS 476 Part 22.
- (f) Joints in all surfaces shall be coordinated. All fixings to be of the hidden secret type (Cover strips at joints are not acceptable).
- (g) Car Floor- 15mm thick Granite/ synthetic artificial stone having anti-slippery design distinguishable through grating of any suitable material which can take the desired load. However, the approval for the color of granite/ artificial synthetic stone and its specifications will be obtained from the Employer during design/ proto type testing.
- (h) Car Ceiling - Scratch Resistant Stainless-steel panels with sufficient LED down lights or other energy efficient light and blower fans subject to the "Engineer" acceptance. Tenderer to submit catalogues, photographs of finish offered as per manufacturers standard for approval.
- (i) Car Kick-Plates and skirting - Scratch Resistant Stainless steel,
- (j) Hand/grip rail- Polished Stainless steel, of straight through type & supported from minimum 3 places. All stainless-steel materials specified for car and landing finishes shall be of grade of 304 and shall be subject to the acceptance of the "Engineer".
- (k) Certificate Holder: A framed and glazed panel made of stainless steel, suitable to display the elevator certificate shall be provided above the car operating panel.
- (l) The degree of ingress protection provided by both Car-door and Landing-door to the car and the internal machinery shall be IP-54.
- (m) All car interiors/architrave, doors and interfaces with civil structure and finishes shall be subject to the acceptance of the "Engineer".
- (n) A laminated framed safety mirror of at least half of the size shall be installed on rear panel of elevators at appropriate position, to facilitate easy reversal/ exit of person on wheel chair from the elevator without the need of rotating the wheel chair in the elevator.

### 4.13 CABIN FAN

Every Lift car will be provided Fan(s) to ensure minimum 20 air changes per hour, inside the lift car. Fan (s) should be located above the suspended ceilings or recessed in car ceilings as appropriate, details to be finalized during prototype.

#### 4.14 EMERGENCY LIGHT

An emergency light unit using sealed Nickel/Cadmium maintenance free battery power pack with charger (SMF battery operated with charger rated for 2 hours) and LED lamp to operate automatically and to illuminate the car with minimum 100 lux for minimum 30 minutes in case of power failure shall be provided in each lift car.

#### 4.15 LOCAL LIGHTING

The artificial lighting of the landings in the vicinity of landing doors shall be **at least 50 lux** at floor level, such that a user can see ahead when he is opening the landing door to enter the lift, even if the car light has failed.

#### 4.16 ALARM BELL

An emergency alarm bell, including wiring shall be provided and connected to a plainly marked push button in the car operating panel. The alarm shall be located in the Security Room.

The alarm unit shall be solid-state siren type, operated by Nickel/Cadmium maintenance free batteries to give warning siren when the alarm button in the car is pressed momentarily.

#### 4.17 INTERCOM SYSTEM

Built in intercom system hands-free type with intercom button connected with EPABX (self-illuminated feedback type), when pressed, shall allow a call to be placed at handset installed at ground level entrance architrave and a simultaneous call to be placed at the Security Room. The power supply arrangements for handsets / intercoms shall be connected with backup supply to operate if no power supply is available.

#### 4.18 DIGITALIZED VOICE SYNTHESIZER

A digitalized state of art Voice Synthesizer shall be provided for lifts which shall announce messages like floor designations, lift operating instructions or any other message to the lift users in both Hindi and English languages.

#### 4.19 CAR OPERATION BUTTONS AND INDICATIONS

The following operation buttons (50 sq mm size, micro-push, with feedback illumination and braille code) and indications shall be provided:

##### a. IN EACH LIFT CAR:

Stainless steel panel of suitable thickness flush mounted shall be provided on one side of the door having:-

- LED Illuminated push buttons of micro pressure type corresponding to the floors served
- Door open/close button
- Car position indicator.
- Audio/Visual overload warning indicator
- Emergency alarm button in yellow color.
- Two position key operated switch for 'with attendant' and 'without attendant' operation.
- Ventilation fan ON/OFF switch with auto OFF when there is no call after 120 seconds.
- Dynamic car direction display.
- Built in intercom of the hands-free type with Intercom button with green indication for call connect.

##### b. AT LANDINGS:

**Terminal Landings**

- LED Illuminated type single push buttons (Jumbo type- 50sq.mm.) with travel indication arrows UP or DOWN in satin finish stainless steel facia plate.
- Digital car position indicator with gong in stainless steel facia plate- Floor numbers shall be digitally displayed using 5X7 square dot matrix display. It shall also be capable of displaying simple message such as, floor names like "First floor", "Ground floor", "Out of service", "Under maintenance", "Landing not in use", "Overload" etc. The surface of the display unit shall be non-glare type.

**Intermediate Landings**

- Two LED illuminated type push buttons (Jumbo type- 50sq.mm.) with travel indication arrows UP/DOWN in satin finish stainless steel facia plate.
- Digital car position indicator with gong in stainless steel facia plate. Floor numbers shall be digitally displayed using 5X7 square dot matrix display. It shall also be capable of displaying simple message such as, floor names like "First floor", "Ground floor", "Out of service", "Under maintenance", "Landing not in use", "Overload" etc. The surface of the display unit shall be non-glare type.
- Hall gong Up/down indicator with single stroke gong/chime at all landing.

**5. SAFETY DEVICES**

All safety devices statutorily required by Lift Inspector, including but not restricted to the following shall be provided.

**5.1 Self Leveling**

The Lifts shall be provided with self- leveling features of  $\pm 5$  mm accuracy during normal operation and  $\pm 10$  mm accuracy during ARD (Automatic Rescue Device) mode operation.

**5.2 Terminal and Final Limits**

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings, and final limit switches shall be furnished to automatically cut off power should the car travel beyond the terminal landings.

**5.3 Terminal Buffers**

Suitable spring/oil buffers shall be installed mounted on steel channels as a means of stopping the car.

**5.4 Interlocking**

Adequate interlocking is to be provided so that the car shall not move if the landing doors are even partially open and also the lift is overloaded.

**5.5 Car Progressive Safety Gear Arrangement and Governor**

- The car safety shall be provided to stop the car whenever excessive descending speed is attained.
- The governor shall be adjusted to operate the progressive safety gear in accordance with the recommended limits set out in IS 14665. The governor rope shall be of steel and shall comply IS: 14665.

**5.6 Emergency Stop Switches**

An emergency stop for use by maintenance personal shall be provided in each lift car top

and maintenance panel and pit as per IS 14665.

### 5.7 Automatic Rescue Device

In the event of power failure or power interruption or single phasing or unbalanced phases (or any problem in the power supply which affect the normal operation of the lifts), the supply to all Elevators shall be automatically switched over to the emergency power supply i.e. To Automatic Rescue Device (ARD) and the Elevators shall be brought to the designated floor and shall park there with the doors remaining open. The speed of lift in ARD mode shall be, subject to review during detailed design stage and prototype testing. In case Power supply to the lift is restored through DG set/ Alternate source (if any) before the lift reaches designated floor even then ARD will complete its function and lift doors open at designated floor to evacuate the passenger. Thereafter, Elevator designated by the authorized person may resume operation depending on the capacity of emergency power.

As a back up to ARD, Manual Rescue arrangement shall be provided. Manual Rescue operation shall be possible even when total load of Lift Car with passengers becomes equal to load of counterweights (i.e. balance load condition).

### 5.8 Door Safety Devices

- **Electrically operated proximity detector devices(s)** shall be installed on the leading edge of the car doors. The device(s) shall create a three-dimensional zone of protection for the entire height of the door opening. This zone of detection shall extend a short distance in front of the landing doors
- **Photo Cells**  
Two Photo cells shall be provided for each car door for preventing door closing when a passenger is entering or leaving the car. This should act as a backup protection to 3D-infrared curtain.

### 5.9 Water level Sensor

The water sensors in the elevator pits shall be provided wherever pits are on the ground level or below the ground level to stop the elevators in case water fills inside the pit up to a predetermined height to prevent any short circuit conditions.

### 5.10 Fireman Switch

The fireman switch shall be provided as per IS-14665 (part-5) and statutory requirement.

### 5.11 Next Landing

The car shall automatically proceed to the nearest floor with a functioning landing door if the car doors fail to open at the designated floor.

### 5.12 Overload Holding Stop

Each Elevator shall be provided with an overload device of accepted design, which shall operate when the load in the car exceeds the rated load. When activated, this device shall prevent any movement of the Elevator car and shall cause a warning buzzer on the car to be set on and illuminate an "Overload" signal with the announcement of overloading. the Elevator shall not operate and the doors shall remain open.

## 6. REGENERATIVE ENERGY

UPMRC intends to obtain IGBC/LEED's certification for Quarters, therefore lift contractor shall provide adequate measures such as provision of inbuilt TOD (Time of Day) Energy Meter to monitor the amount of energy regenerated & also facilitate UPMRC Representative to obtain IGBC/LEED's

Certification.

## 7. ASSOCIATED CIVIL AND E&M WORKS

All civil and Electrical works associated with erection and operation of lifts shall be provided by the Contractor at his cost including (but not restricted to) the following:

- All minor civil work inside shaft including Architrave/ entrance floor finishing shall be done by elevator vendor.
- Temporary Scaffolding and safety barricades during lift installation in and around lift hoist ways.
- Bearing plates
- Buffer supports
- Facia plates
- Ladder in pits
- Safety railing in car
- Channels, Steel beams, separators, stretchers etc.
- Structural works for foundations of machine etc.
- Lift Floor stone/granite to be provided and fixed by elevator vendor.
- Breaking, load hook fixing and making good spaces for leveling switches and any other erection work.
- Cable laying in cable trays from Input power panel to elevator and Earthing to be done by vendor.
- The Contractor shall ensure erection and fixing of steel work in such a manner that no RCC wall or any other structural member is damaged and if damaged, the contractor shall be responsible for making good the damage to original finish.

## 8. TESTING AND COMMISSIONING

- The Contractor shall submit for acceptance by the “Engineer”, test specifications for **type tests, routine tests, tests on site, final acceptance tests, load tests and commissioning tests**. The specifications shall detail the methods of conducting the tests, the tools and instruments used.
- **Motor tests** shall be conducted in accordance with the relevant parts of BS 4999.
- **Commissioning and Acceptance Tests** shall be carried out on each Elevator in accordance with the relevant portions of BS 5655, which shall include but not be limited to the following: -
  - a. Readings on starting current, running current and supply voltage shall be taken at the rated speed of each Elevator in both directions of operation under no load, 20%, 40%, 60%, 80% and full load conditions.
  - b. The overspeed governor shall be tested to ensure that it will activate when the speed exceeds 40% of the nominal speed.
  - c. Functional tests on the safety gear with no load at rated speed by manually tripping the governor.
  - d. The Elevator car shall be operated up and down several times including tests to demonstrate the levelling operation.
  - e. Test on the car and landing doors system:
    - (i) Checking of the condition of the landing and car door for smooth operation,
    - (ii) Functional tests on the door closing time, door speed, re-opening, safety edge, proximity detection landing and car door contacts of the door lock.
  - f. Functional tests on all the landing call buttons, indicators and all function provided in key-switch operated cabinet mounted below the car operating panels.
  - g. Functional tests on the emergency call buttons.
  - h. Functional tests on the final limit switches, terminal slow down and terminal over travel

limit switches.

i. Functional tests on the following safety switches and devices:-

- (i) Overload device.
- (ii) Phase protection device.
- (iii) Emergency devices.
- (iv) Over current protection device.
- (v) Over speed safety
- (vi) CCTV function and display unit.
- (vii) Functional test on the car top and landing maintenance panel
- (viii) Testing of the Intercom system.
- (ix) Compress buffer test.
- (x) Running clearance tests.
- (xi) Functioning test of Elevator management, monitoring and fault diagnostic system.
- (xii) Noise/ sound level test of equipment and installation.
- (xiii) Functional tests of battery backup device.
- (xiv) Complete function tests on track machine, motor brake and control equipment.
- (xv) Floor leveling accuracy and re-leveling at different loads.
- (xvi) Tests on Emergency Power and Fire operation.
- (xvii) Temperature readings of elevator controller and equipment shall be taken every fifteen minutes for at least 2 hours or the duration of test whichever is longer.

(xviii) EVA Meter Ride Comfort test of Elevators:

The contractor by performing suitable tests as per ISO 18738 shall ensure that following permissible values of above parameters shall be achieved for satisfactory ride comfort quality:

S. No	Ride Comfort Parameter	Unit	Permissible value
1.	Maximum Lateral Quaking (in any of X or Y direction)	Gal	12 Pk - Pk
2.	Acceleration/ deceleration (adjustable)	m/s <sup>2</sup>	0.5
3	Maximum Jerk	m/s <sup>3</sup>	2.0
4.	Maximum Vertical Vibration (in Z direction)	Gal	20 Pk-Pk(1-100 Hz)

Note: - The permissible values given above for various 'Ride Comfort Parameters' are indicative only. The actual values shall be those prevailing in the elevator industry at the time of commissioning of the elevators and the contractor has to ensure that those values are achieved. The contractor shall submit the "Ride Comfort Report" whose acceptance shall be subject to Engineer's approval.

(xix) Functional tests of all features and functions not included in the above but required in the Contract.

An indicative Commissioning Checklist (**Appendix-C**) is being provided by Employer for reference. The Contractor is required to update the above-mentioned checklist with their specific models/make/nomenclature/ rating in line with the proposed model of the Elevators and include all tests mentioned in this Clause 8 and get it approved by "Employer". Reports and records pertaining to all testing are to be submitted to the Employer's Representative shall be in a format reviewed by the Employer's Representative. Reports and records shall be signed by the Contractor's agent or by a representative authorized by the Contractor.

## 9. CERTIFICATE OF TAKING OVER

The final acceptance tests of each item of equipment shall be undertaken in the presence of the "Engineer", in accordance with the test specification. Any defects and/or deviations discovered without prior written approval during the tests shall be rectified at the Contractor's own expenses. These shall be entered into a defects list agreed between the Contractor and the "Engineer". The Certificate of Taking Over will not be issued until these tests have been completed and the defect list substantially reduced to such an extent that the "Engineer" considers that the equipment is safe for operation.

## 10. CERTIFICATION

Upon completion of each elevator the Contractor shall submit to the Employer, a Certificate of Supervision issued by the Contractor's Professional Engineer, in a format acceptable to the "Engineer".

## 11. DLP AND AMC REQUIREMENTS

For details of DLP and Comprehensive AMC please follow maintenance requirements as per Annexure-A

## 12. TRANSFER OF TECHNOLOGY

The training Program shall enable the staff to operate, service, enhance, maintain, and interact with, the hardware, software, and firmware, such that the elevator systems and associated equipment will perform in accordance with the specifications of this contract. The Contractor shall provide comprehensive training to the Employer's staff, including Employer's training Instructors. The training shall be provided by the Contractor to the Employer's personnel in design, Operation and Maintenance, manufacturing, testing, system architecture and installation practices related to elevators.

The Contractor shall provide competent training instructors, training manuals, all necessary aids and materials in support of all training courses. The travel, boarding and lodging expenses for the training of Employer's staff shall be borne by the Contractor (if required). The training manuals shall be submitted in original plus five hard copies and in electronic format. The training instructors shall be qualified, competent, with sufficient years of practical experience in the relevant fields and possesses good communication skills. The training instructors shall be competent staff of the Contractor, or the subcontractors or the equipment manufacturers.

All places of training shall be subject to review by "Engineer".

The training courses shall be delivered to all relevant Employer's staff, including instructors, operation and maintenance engineering staff.

### NOTE:

\* In this document, term "**LIFTS**" or "**ELEVATORS**" have been used interchangeably and imply one and the same.

\* In this document, term "**Employer**" or "**Engineer**" have been used interchangeably and imply one and the same.

\* Tenderers to ensure all **Wires to be FR** (fire rated) and cables should be **FRLS-XLPE** with armoring.

## **EMPLOYER'S REQUIREMENTS**

## **PARTICULAR SPECIFICATION**

## **DESIGN REQUIREMENTS FOR CCTV**



## 1. Scope of Work

- a. The scope of work includes the supply, installation, testing, and commissioning of IP Based CCTV Cameras as per given specifications inside the lifts of Agra Staff Quarter.
- b. Camera should cover the complete area inside the Lifts.
- c. To view the visuals of the Camera, a Monitor has to be provided and placed in the Security Control Room.
- d. CCTV should be provided with Optical Fiber Cable wherever the distance between the Lift and the Control Room is more, and Cat 6 Cable should not be used.
- e. The configuration of the view of the camera with the Monitor shall be done by the contractor as per Employer's requirements.
- f. The work is turnkey basis and shall include all the works related to installation, testing, commissioning, display and recording of camera visuals in Security Control Room in working condition even if any of the above work is not specifically mentioned in BOQ/Tender Document.
- g. As per site conditions the contractor may also have to carry out the work during night hours. No extra payment shall be made on this account.
- h. Cameras should have motion detector capabilities to ensure that recording is done only when there is some movement in the field of view of the camera. This will enhance the storage capability of the system.
- i. Camera should be of Image sensor 1/2.8", 2 MP IP Dome Camera Type. Camera Image Sensing capacity 2MP (1920 x 1080 Pixel) or better.
- j. Cameras should have Night Vision technology capability.
- k. The cameras shall be tamper-proof and should have an alarm system to avoid tampering and shall log the event to the main database and should be plug-in type with suitable locking devices.
- l. The Video Management Software should be user-friendly GUI or Menu-Driven with self-checking i.e. all the routines shall be checked periodically for their proper functioning and integrity.
- m. The complete hardware and software support to be extended by the contractor.
- n. Memory back up should be of minimum 7 days.
- o. The Camera should be of weatherproof standard IP66 or better.
- p. All the cables are to be tagged as per the drawing tag. All the termination of cables shall have necessary markers /ferrules and terminated through metallic ferrules by crimping only (Industrial type).
- q. The CCTV cameras should comply with standard **IS 13252: Part I: 2010 and STQC Standards.**
- r. All materials shall have at least 1 year warranty & shall be replaced by the supplier at no additional cost such as transportation cost etc.
- s. Cat-6 Cable should be of Solid bare Electrolytic Grade Copper type.

**2. Following features (but not limited to) to be complied for CCTV design aspect:**

S.N.	Device Description	Specification
1	2 Mp IP Dome Camera	<ul style="list-style-type: none"> <li>• Camera Image Sensing capacity: 2MP (1920 x 1080 Pixel) or better</li> <li>• Maximum Frame Rates (frames per second)- 24-30 FPS</li> <li>• Type of network required to transmit video / Image recorded by camera- Wired</li> <li>• Number of simultaneous video Streams -Min Quad Stream</li> <li>• IR illumination Range(meter)- 15-30</li> <li>• Installation Type/ Area of use- Indoor</li> <li>• Lens Type- Fixed</li> <li>• Focal Length (mm) -2.8 or better</li> <li>• Availability of security testing report for CCTV/VSS -Issued by standardization Testing and Quality certification (STQC) Laboratory or any other agency notified by Meity.</li> <li>• BIS Registration (CRS) for Safety general requirements -as per IS 13252 (Part 1): latest</li> <li>• Make-Strictly Make in India and GeM approved only.</li> </ul>
2	4 Channel NVR	<ul style="list-style-type: none"> <li>• IP Camera input : 4 channels</li> <li>• Playback: Play, pause, stop, Fast forward, fast backward, rewind, play by frame, full screen, backup (cut/file), partially enlarge, audio on/off.</li> <li>• Recording mode: Priority of record mode: Manual recording, alarm recording, motion detection recording, timed recording.</li> <li>• Video Output: 1 HDMI simultaneous video output, maximum resolution 1080P.</li> <li>• User Interface: Web/operating in local GUI.</li> <li>• Network Bandwidth: 80 Mbps for access, 80 Mbps for storage &amp; 60 Mbps for forwarding.</li> <li>• Decoding capability: 4-ch @ 1080p(30FPS).</li> <li>• Hard Disk: 1 SATA 2.0, up to 8TB Each.</li> <li>• Backup Mode: USB Device.</li> <li>• Storage: Local HDD &amp; Network</li> <li>• Ethernet: 1 RJ-45 Port (10/100Mbps)</li> <li>• Interface ports: 2 USB Ports (1 Rear USB 2.0, 1 Front USB 2.0)</li> <li>• Power Supply: DC 12V, 1.5A</li> <li>• Power Consumption: &lt;10 W (Without HDD)</li> <li>• Operating Temperature range: -10°C to 45°C or higher</li> <li>• Compatible with third-party network cameras</li> <li>• Metal case for professional industrial applications.</li> <li>• Make: GEM approved only</li> </ul>

3	1 TB Hard Disk	<ul style="list-style-type: none"> <li>Digital Storage Capacity- 1TB</li> <li>Hard Disk Interface- Serial ATA</li> <li>Connectivity Technology- SATA</li> <li>Hard Disk Description- Mechanical hard disk</li> <li>Compatible device- IP Dome Type Camera &amp; 4 ch-NVR</li> <li>OS Compatibility- Microsoft Windows 7, Microsoft Windows 10,11 Etc.</li> <li>Hardware Platform- NVR</li> <li>Make: GEM approved only.</li> </ul>
4	CAT 6 cable	<ul style="list-style-type: none"> <li>Cat6, per the ANSI/TIA 568.2-D specification, supports 250 MHz bandwidth frequency and 5 Gbp/s transmission speed at 328 feet (100 meters).</li> <li>Make: GeM approved only.</li> </ul>
5	Other accessories (including power extension board, Power Adaptor, junction boxes, MCBs, etc.)	<ul style="list-style-type: none"> <li>All accessories must be compatible with CCTV camera.</li> <li>Qty to be used as per site requirements.</li> <li>GeM Approved Make only to be used.</li> </ul>
6	OFC Cable	<ul style="list-style-type: none"> <li>Optical fiber cable Core: 6 cores</li> <li>Central Strength Member: Glass Reinforced Plastic (GRP) fiber.</li> <li>Protection (Tubes): Polybutylene Terephthalate (PBT) Fillers: As Required.</li> <li>Water Blocking: Thixotropic Gel (Tubes) Petroleum Jelly (Interstices)</li> <li>Core Wrapping: Polyethylene Terephthalate Tape</li> <li>Inner Sheath: Polyethylene</li> <li>Armoring: Copolymer Laminated Steel Tape</li> <li>Sheath: Polyethylene (UV stabilized)</li> <li>Jacket: Nylon (UV Stabilized)</li> <li>Overall, Cable Diameter (Nominal): 15.1mm</li> <li>Cable Mass (Nominal): 220 kg/km</li> <li>Max. Bending Radius - Full load: 450mm</li> <li>Tensile Strength - Short Term: 2500N Max.</li> <li>Crush Resistance – Short Term: 6000 N/10 cm.</li> <li>Operating Temperature Range: -20°C to +60°C or higher</li> <li>Core Diameter: 50±2.5 µm.</li> <li>Cladding Diameter: 125±2.0µm or better.</li> <li>Make: GeM approved only.</li> </ul>

7	Transmitter & Receiver	<ul style="list-style-type: none"> <li>• 2.4GHz 11n 300Mbps</li> <li>• 8dbi directional antenna</li> <li>• IP64 waterproof enclosure</li> <li>• AP, Station, WISP operating mode supported.</li> <li>• Up to 30 meters of flexible deployment with included PoE Injector</li> <li>• Auto-bridge For Two Device</li> <li>• Smart Signal Indicator LED</li> <li>• Antenna Beamwidth-Horizontal: 60° Vertical: 30°</li> <li>• Max Power Consumption- 2.6W</li> <li>• LED indicator-PoE/LAN, WiFi, LED1, LED2, LED3</li> <li>• Compliant Standards- IEEE 802.11b/g/n</li> <li>• Package- 1*500m Outdoor point to point CPE, 1*Power Adapter, 1*PoE Injector, 2*Plastic Staps, 1*Quick Installation Guide</li> <li>• Operating Temperature--30°C ~ 55°C</li> <li>• Storage Temperature- -30°C ~ 70°C</li> <li>• Operating Humidity- 10%~90% non-condensing</li> <li>• Storage Humidity- 10%~90% non-condensing</li> <li>• Make: GeM approved only</li> </ul> <p style="text-align: center;">OR</p> <p style="text-align: center;">Integrated Travelling Cable</p>
8	8 port POE Switch	<ul style="list-style-type: none"> <li>• Network ports- Eight (8)x10/100/1000 Mbps Port, Two (2)x1000 Mbps SFP ports, One (1)x Console Port.</li> <li>• Features- Protocol: IEEE802.3af, IEEE802.3at, IEEE802.3i, IEEE802.3u, IEEE802.3ab, IEEE802.3x, IEEE802.3az.</li> <li>• Switching Capacity- 20 Gbps.</li> <li>• Transfer Method- Store &amp; Forward</li> <li>• Packet Forwarding rate- 14.88 Mbps or better.</li> <li>• Packet Buffer Memory- 4 Mbit or better.</li> <li>• Power Requirements- 48 VDC to 55 VDC.</li> <li>• Working Temperature range- 0° C to 45° C or better</li> <li>• Application Humidity range- 10% to 90% or better</li> <li>• Make: GeM approved only.</li> </ul>
9	Repeater	<ul style="list-style-type: none"> <li>• Cat 6 LAN Extender.</li> <li>• Make: GeM approved only.</li> </ul>
10	Optical to Ethernet Media Converter	<ul style="list-style-type: none"> <li>• Gigabit SFP Media Converter, 1000 Mbps RJ45 Port, Half-Duplex/ Full-Duplex Transfer Mode, With Power Supply, (D-Link/TP-Link make).</li> <li>• OFC to Ethernet Media Converter</li> <li>• Mounting Hardware- 10/100 Mbps Single-Mode Media Converter</li> <li>• Data Transfer Rate- 100 Megabits per second</li> <li>• Connector Type- Ethernet, RJ45</li> <li>• Make: GeM approved only</li> </ul>
11	Splicing with accessories	<ul style="list-style-type: none"> <li>• Splicing work including Junction box, SC Fiber patch cord</li> </ul>

12	PVC Conduit	<ul style="list-style-type: none"> <li>• 25 mm dia, ISI marked, PVC conduit</li> <li>• Make: GeM approved only</li> </ul>
13	GI Conduit	<ul style="list-style-type: none"> <li>• 25 mm dia, ISI marked, steel conduit</li> <li>• Make: GeM approved only</li> </ul>
14	2U Rack	<ul style="list-style-type: none"> <li>• Material- Iron &amp; Cast Iron</li> <li>• Make: GeM approved only</li> </ul>
15	Desktop	<ol style="list-style-type: none"> <li>1. Processors- Intel Xeon Processor E5-2600 series, 2.4 GHz, Hyper threading, 10MB L3 Cache, 1600 MHz memory or better as per latest available.</li> <li>2. Operating System- Genuine Windows /Linux or better as per latest available</li> <li>3. Chipset- Intel C600 or better as per latest available</li> <li>4. Memory (RAM)- DDR3 1600 MHz memory 16GB expandable to 64 GB</li> <li>5. Graphics Display card- Dual NVIDIA Quadro 600/FirePro V4900 or better as per latest available.</li> <li>6. Drive Controller- 6 Gb/s controller, RAID 0,1,5 and 10 capable.</li> <li>7. SSD (Hard Drives- 2 x 146GB SSD</li> <li>8. Networking- Dual Integrated GbE Controller</li> <li>9. Keyboard- USB keyboard wireless</li> <li>10. Mouse USB two-button optical mouse wireless</li> <li>11. Optical Storage Devices DVD-ROM</li> <li>12. Approvals- The workstation shall be UUFCC approved and shall be from reputed makes such as IBM (Lenovo), Dell, Toshiba, Fujitsu, Samsung, HP or equivalent subject to meeting the above specifications.</li> </ol>

## Annexure-A

### DLP and Comprehensive Annual Maintenance Requirements

#### 1.0 Maintenance

The Contractor shall provide maintenance services throughout the 1 Years Defects Liability Period (DLP) and 2 years AMC period under the Supplementary Comprehensive Annual Maintenance Contract for the elevators supplied under the Main Contract and also The Maintenance work shall include attendance to all service calls, work described in approved Maintenance Schedule, and the followings:

- 1.1 Service shall include all work necessary to maintain entire elevator system in good working order at all times through Preventive/ Scheduled Maintenance (PM) & Corrective Maintenance (CM). Preventive Maintenance can be carried out between **day/night as specified by Engineer**. The Contractor shall deploy competent personnel to rectify stoppages at any time during the day or night when being called on by the Employer within a time of **Four hours (maximum)**.
- 1.2 The Contractor shall maintain adequate quantity of consumable and contingent spare parts as per agreed list at mutually agreed location in order to minimize the shut down time due to repairs and maintenance. The indicative List is enclosed as **Appendix "A"**.
- 1.3 An indicative **List of Spares for 15 years after 1 years DLP & 2 years CAMC** is attached in **Appendix "B"** which needs to be updated and quantity and price to be submitted along with tender documents.
- 1.4 The DLP and Comprehensive AMC includes all spare parts of lift including consumables i.e. Car Enclosure, door panels , Ceilings , Car gates, light diffusers, light bulb, florescent tubes, handrails, starters , chokes , Mirrors, floor covering carpets , other Lift architectural features, hoist way enclosure , hoist way gates, door frames, doors , sills, batteries, securing system , external wiring to Elevator and hoist way/ Machine room, Imported components like LED, Plasma Display, EVIAS, CCTV including display etc. Securing system, external wiring to Elevator and hoist way/ Machine room, imported components like LED, Plasma Display etc.
- 1.5 Contractor shall carry out periodic testing and examination of Lift safety devices as required by the provisions of any enactment in force relating thereto or of any enactment, regulations or by- laws of any local or other duly constituted authority which may be applicable to such tests and to provide such copies of the test certificates, duly signed by a competent Elevator "Engineer."
- 1.6 Contractor shall be fully responsible for obtain & ensure timely renewal of relevant **safety certificate (s) or license(s)** or any other documents required from statutory authorities for operation & maintenance of lifts, during 1 Years Defects Liability Period (DLP) and also during the 2- year Comprehensive Annual Maintenance Contract. Nothing extra shall be payable.
- 1.7 Annual Independent Third- Party Safety Check including loading test for each elevator and corrective adjustment (if necessary) shall be done by the Contractor. The report format shall be approved by Employer.
- 1.8 **Reports**
  - 1.7.1 The Contractor shall provide monthly, quarterly, half-yearly and yearly reports on the condition of the equipment in a format approved by the Employer.
  - 1.7.2 A report in duplicate shall be sent to the Employer immediately following every call out, indicating the time of call out visit, cause, remedial action taken and the time that the service was restored. The monthly summary of failure report along with the analysis giving details of nature of fault, remedial action taken etc in the approved format shall be provided.
  - 1.7.3 Reports on routine visits are not required except where necessary to draw attention

to defects of a minor nature, which could not be rectified during the routine visit. Records of each routine visit and call-out visit, together with details of the work done or action taken, shall be entered on a log book which shall be provided by the Contractor and retained in the location as decided by the "Engineer".

## 2.0 Failure Investigations

- 2.1 The Contractor shall conduct failure investigations. The Contractor shall make available to the Employer all test and failure data as required. Disputes (if any) will be resolved by "Engineer".
- 2.2 Contractor shall provide Operation and Maintenance Manuals (in Hindi & English).
- 2.3 Contractor shall provide training to UPMRC personnel (a batch of 10 person) in operation & maintenance related to elevators for 15 trainer working days (from 10:00 hrs to 17:30 hrs).

## 3.0 THE RELIABILITY, AVAILABILITY AND MAINTAINABILITY REQUIREMENTS

The Contractor shall dispatch competent personnel to rectify stoppages at any time during the day or night when being called on by the Employer within a time of Four hours (maximum). Repairs shall be carried out on a 24 hours per day, 7 days per week basis until the faulty unit elevator is put back in service.

### 3.1 Reliability Requirement

The Reliability requirements of this PS shall be subsidiary to the Availability and Maintainability requirement of this PS. The reliability of equipment should be of level that it does not result in passenger trappings in the Elevator due to equipment failure. Any claim/ Damage /Compensation claimed by the affected passenger/ elevator user on account of equipment failure shall be recovered from the firm. In addition, UPMRC shall impose a penalty @ **Rs.15,000/-**(Rs Fifteen Thousand Only) per case. The penalty shall applicable during DLP and AMC.

The Reliability measure for the Elevators shall be the Mean Time Between Maintenance Action (MTBMA). This covers both preventive as well as corrective maintenance. The Elevators shall achieve a MTBMA not less than 7 days.

### 3.2 Availability

#### Service Availability Targets:

The Systems shall be designed to ensure that failure of any major equipment, caused by an external accident or negligence of internal staff, will not lead to unavailability of the whole System, other than temporary outage of the failed equipment.

If elevator is kept out of service for more than 24 hrs. due to non-availability of Spares or due to lack of proper attention. UPMRC shall impose a penalty of **Rs. 15,000/-** (Rs Fifteen Thousand Only) per day for each such case. The penalty shall applicable during DLP and AMC.

The Employer will assess the reasons for the equipment not being in service, accordingly the penalty will be imposed. The Employer decision is final. The measure for Availability for the Elevators shall be based on call out ratio.

$$\text{Availability} = \frac{\{(365 \times 24 \text{ hrs.}) \times \text{No of lift population}\} - \{\text{Total Unavailability hrs. in one year}\}}{\{(365 \times 24 \text{ hrs.}) \times \text{No of lift population}\}}$$

The Elevator shall achieve minimum availability of **98%** calculated as above.

For the purposes of Availability calculation, the contractor shall assume the service operating hours are 24 hours per day (00:00 AM to 23:59 Mid Night). For 365 days a year for the design life.

### 3.3 Maintainability

The Contractor shall undertake maintainability analysis to assess the preliminary maintainability targets of the systems.

The Contractor shall state the maintainability requirements, and demonstrate that System maintainability is sufficient to support the claimed System reliability and availability performance. The Contractor shall demonstrate that maintenance errors have been considered, and, as far as is practicable, the risk of maintenance-induced faults has been mitigated by the appropriate design.

The equipment to be supplied by the Contractor must be designed for minimum or no maintenance. Maintenance activity required must be capable of being performed with minimum impact on passenger service.

Maintenance activities may be classified into two areas, routine preventative and corrective, both of which affect service availability. Other maintenance strategies such as condition monitoring may be incorporated.

Routine/preventive maintenance periods shall be essentially during off peak periods.

To optimize speedy corrective maintenance, techniques employing automatic diagnostics test points, and rapid repair facilities shall be provided.

The MTTR time measurement shall include on site diagnostics and rectification of the failure up to point that the system is restored to full measurement shall include the time necessary to remove the failed piece of equipment from the system and replaced it with a functioning module.

The maintainability shall be measured by fault rectification time which shall not exceed **4 hours** since its reporting to contractor call center or his representative by UPMRC/staff.

If contractor fails to comply above conditions the penalty of Rs. 1,000/- Per hour if response time is more than four hour and Rs. 10,000/- per day if repair is not carried out on 24 hours, 7 days per week basis, until the faulty unit is put back in service shall be imposed.

### 3.4 Call out ratio

**Failure:** Elevator not available for more than one hour for passenger service shall be registered as a failure provided:

Failure is attributable to –

- Design defect
- Equipment failure / replacement
- Manufacturing defect.
- Wrong Erection
- Maintenance lapse (during DLP & AMC by the contractor) or
- “Mantrap” resulted because of any of the above defect.

The call out ratio i.e. engineer visit to site for non-scheduled maintenance for the failures as defined should not exceed 2 on any one of the elevators in a year. The period of DLP year will commence from date of Taking over. If per lift per year. If the visit of engineer for non-schedule maintenance above exceeds 2 per lift per year or 1.5 average call out ratio, a penalty of **Rs. 15,000/-(Rs Fifteen Thousand Only)** shall be imposed for each such visit. The penalty shall be applicable during DLP and AMC.



**3.5** The contractor shall ensure that the Maintenance Performance requirements as mentioned below are achieved:

Sl.No.	Maintenance Performance Requirement for each Staff Quarter Complex	
1	Availability	>98 .00%
2	Maintainability (based on Mean Time to Repair)	< 4 hrs.
3	Call out Ratio (per Lift per Year)	< 2
4	Average Call out Ratio per Year under the contract	< 1.5

**APPENDIX- A:- Indicative List of Spares to be maintained during 1 years DLP and 2 years CAMC**

<b>S. No.</b>	<b>Item</b>	<b>Quantity</b>
1	LIFT ANNOUNCEMENT UNIT	1
2	DOOR BELT	1
3	BRAKE RELEASE WIRE	1
4	DOOR CONTACT SWITCH	6
5	BRAKE- UNIT	2
6	E-MOTIVE DISPLAY BOARD	1
7	DOOR GUIDE SHOE -	10
8	V3F DRIVE WITH REGENERATION UNIT	1
9	AUTOMATIC RESCUE DEVICE UNIT	1
10	DOOR MODULE CARD	1
11	EMERGENCY KEY	6
12	DOOR MOTOR	1
13	CAR SHOE LINER	20
14	EPABX	1
15	LCE CAN	1
16	LCE CCB BOARD	2
16	LCE COB	2
18	LCE CPU	2
18	LCE FCB BOARD	2
20	LCE OPT BOARD	2
21	LCE REC BOARD	2
22	LCE-230(ADO/ACL CARD)	2
23	LCE-CIB ,PCB BOARD	2
24	LIGHT CURTAIN (COL 3D )	2
25	MONO STABLE SWITCH (FOR LEVELING AND DOOR ZONE)	2
26	BISTABLE SWITCH (DECLARATION SWITCH)	2
27	INSPECTION BOX (MAINTENANCE-STATION)	2
28	TRACK ROLLER	10
29	ROPE FOR SYNCHRONISATION- CAR	2
30	ROPE FOR SYNCHRONISATION LANDING DOOR	2
31	LANDING CALL BUTTON SET	2 sets
32	ALL TYPE OF BUTTONS INSIDE CAR	6 sets
33	STOP SWITCH	3
34	SYNCHRONISATION ROLLER FOR CAR DOOR A-1,	5
35	SYNCHRONISATION ROLLER FOR CAR DOOR A-2,	5
36	SYNCHRONISATION ROLLER FOR LANDING DOOR A-1,	5
37	SYNCHRONISATION ROLLER FOR LANDING DOOR A-2,	5
38	SURGE SEPARATOR	1
39	ELCB	2

40	MCB (4 POLE)	1
42	AMD2 COUPLER	1
44	ROPE FOR CLOSING WEIGHT. ASSY.	5
45	ANTI LIFT ROLLER	1
46	BATTERY SEALED LEAD ACID 12V/12 AH (EBD)	3
47	BATTERY SEALED LEAD ACID 12V/7AH (CCB)	3
48	BLOCKING DEVICE SWITCH	1
49	BRAKE OPENING DEVICE	1
50	CAR DIVERTER WHEEL ASSY.	1
51	CAR DOOR HEADER	1
52	CONTROL CURRENT TRANSFORMER	1
53	CWT SAFETY GEAR	1
54	CWT. DIVERTER WHEEL ASSY	1
55	DOOR BELT PULLEY,	1
56	DOOR CONTACT BULLET (BEAK)	2
57	DOOR SET COMPLETE (CAR & LANDING DOOR)	1 set
58	END BUFFER ,	1
59	FAN AND STOP PCB ASSY.	2
60	CAR FAN	2
61	FINAL LIMIT SWITCH	3
62	FULL LOCK LATCH UNIT I LOCK ROLLER UNIT	1
63	GUIDE SHOE FOR CWT --	2
64	GUIDE SHOE ASSY . (CAR)	2
65	HANDS FREE UNIT (Car)	1
66	HANDSET PHONE (USED IN SECURITY ROOM)	1
67	INTERCOM PCB USED IN LANDING)	1
68	KDS 300 HLG ASSY.- BOTTOM	1
69	KDS 300 HLG ASSY.- TOP	1
70	LIMIT SWITCH	3
71	LOP 230 FUSE 250V 1A	3
72	LOP 230 FUSE 250V 2A	3
73	LOP230 BOARD	1
74	LOPCB BOARD	1
75	LWD DEVICE	1
76	MAIN STEEL ROPE	100 metres
77	MAIN MOTOR	1
78	OIL CUP	3
79	OSG	2
80	OSG ROPE	10 meter
81	PFRR CARD	1
82	PHOTO CELL	2
83	RESISTER BOX ASSY.	1
84	SAFETY GEAR JAW	2
85	SAFETY GEAR SWITCH	1
86	SHAFT DOOR HEADER(LANDING TOP TRACK)	1
87	TENSION WEIGHT SWITCH	1
88	TRAVELING CABLE	1 Set

89	UPPER ISOLATION RUBBER PAD	6
90	WATER SENSOR IN PIT	2
	<b>CONSUMABLES</b>	
1	COTTON WASTE	To be decided mutually
2	GUIDE LUBE OIL	
3	COLLIN SPRAY	
4	3M POLISH	
5	THINNER	
6	GREASE	
7	RUBBER WASHERS	
8	ALLEN- KEY SCREWS	
9	INDICATION LAMPS	
10	ANY OTHER ITEM REQUIRED.	

Note:-

- a) The above list is based on Experience with Johnson Make Elevator. The Contractor is required to update the above list with their specific models/make/nomenclature/ rating in line with the proposed model of the Elevators and submit.
- b) The list is indicative and not exhaustive.
- c) These spares and any additional spares required during the 1 year DLP and 2 year CAMC period will be arranged by the Contractor, without any Extra Payments.
- d) This will not absolve the firm of the responsibility to fulfil the DLP obligations as per relevant clauses of TS.

**APPENDIX- B: List of Spares for 15 years after 1 years DLP & 2 years CAMC**

S. No.	Item		Unit price at Base year 2025
		Quantity	INR
1	ALS UNIT		
2	AMD2 COUPLER		
3	AMD2 DOOR MODULE		
4	ANTI LIFT ROLLER		
5	BATTERY SEALED LEAD ACID 12V 17AH (EBD & CCB)		
6	BISTABLE SWITCH 77U/N		
7	BLOCKING DEVICE SWITCH		
8	BRAKE UNIT		
9	BRAKING REGISTER ASSY.		
10	US90-30, DEWHURST BUTTON-RED (AS PER SPEC)		
11	US90-30, DEWHURST WHITE/ GREEN (INTERCOM)		
12	US90-30, DEWHURST BUT, SHROUDED (ALARM)		
13	CAR DIVERTER WHEEL ASSY.		
14	CWT. DLVERTER WHEEL ASSY		
15	CAR DOOR HEADER		
16	CAR DOOR TRACK ROLLER		
16	CONTROL CURRENT TRANSFORMER		
18	CAR LIGHT SWITCH		
18	COL 3D (PANA-40)		
20	CWT SAFETY GEAR		
21	DOOR BELT		
22	DOOR GLIDE SHOE		
23	DOOR CONTACT BULLET		
24	DOOR BELT PULLEY ,		
25	DOOR CONTACT SWITCH		
26	DOOR GUIDE SHOE		
27	DOOR TRANSFORMER		
28	EBD UNIT-MXI0/11 MACHINE.		
29	EMOTIVE DISPLAY		
30	EMERGENCY KEY		
31	END BUFFER ,		
32	FINAL LIMIT SWITCH SIEMENS MAKE		
33	FULL LOCK LATCH UNIT I LOCK ROLLER UNIT		
34	GUIDE SHOE IOMM CWT		
35	GUIDE SHOE JIB 16MM SPRING LOADED		
36	GUJDE SHOE ASSY. (UPMRC)		
37	GEARED MOTOR		
38	INSPECTION BOX		
39	TENSION WT SWITCH		
40	TACHO (RADIO ENERGY)		
41	LIMIT SWITCH		
42	LWD DEVICE		

43	LCE CAN		
44	LCE CCB BOAR		
45	LCECPU		
46	LCE FCB BOARD		
47	LCE OPT BOARD		
48	LCE REC BOARD		
49	LCE-230(ADO/ACL CARD)		
50	LOP230 BOARD		
51	LCE-CIB ,PCB BOARD		
52	LCECOB		
53	LANDING DOOR TRACK ROLLER		
54	LOP 230 FUSE 250Y 2A		
55	LOP 230 FUSE 250Y 1 A		
56	LOPCB BOARD		
57	LIGHT ELEMENT (MAP LIGHT)		
58	KDS 300 HLG ASSY .- BOTTOM		
59	KDS 300 HLG ASSY.- TOP		
60	MONOST ABLE SWITCH (SENSOR 61 U/N&30)		
61	MOTOR MX-10/11		
62	OIL CUP		
63	OSG		
64	PIT STOP SWITCH		
65	PHOTO CELL		
66	ROPE FOR SYNCHRONISTION -CAR		
67	ROPE FOR SYNCHRONISATION - LANDING DOOR		
68	ROPE FOR CLOSING WEIGHT. ASSY.		
69	RESISTER BOX ASSY .		
70	MAIN STEEL CORE ROPE		
71	SAFETY GEAR SWITCH		
72	SAFETY GEAR JAW		
73	SHAFT DOOR HEADER (LANDING TOP TRACK)		
74	SYNCHRONISATION ROLLER FOR CAR DOOR A-2,		
75	SYNCHRONISATION ROLLER FOR CAR DOOR A-1 ,		
76	TRA YEUNG CABLE UPMRC 16 CORE		
77	TRAYEUNG CABLE UPMRC 8 CORE		
78	SYNCHRONISATION ROLLER FOR LANDING DOOR A-2,		
79	SYNCHRONISATION ROLLER FOR LANDING DOOR A-1,		
80	Y3F 18 MODULE		
81	UPPER ISOLATION RUBBER PAD		
82	WHEEL FOR TACHO METER		
83	WATER SENSOR IN PIT		
84	INTERCOM BOX ASSY.		

Annual Escalation beyond 2025 :% ( \_\_\_\_\_ Percent).

- e) This list is of Indicative Nature. The above list is based on Experience with Johnson Make Elevator. The Contractor is required to update the above list with their specific models/make/nomenclature/ rating in line with the proposed model of the Elevators and submit.