

# ***Maha Metro***



## **Tender Documents**

**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT  
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

### **PART II – EMPLOYER’S REQUIREMENT**

#### **SECTION VI - EMPLOYER’S REQUIREMENT AND APPENDICES**

June 2018



# PUNE METRO UNDERGROUND SECTION

## CONTRACT UGC-02

### TENDER DOCUMENTS

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# **PUNE METRO UNDERGROUND SECTION**

## **CONTRACT UGC-02**

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### **PART II – EMPLOYER’S REQUIREMENT**

#### **Section VI – Employers Requirement**

##### **Section A - General**

June 2018

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## A1 INTRODUCTION

These Employer's Requirements are divided into five sections as follows:

- (a) **General:** these apply throughout the Contract (Section A).
- (b) **Functional:** these include the specific core requirements for the design and performance of the Works (Section B).
- (c) **Design:** these apply in respect of responsibilities and obligations relating to the design of the Permanent Works (Section C).
- (d) **Construction:** these apply in respect of responsibilities, obligations and other requirements relating to the construction of the Works (Section D).
- (e) **Manufacturing, Installation and Testing:** these apply to the requirements relating to manufacturing, procuring & delivery of plant and equipment and the requirements for testing and commissioning (Section E).

## A2 DEFINITIONS AND INTERPRETATIONS

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

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

**"Baseline Programme"** means the first Works Programme issued with a Notice of No Objection by the Engineer that is used solely to assess the Contractor's progress.

**"Construction Phase":** has the meaning identified in Clause A4 of the Employer's Requirements - General.

**"Construction Reference Drawings":** means those drawings referred to in Clause C2(8) of the Employer's Requirements Sub-division C - Design in respect of which a Notice has been issued.

**"Construction Reference Drawings Submission":** means the submission of Construction Reference Drawings representing elements of the Permanent Works and for which the Contractor seeks a Notice.

**"Construction Specification":** means those parts of the Standard Outline Specification which relate to construction.

**"Commencement date"** : is the date of issue of Letter of Acceptance (LOA)

**"Core System"** means the trainsets, catenary, electrification, signalling, communication, driving simulator, wayside electrical and mechanical facilities, ventilation systems, escalators and lifts, and any other related miscellaneous equipment.

**"Designer" or "Lead Designer"** means the designer (in house or consulting firm) appointed by the Contractor to Design the Works and Temporary Works

**"Design Checker" or "Lead Design Checker"** means a suitably qualified person(s) (in house or consulting firm) appointed by the Contractor to check the Design and Temporary Works.

**"Definitive Design Submission":** means the submission of documents which comprise the whole or parts of the proposed Definitive Design and for which the Contractor seeks a Notice of No Objection from the Engineer.

**"Design Criteria":** means those parts of the Outline Design Specification which relate to design.

**"Design Manual":** means the manual to be prepared and submitted by the Contractor as part of the Definitive Design and as described in the Employer's Requirements – Design (Sub-division C).

**"Design Package":** has the meaning identified in Clause C2(6) of the Employer's Requirements – Design (Sub-division C).

**"Design Phase":** has the meaning identified in Clause A4 of the Employer's Requirements – General (Sub-division A).

**"Employer's or Outline Drawings"** means those drawings included in Part 2, Section IX.

**"Employer's Requirements"** means the requirements set out in this Part 2, Section VI.

**"Final Design":** has the meaning identified in Clause C3(5) of Employer's Requirements – Design (Sub-division C).

**"Key Equipment"** means items of Contractor's Equipment (whether owned by the Contractor or not) specified as such in the Pre-qualification application.

**"Key Personnel"** means those persons named or positions so specified in Form T-III- A of the Contract or so designated by the Engineer at any time during the Contract.

**"Monthly Progress Report"** means the report referred to in General Conditions (GC) clause 4.21 to be prepared by the Contractor, in the form and detail prescribed in Appendix 5 of this Part 2, section VI, and submitted monthly to the Engineer.

**"Notice":** means a Notice of No Objection, as given in writing by the Engineer, refer to Attachment A3 for the format of the document to be used by the Contractor for obtaining a Notice of No Objection.

**"Outline Design Specification":** means the Design Criteria and the Outline Construction Specifications that specify standards issued by the Employer for development by the Contractor for design and construction.

**"Particular Specification":** means the combined Specifications prepared by the Contractor in Construction Specification Institute (CSI) format which combines the Employer's Outline Design Specifications, any Design Criteria contained elsewhere within the Contract, the Employer's Outline Construction Specifications and those parts of the Contractor's Technical Proposals which specify standards for design and construction which are developed during the Design Phase.

**"Preliminary Design":** means the submission of documents which comprise the initial stage of the design phase.

**"Pricing Document"** means Part 1, Section IV-b of the Contract.

**"Project"** means the design, construction, commissioning, operation and maintenance of Pune Metro rail system , including the Core System, E&M Works, Trackwork, Stations, Depot and Stabling Yards and Civil Works.

**"Quality Plan"** means the quality plan, setting out the Contractor's means of complying with his obligations in relation to Quality Assurance provided and maintained in accordance with General Conditions (GC) Clause 4.9, in the form and detail prescribed in Appendix 6 of Part 2, Section VI of the Contract.

**"Railway Envelope"**: means the zone or zones within the Works which will contain the track-work and equipment necessary for the operation of the railway.

**"Safety Plan"** means the safety plan setting out the Contractor's means of complying with his obligations in relation to safety provided and maintained in accordance with GC Clause 6.7, in the form and detail prescribed in Appendix 20 of Part 2, Section VI of the Contract.

**"Scope of Works"** means the brief description of the Works.

**"Specification"**: has the meaning identified in Clause A5 of the Employer's Requirements - General.

**"Structure Gauge"**: means the profile related to the designed normal co-ordinated axis of the track into which no part of any structures or fixed equipment may penetrate.

**"Volume"** means a separate part of the Contract.

**"Working Drawings"**: comprise the Construction Reference Drawings and such other drawings and documents, such as bar bending schedules and manufacturing drawings, as are necessary to amplify the Construction Reference Drawings for construction purposes.

**"Works Programme"** means the time-scaled and resource-loaded critical path network, updated from time to time in accordance with GC Clause 4.14 and Appendix 4 of this Part 2, Section VI of the Contract, depicting activities, durations, sequences and interrelationships that represent the Contractor's work plan, work breakdown, schedule structure for constructing and completing the Works, distributed over the Time for Completion of the Contract, as given a Notice by the Engineer.

### **A3 RELEVANT DOCUMENTS**

The Design Criteria shall be read in conjunction with the Conditions of Contract (CC) **Part 3**, the Employer's Requirements, the Employer's Drawings and any other document forming part of the Contract.

In the event of a conflict between the Employer's Requirements and any Design Criteria, the Design criteria shall prevail.

In the event of a conflict between any Design Criteria and any other standards or specifications quoted, the requirements of the Design Criteria shall prevail.

Notwithstanding the precedence specified above the Contractor shall always immediately seek advice from the Engineer in the event of conflicts between Specifications.

The order of precedence is:

- Design Criteria
- Employer's Requirements
- Indian and other International Standards referenced herein.

### **A4 PHASES (DESIGN AND CONSTRUCTION)**

- (1) The Contractor shall execute the Works in two phases, the Design Phase and the Construction Phase.
- (2) The Design Phase shall commence upon the Commencement Date. This phase shall include the preparation and submission of:
  - (a) the Preliminary Design

- (b) the Definitive Design; and
- (c) the Construction Reference Drawings.

The Design Phase will be completed upon the issue of a Notice by the Engineer in respect of the comprehensive and complete Construction Reference Drawings Submission for the whole of the Permanent Works.

- (3) The requirements for the Preliminary Design, Definitive Design and Construction Reference Drawings are stated in Clause C2 of the Employer's Requirements – Design.
- (4) The Construction Phase for the whole or a part of the Permanent Works shall not commence until the issue by the Engineer of a Notice in respect of the relevant Construction Reference Drawings submission. Such Notice may be issued by the Engineer in respect of a Construction Reference Drawing submission covering a major and distinctive part of the Permanent Works.

The Construction Phase shall include the completion and submission of the Final Design and the preparation and submission of the As-Built Drawings and other records as specified.

- (5) Notwithstanding Clause A4(4) above, for those elements identified under Clause C2(6) of the Employer's Requirements – Design, the Construction Phase may commence immediately upon the issue of the Notice in respect of the Definitive Design Submission in respect of each such element subject to availability of the Site in accordance with the agreed programme.

#### **A5 SPECIFICATIONS**

In accordance with the provisions of these Employer's Requirements, the Outline design Specification contained in the Contract shall be developed during the design stage and submitted as part of the Definitive Design Submission. When the Specification has received a Notice of No Objection from the Engineer it shall become the Particular Specifications and shall take precedence over other Specifications for construction purposes.

#### **A6 SPECIFICATIONS IN METRIC AND IMPERIAL UNITS**

- (1) The Contract shall utilise the SI system of units. Codes and Standards in Imperial units shall not be used unless the Engineer has given a Notice.
- (2) Conversion between metric units and imperial units shall be in accordance with the relevant Indian Standards.

#### **A7 WORKS PROGRAMME**

- (1) The Key Dates are defined in Appendix 2B to these Employer's Requirements.
- (2) The Contractor shall prepare and submit his Works Programme and three month rolling programmes in accordance with the detailed requirements contained in Appendices 3 and 4 to these Employer's Requirements.
- (3) In compiling his Works Programme and in all subsequent updating and reporting, the Contractor shall make provision for the time required for co-ordinating and completing the design, testing, commissioning and integrated testing of the Works, including, inter alia, design co-ordination periods during which the Contractor shall co-ordinate his design with those of Project and other Interfacing Contractors, the assessment procedures, determining and complying with the requirements of all

Government Departments and all others whose consent, permissions, authority or license is required prior to the execution of any work.

- (4) The Works Programme shall take full account of the Design Submission Programme.
- (5) The Employer and the Engineer shall designate certain of their computers for installation, by the Contractor, of software programmes that the Contractor intends to use for the design, programming, production of drawings, etc... All software shall be originals and licensed by the manufacturer and issued at the Contractor's cost.

#### **A8 MONITORING OF PROGRESS**

- (1) The Contractor shall submit to the Engineer six copies of a Monthly Progress Report (MPR), as described in Appendix 5 to these Employer's Requirements, describing the progress and current status of the Works. The MPR shall address the matters set out in the Works Programme.
- (2) The MPR shall be submitted by the last day of each calendar month. It shall account for all works actually performed from the twenty sixth day of the last month and up to the twenty fifth day of the current month. The processing of the Interim Payment Certificate will only commence after the receipt of the MPR on the due date. Late receipt will delay the processing of the IPC.
- (3) The MPR shall be divided into two sections. The first section shall cover progress and current status relating to design and the second section shall cover progress and current status relating to construction.
- (4) The MPR shall be signed by the following Key Staff; Project Manager, QA Manager, Safety Manager, Chief Interface Coordinator and the Engineering Manager (Design ), who by signing the MPR shall certify that all information contained in the MPR, as relating to their section of the Works, has been accepted and verified by each signatory as being accurate, honest, true and meets the requirements of the Contract.
- (5) A monthly meeting to monitor the progress of the project shall be convened by the Engineer and the Contractor and the representative's of the Interfacing Contractors shall also attend the meeting. The Employer may also be present in the meeting. Refer to Clause A18 of this Employer's Requirements-General.
- (6) The Employer shall arrange Quarterly Review Meetings for the Project which the Contractor shall attend and participate in as required. Refer to Clause A18 of these Employer's Requirements - General.
- (7) Contractor on request from Engineer shall submit to the Engineer three copies of a Daily Progress Report (DPR), describing the progress of the day and current status of the Works. The DPR shall be submitted by the 12 am next day and it shall account progress and current status for all works actually performed on the day. The DPR shall be signed by the Site Manager, QA Manager and Safety Manager.

#### **A9 QUALITY ASSURANCE**

The Contractor shall establish and maintain a Quality Assurance System in accordance with Appendix 6 to these Employer's Requirements for design and construction procedures and the interfaces between them. This Quality Assurance System shall be applied without prejudice to, or without in any way limiting, any Quality Assurance Systems that the Contractor already maintains.

## A10 SOFTWARE SUPPORT

### General

- (1) The Contractor shall provide copies of all computer programs and full support to the Employer or Engineer for all computer programs used/proposed to be used, by the Contractor under the Contract, also refer to Clause A7(5) of these Employer's Requirements - General.
- (2) The Contractor shall submit a software support plan at least 90 days before commencement of software installation. This plan shall require the Contractor to provide all changes, bug fixes, updates, modifications, amendments, and new versions of the program as required by the Engineer.
- (3) The Contractor shall provide all tools, equipment, manuals and training as necessary for the Employer / Engineer to use, maintain and re-configure all of the software provided under the Contract.
- (4) The Contractor shall submit all new versions to the Engineer for a Notice at least 2 weeks prior to their installation. New Versions of any program shall not result in any non-conformance with the Specification, or degrade the operation of the System. The Contractor shall:
  - ensure that all new versions are fully tested and validated on the simulation and development system prior to installation.
  - ensure that all new versions are fully tested and commissioned once installed on the Site.
  - deliver to the Employer and the Engineer any new version, together with the updated Operation and Maintenance Manuals.
- (5) The Engineer shall not be obliged to use any new version and that shall not relieve the Contractor of any of his obligations. Any effect upon the performance or operation of the computer controlled system that may be caused by a new version shall be brought to the Engineer's attention including updating the files to suit the new version.

### Software Obligations

- (6) 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 and the Engineer, two backup copies of the software, which shall include, without limitation:
  - All licenses in favour of the Employer for their use.
  - all source and executable codes;
  - all design documentation relating to the software; and
  - any specified development tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers.

### Error Correction

- (7) When a fault is discovered within delivered software or documentation, the Contractor shall take necessary steps to rectify errors or faults at the earliest.
- (8) The Contractor shall provide written details as to the nature of the proposed correction to the Engineer.

- (9) The Contractor shall notify the Employer promptly of any fixes or patches that are available to correct or patch faults.
- (10) The Contractor shall detail any effect such fixes or patches are expected to have upon the applications.

#### **Training**

- (11) The Contractor shall provide training for the Employer's staff to enable them to make proper use of any software, training for any new versions.

### **A11 CO-ORDINATION WITH INTERFACING CONTRACTORS.**

- (1) The Contractor shall be responsible for coordinating his own design, technical, programming and construction activities and for coordinating these with the design, technical, programming and construction activities of other Project Contractors, Utility Agencies, Statutory Authorities, Public Service Providers, Developers, Consultants and other Contractors whether or not specifically mentioned in the Contract, that may be working on or adjacent to the site, to achieve fully coordinated construction of the facilities. For the purpose of these Employer's Requirements and the Contract, all of the above parties shall be referred to as "Interfacing Contractors".

The Engineer shall oversee, monitor, provide direction and clarification where required, attends Interface meetings, in conjunction with the Contractor and other Interfacing Contractors. The Contractor shall note that the Employer may engage other Contractors, Consultants, etc.. from time to time with whom the Contractor shall have to similarly co-ordinate. Such co-ordination responsibilities of the Contractor shall include, but not be limited to, the following;

- (a) To provide all information reasonably required by the Interfacing Contractors in a timely and professional manner to allow them to proceed with their design and construction activities, and specifically to meet their contractual obligations.
- (b) To ensure that the Contractor's requirements are provided to all other Interfacing Contractors before the cut off dates identified in the Interface Management Plan (IMP) to be developed by the Contractor.
- (c) To obtain from the Interfacing Contractors information reasonably required to enable the Contractor to meet the Construction Key Dates as identified in Appendix 2B of this Employers Requirement.
- (d) Where the execution of the Work of the Interfacing Contractors depends upon the site access, management or information to be given to them by the Contractor, the Contractor shall provide to such Interfacing Contractors the services or correct and accurate information required to enable them to meet their programme or construct their work.
- (e) To co-ordinate access and delivery routes, and ensure that all provisions for access and delivery of plant are co-ordinated with and reflected in the Interfacing Contractor's Delivery Route Drawings. The Interfacing Contractor shall ensure that all plant are delivered at the time agreed to allow openings left in the structure for such delivery to be sealed in accordance with the Contractor's programme.
- (f) To co-ordinate with the Interfacing Contractors on attendance.

- (g) To attend regular and quarterly co-ordination meetings convened by the Engineer with the Interfacing Contractors. The Contractor shall conduct separate meetings with the Interfacing Contractors as necessary to clarify particular aspects of the interfacing requirements of the Works. The party who convenes the meeting shall prepare minutes recording all matters discussed and agreed at the meeting.
- (h) To ensure a clear flow and exchange of information, direction and timings, copies of all correspondence, drawings, meeting minutes, programmes, etc.. relating to the Contractor's co-ordination with all of the Interfacing Contractors shall be issued to all concerned parties, four (4) copies shall be issued to the Engineer no later than three (3) calendar days from the date of such correspondence and meetings.
- (2) The Contractor shall, in carrying out his co-ordination responsibilities, raise in good time, and provide sufficient information for the Engineer to decide on, any disagreement between the Contractor and Interfacing Contractors as to the extent of services or information required to pass between them. If such disagreement cannot be resolved by the Contractors, despite the Contractor taking all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.
- (3) Where an Interfacing Contract has yet to be awarded the Contractor shall proceed with the co-ordination activities with the Engineer until such time when the Interfacing Contractor is available. The Contractor shall provide the Interfacing Contractor with all information and documents necessary to enable the Interfacing Contractor to follow on and proceed with their co-ordination.
- (4) The Contractor has to include in his Interface Management Plan, as required in Appendix 19, the latest dates for the Contractor to pass information to the Interfacing Contractors in order for them to complete their design submissions to the Engineer. Any claims of additional costs by the Interfacing Contractors as a result of the Contractor's failure in adhering to these dates shall be borne by the Contractor. The Contractor shall note that the information exchange is an iterative process requiring the exchange and updating of information at the earliest opportunity and shall be carried out on a regular and progressive basis so that the process is completed for each design stage by the cut off dates.

**Dedicated Co-ordination Team.**

- (5) The Contractor shall establish a dedicated co-ordination team, led by a Chief Interface Co-ordinator permanently stationed in Pune reporting to the Contractor's Project Manager or Representative. The primary function of the team is to provide a vital link between the Contractor's design and construction teams and the Interfacing Contractors.
- (6) The Chief Interface Co-ordinator shall assess the progress of the co-ordination with Interfacing Contractors by establishing lines of communication as indicated in the co-ordination model in Figure 1 and promote regular exchange and updating of information so as to maintain the Contractor's programme.
- (7) The complexity of the Project and the importance of ensuring that work is executed within time limitations require detailed programming and monitoring of progress so that early programme adjustments can be made in order to minimise the effects of potential delays
- (8) The Chief Interface Co-ordinator in conjunction with the Interfacing Contractors shall identify necessary provisions in the Works for plant, equipment and facilities of the

Interfacing Contractors. These provisions shall be given due allowance by the Contractor in his design, and construction, of the Works.

- (9) During the course of the Contract, information will be obtained in a number of ways. These may include direct inspection, regular site meetings, the obtaining of progress reports and the use of turnaround documents to obtain design and programme data. Turnaround documents shall be issued to the Interfacing Contractors, copied to the Engineer, to be returned by the receiving party within a set time period, giving the current positions on their programme.

#### **Design Interface**

- (10) The information cut off dates in the Interface Management Plan developed by the Contractor will be critical for the timely completion of the Project. The dates shall be determined to create a time frame during which design interface with the Interfacing Contractors on the Project has to be completed in order for the construction interface to follow. The Contractor shall commence design interface with the Interfacing Contractors as soon as he has been notified by the Engineer that such Interfacing Contract(s) has been awarded. In the case of Utility Agencies and other Statutory Authorities, interface shall commence as soon as possible. Where no design interface date has been established, whether because the Interfacing Contractor has not been identified, or for whatever reason, the Contractor shall liaise with such Interfacing Contractor(s) as soon as they have been awarded.
- (11) The Contractor shall immediately upon the award of the Contract gather all necessary information and develop his design to a level where meaningful interaction can take place as soon as the Interfacing Contractors are available. The Contractor shall submit with each of his Design Submissions a joint statement from the Contractor and the relevant Interfacing Contractors confirming that design co-ordination has been completed and that they have jointly reviewed the appropriate document to ensure that a consistent design is being presented.
- (12) The design interface is an iterative process requiring regular exchange and updating of interfacing information. The Contractor shall ensure that the information he requires from the Interfacing Contractors is made known at the outset of each design interface, and vice versa, so that information can be provided in time for the Contractor and Interfacing Contractors to complete their designs to meet their various design submission dates.

#### **Construction Interface.**

- (13) Construction Interface will be necessary throughout the duration of the Works commencing from the time the Contractor mobilises on site, to the completion of the Works. Construction interface will overlap design interface, involving cast in and buried items such as pipes for electrical and mechanical services, supports, brackets, plinths, ducts, service buildings, openings, cableways, trenches, etc.. that are to be incorporated at the early stage of the construction up to provision of attendance during testing and commissioning stage.
- (14) The Contractor shall ensure that there is no interference with the Works of the Interfacing Contractors and shall maintain close co-ordination with them to ensure that his work progresses in a smooth and orderly manner. The Contractor shall carry out and complete the Works, or part thereof, in such order as may be Noticed by the Engineer or

in such order as may be requested by the Engineer from time to time. The Contractor shall, unless otherwise provided, be liable for and shall indemnify the Employer against all costs, charges, expenses and the like resulting from the failure of the Contractor to co-ordinate the Works as specified.

- (15) The Contractor shall prepare a Station Installation Coordination Plan (ICP) for each station (including station subways) on a room by room basis covering the period of Interfacing Contractors' access. The ICP shall allow adequate time periods for each Interfacing Contractor to install their plant and equipment in the station rooms/areas, as per their specific requirements. The ICP shall be agreed with and signed off by each Interfacing Contractor and then submitted to the Engineer for a Notice no later than six months before the basic Structure Completion date.
- (16) The Contractor shall be responsible for co-ordinating all aspects of the design and construction including the production of Combined Services Drawings, SEM Drawings and Consolidated Design Drawings. This shall include the requirements for Design Consolidation as per Appendix 15 of this Employers Requirement.
- (17) The list of major public infrastructure works contracts, which may be planned to be undertaken in the vicinity of the Pune Metro - Phase-I underground Section (Agriculture College to Swargate) site areas will be given to the Contractor. The works contracts interfacing with the project are subject to change as and when any additional works are planned by any agency and accordingly additional contracts may be added to the list from time to time and the Contractor shall be responsible for identifying relevant contracts and interfacing with them as required. Please refer Appendix-17 in this regard.

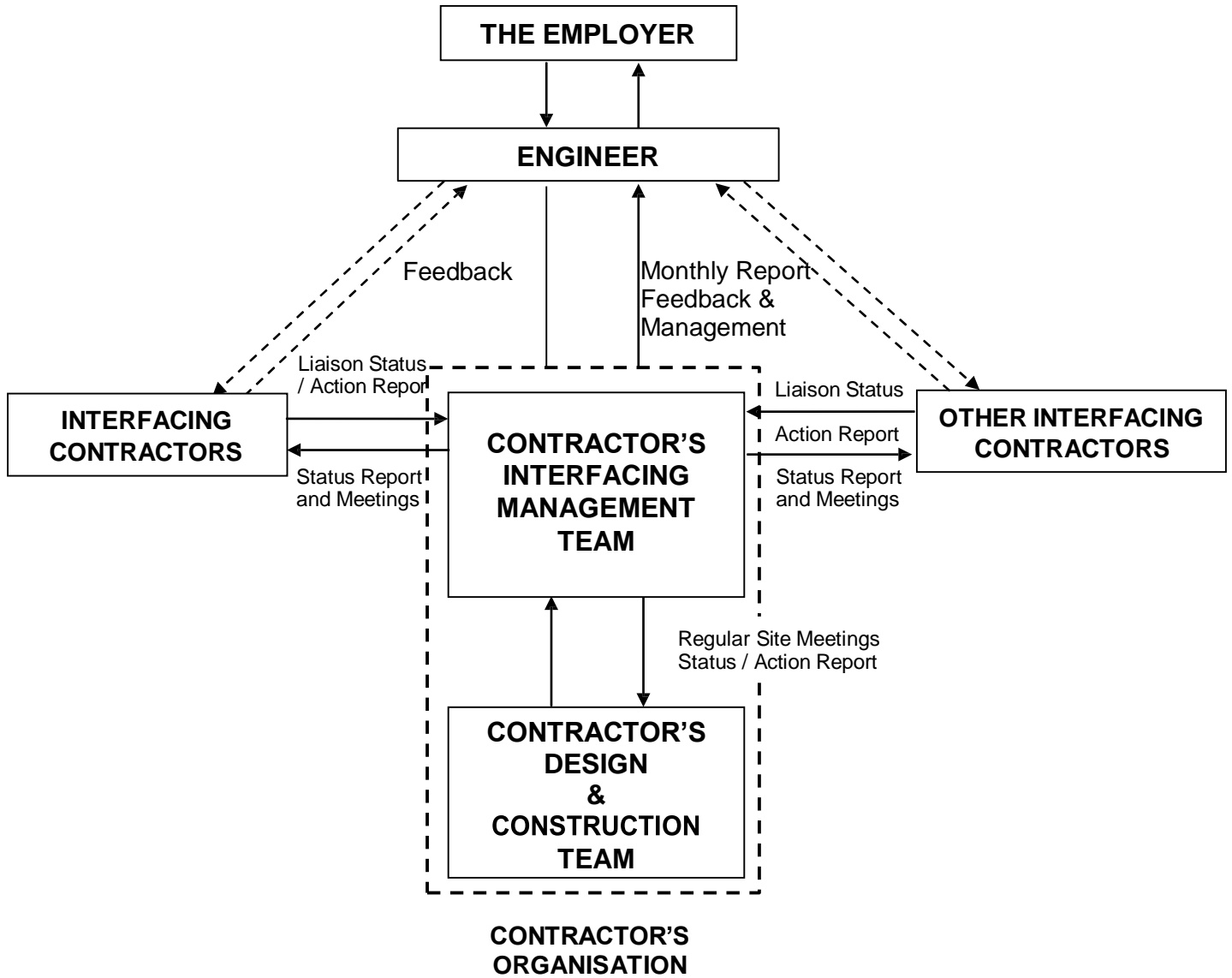


Figure 1 - Interface Communication and Coordination Model.

## **A12 SURVEY AND SITE INVESTIGATIONS**

- 1) The datum to be used for the Contract shall be Mean Sea Level Datum.
- 2) The Contractor shall carry out all further site investigations, including surveys, necessary for the design of the Permanent Works and to enable the determination of the methods of construction and the nature, extent and design of the Temporary Works.

## **A13 CLIMATIC CONDITIONS**

Pune has a hot semi-arid climate bordering with tropical wet and dry with average temperatures ranging between 19 to 33 °C (66 to 91 °F). Designs and plans for the Works must take this into account accordingly. The Contractor shall obtain information on the climatic conditions in Pune, such as temperature, rain fall, wind, sunshine, relative humidity, etc. from the Meteorological Department and/or other authorities and shall make full provision for the effects of the local weather/climatic conditions in his designs, planning, programming and execution of the Works.

## **A14 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)**

The Contractor shall utilise a PMIS provided by the Employer such that all documents generated by the Contractor can be transmitted to the Engineer by electronic means (and vice versa) and that all documents generated by either party are electronically captured at the point of origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the Engineer's office at site and the Employer's Office by the Contractor. The number and format of the required document submissions is detailed in Attachment A1 to this Section - A. The Transmittal Form is given in Attachment A2 to this Section - A and the Document Submission Report, for the obtaining of a Notice of No Objection from the Engineer, is given in Attachment A3 to this Section A.

## **A15 CONTRACTOR'S PROJECT ORGANISATION**

- (1) The Contractor shall employ on this Project, a competent team of Managers, Engineers, Technical staff, etc.. so as to complete the Work satisfactorily as per the various requirements of the Contract.
- (2) A site control room with 'around the clock' radio communication or telephone switch board links with all safety offices, works sites, design offices, site offices, batching plants, casting yards, workshops, fabrication yard, off site offices, Engineer's site offices, testing labs etc shall be maintained and manned 24 hours a day, seven days a week. Residence and mobile telephone numbers of the Contractor's Senior Project team members shall also be linked with the control room. Vehicles for emergency use should be on stand-by at the control room around the clock.
- (3) The designations of the various project organisations team members shall be subject to a Notice from the Engineer before adoption so as to avoid any duplication of the designations with those of the Employer or the Engineer.
- (4) The Contractor shall submit his Staffing Proposal to the Engineer for a Notice, which shall include:
  - (a) The Contractor's proposed Staff Organization showing in chart form the names of his proposed staff for each position;

- (b) CVs of the Contractor's proposed Key Staff, with adequate details and copies of documentary proof on the qualification and experience (with contract titles, position held and dates) of each staff to substantiate that he is competent for undertaking the proposed position;
  - (c) The scope of responsibilities of each staff and the reporting lines between individual staff;
  - (d) The documents that each staff is authorized to sign on behalf of the Contractor.
- (5) The Staff Organization shall cover the Contractor's Key Staff and Specially Required Staff as specified in Sub-clauses A15(8) and (9) below, as well as other working-level staff, with a narrative of the authorities and responsibilities of each staff member in directing execution of the Works on Site, or in deciding technical details of the Contractor's proposals.
- (6) The Contractor shall note that financial penalties can be levied for the failure to employ some of the Key Staff required by this Clause, refer to Pricing Document.
- (7) The Contractor's Staffing Proposal shall include the Key Staff proposed in their Tender submission, unless it is necessary to propose better qualified and more experienced staff in order to meet the requirements of the Contract, in which case the Contractor shall include in the Staffing Proposal an explanation for each change in Key Staff. Any such change in Key Staff shall require a Notice from the Engineer.

Each member in the Contractor's Staffing Proposal, including the Key Staff and the Specially Required Staff, shall be allocated to this Contract on a full-time basis on Site, until the activities that he is responsible for have already been completed or have to be carried out off-site. Should it be necessary to replace any staff before the activities he is responsible for have been carried out, the Contractor shall submit the CV of the proposed substitute for the Engineer Notice of No Objection, at least 30 days before the proposed change. The substitute shall not be less qualified or experienced than the person he is replacing.

**(8) Key Staff**

- (a) The Contractor's Staffing Proposal shall include as a minimum the following Key Staff:
  - (i) Project Manager, who shall be the Contractor's Representative.
  - (ii) Construction Manager (Tunnels);
  - (iii) Construction Manager (Civil and Geotechnical);
  - (iv) Construction Manager (Stations) ;
  - (v) Construction Manager (Architectural, and Finishes)
  - (vi) Construction Manager (Building Services )
  - (vii) Chief Interface Co-ordinator
  - (viii) Engineering Manager (Lead Designer and Technical Support).
  - (ix) Engineering Manager (Lead Design Checker).
  - (x) Quality Assurance Manager.

- (xi) Construction Quality Control Manager.
- (xii) Design Quality Assurance Manager.
- (xiii) Safety Manager.
- (xiv) Project Programmer
- (xv) Heritage Conservation Architect (wherever applicable)
- (b) All the foregoing Key Staff shall hold, as a minimum, a University Degree or an equivalent qualification in Civil Engineering, or in a branch of engineering appropriate to the nature of the Work included in the Contract acceptable to the Engineer.
- (c) The Project Manager shall be authorized to represent the Contractor on all aspects under the Contract and shall bear overall responsibility for the management, coordination and progress of the Contract.

The Project Manager shall have at least 25 years' relevant experience, including experience as a Main Contractor's Project Manager on site with overall responsibilities for large-scale construction projects similar to the Works under this Contract. The proposed Project Manager shall hold a University Degree acceptable to the Engineer or an equivalent qualification, in civil engineering or in a branch of civil engineering appropriate to the nature of the Work included in the Contract.

The Project Manager must be bestowed with adequate authority to receive and carry out the directions and instructions from the Engineer.

The Project Manager shall have a fluent command of written and spoken English and shall be employed fulltime on this site.

- (d) The following Key Staff; Construction Manager (Tunnels), Construction Manager (Civil and Geotechnical), Construction Manager (Stations), Construction Manager (Architectural Builders Works and Finishes), Construction Manager (Building Services) and Chief Interface Co-ordinator; shall be authorized to represent the Contractor on construction aspects for their individual scopes, and shall bear overall responsibilities on all aspects within each scope. Each of them shall have at least 15 years relevant experience, including experience in a key position on site for supervision or construction of:
  - For 8 (a) (i) Large-scale tunnelling works similar to the Works under this Contract;
  - For 8 (a) (ii) Large-scale civil and geotechnical works similar to the Works under this contract;
  - For 8 (a) (iii) Large scale underground station construction similar to the Works under this Contract, including at least 3 underground stations;
  - For 8 (a) (iv) Large scale underground station Architecture and finishes similar to the Works under this Contract, including at least 3 underground stations;
  - For 8 (a) (v) Large scale underground station Building Services under this Contract, including at least 3 underground stations;

For 8 (a) (vi) Interface coordination and management with a Contractor on large scale tunnel and underground projects similar to the Works under this Contract, with experience in at least 3 stations and/or tunnel projects;

- (e) The Lead Design Manager (Lead Designer & Technical Support - Detail Design Consultant) shall be authorized to represent the Contractor on matters related to the Contractor's proposals with respect to construction methodologies, Contractor's designs, material proposals, and shall bear overall responsibilities on these aspects. He shall coordinate the input of the Project Manager and the Construction Managers for ensuring that the proposals are of good constructability and are conducive to the assurance of quality of the Works as well as conducive to the assurance of safety and environmental requirements. The Lead Design Manager (Lead Designer & Technical Support - DDC ) shall have at least 20 years' relevant experience, including experience in a key position with Contractors for the formulation of construction methodologies and Contractor's designs for large-scale construction projects similar to the Works under this Contract.
- (f) The Engineering Manager (Lead Design Checker) shall be a Professional Engineer with at least twenty (20) years' experience in the design of underground civil works, including bored and NATM and cut & cover tunnels, with at least ten (10) years' experience managing a large, complex design project(s) that included work of a similar nature. Experience shall include management of design projects that include the types of work included in the Works. The Engineering Manager (Lead Design Checker) shall be assisted by a team of Design Checkers to cover the full scope of the design required by this Contract.
- (g) The Quality Assurance Manager shall be a Professional Engineer and an experienced manager with at least fifteen (15) years' experience in the design and/or construction of underground civil works with at least 10 years' direct relevant experience in administering Quality Assurance programs for civil works of a similar scope. The QA Manager shall be knowledgeable of, and have experience in, the development and application of ISO 9001 standards for the design and construction of civil works.
- (h) The Construction Quality Control Manager shall be a Professional Engineer with a minimum of ten (10) years' experience as a QC Manager on similar size and type of construction projects, which shall have included work with the major trades which are expected in this Contract.
- (i) The Design Quality Assurance Manager shall be a Professional Engineer with at least fifteen (15) years' experience in the design of civil works, underground civil works, including bored and NATM and cut & cover tunnels including QA management experience on projects having work similar to that included in the Works. Previous experience in directing Quality Control and Quality Assurance for similar design activities is required.
- (j) The Safety Manager shall be a professional and experienced manager with at least fifteen (15) years' experience in the construction of underground civil works with at least 10 years' direct relevant experience in administering

safety assurance programs of underground stations, tunnels and civil works of similar scope. The Safety Manager shall be knowledgeable of, and have experience in, the development and application of ISO 9001 standards for the construction of civil works.

- (k) The Project Programmer shall be a Professional Engineer with at least ten (10) years' relevant experience in programming of civil works (comprising underground stations and tunnels) of similar scope. The Project Programmer shall be knowledgeable of, and have experience in, preparing programmes (scheduling) with computerized Critical Path Method (CPM) networks using the Precedence Diagramming Method (PDM) with Primavera Project Planning software.
- (l) The Heritage Conservation Architect (wherever applicable) shall be a Professional Architect with at least Eight (8) years' of experiences in heritage building/structure works, of which at least three (3) years' of experience shall pertain to condition assessment, protective measures and renovation works of heritage buildings/structures.
- (m) The Project Manager, Construction Managers and Engineering Managers shall be assisted by engineers and foremen of adequate number and experience for ensuring that the Works will meet the requirements of the Contract from quality, progress, safety and environmental points of view. Without prejudice to the generality of the above, the Contractor's Staffing Proposal shall also include Specially Required Staff as stipulated in Sub- Clause A15(9) below.
- (9) **Specially Required Staff**
- Geotechnical Key Staff - The Construction Managers shall be assisted by the following staff:
- (i) Tunnel Construction Engineer (Main Tunnel) is responsible for the construction of the main tunnel including cross passages, and shall have the following minimum qualification and experience:
- University degree in civil/structural/geotechnical engineering or equivalent acceptable to the Engineer;
  - 5 years' experience in tunnelling by TBM.
- (ii) Tunnel Construction Engineer (NATM Tunnel) is responsible for the construction of the NATM tunnels including cross passages, and shall have the following minimum qualification and experience:
- University degree in civil/structural/geotechnical engineering or equivalent acceptable to the Engineer;
  - 5 years' experience in tunnelling by NATM.
- (iii) Cut and Cover Tunnel Construction Engineer (Adits) is responsible for the excavation and construction of cut & cover structures including stations, shafts, adits and tunnels and shall have the following minimum qualification and experience:
- University degree in civil/structural/geotechnical engineering or equivalent acceptable to the Engineer;

- 5 years' experience in tunnelling by cut and cover techniques including drill and blast methods.
- (iv) Design Consolidation Unit in accordance with the requirements of Appendix 15 of this Employers Requirement.

#### **A16 TRAINING AND TECHNOLOGY TRANSFER**

- (1) The Contractor shall ensure that all local Contractors and Sub-Contractors engaged in the Works are given training, guidance and the necessary opportunity for transfer of technology in various areas of construction such as, control of ground settlements, instrumentation, safety, quality assurance, interface management, etc.
- (2) Refer to Clause E8 of Section E of these Employer's Requirements for training requirements for the Employer's staff.

#### **A17 MAINTENANCE REPORT**

- (1) The Maintenance Report shall be submitted as part of the Definitive Design and shall include full details of the long term inspection and maintenance operations for each major component of tunnel, station structure, station building services equipment, station finishes, water supply, drainage and sewerage.
- (2) The Contractor shall provide inspection and maintenance manuals for the civil, structural and building works and services covering the following areas:-
  - Tunnel structures,
  - Underground Station Structures (separated into the main structural elements), and
  - Ancillary structures including entrances, adit tunnels, subways, ventilation and access shafts and plant buildings.
- (3) For each area an inspection checklist shall be supplied giving inspection frequency, items to be inspected, criteria for acceptance, criteria for remedial works and details of the remedial works, including proposed materials and method statements. The recommended regular maintenance regime of each area shall also be given including cleaning methods and frequency for different surfaces; removal of leakage borne salts from concrete surfaces; cleaning of drainage channels, sumps and pipes; repainting of metallic items;
- (4) A long term monitoring regime shall also be included covering items such as
  - Station and tunnel water leakage
  - Differential movement at tunnel/station / junctions or other areas identified in the design
- (5) All instruments necessary to carry out the inspections and monitoring that are identified in the report shall be provided by the Contractor.

#### **A18 MEETINGS**

##### **A18.1 General**

The Contractor shall participate in meetings as indicated in this Section. The Engineer shall record minutes of all meetings and distribute them within 5 days of the meeting. Meetings will be chaired by the Engineer.

### **A18.2 Initial Kickoff/Contract Meeting**

The Engineer shall arrange an initial meeting within seven (7) days following the issue by the Employer of the Letter of Acceptance.

The meeting shall take place at a location in Pune, India, determined by the Engineer.

The agenda of the meeting shall include, but not be limited to, the following:

- (a) Arrangements to be made for execution of the Contract Agreement;
- (b) Submission of bonds, guarantees, undertakings, warranties, insurance policies, certificates, etc.. if not already provided;
- (c) Arrival of Key Staff and plant;
- (d) Planned activities for the first 30 days and 60 days after the Commencement Date; and
- (e) Other items as may be advised by the Engineer.

The Contractor shall be represented by all appointed Key Staff.

### **A18.3 Site Mobilisation Meeting**

The Engineer shall arrange a meeting at the Engineer's office prior to the Contractor being given possession of any part of the Site. The agenda shall include, but not be limited to, the following:

- (a) Proposed use of the Site by the Contractor;
- (b) Employer's Requirements;
- (c) Temporary utilities and facilities;
- (d) Pre-conditional surveys of existing buildings and structures, with reports;
- (e) Security and "housekeeping";
- (f) Land and setting-out survey;
- (g) Programme for establishing work areas, temporary facilities, and Site accommodation for the Engineer;
- (h) Temporary Works; and
- (i) Contractor's initial Three Month Rolling Programme.
- (j) Procurement and delivery dates for major items of plant.

The Contractor's Key Staff, and those with responsibility for activities on the agenda, shall attend.

### **A18.4 Quarterly Review Meetings**

Quarterly Review Meetings shall be arranged at a time and venue determined by the Engineer to generally review progress and outstanding issues in regard to the Contract and the Project. They shall be attended by the Project Manager and supervisory board members of the Contractor and Interfacing Contractors. The agenda for these meetings will be advised by the Engineer, at least 5 days in advance. The Engineer or his designated representative will chair the meeting, and prepare and distribute the minutes.

Attendance shall be limited to the Contractor's Key Staff Nos. (i) to (vii) as relevant, as listed in Clause A15 (8) (a) of this Section A

#### **A18.5 Monthly Progress Meetings**

Monthly Progress Meetings shall be held throughout the progress of the Works. These meetings shall normally be held at the Engineer's Site office on the first Monday of the month, following receipt of the Contractor's Monthly Progress Report. Contractor's Key Staff shall attend the Progress meetings. The Engineer shall chair progress meetings, and prepare and distribute the minutes. The Engineer shall prepare and distribute the agenda at least 1 day prior to the meeting which may include, but not be limited to, the following:

- (a) Confirmation of minutes of the previous month's meeting and matters arising there from;
- (b) Review of design work progress;
- (c) Review of construction work progress;
- (d) Field observations, problems and decisions;
- (e) Identification of issues affecting planned progress;
- (f) Planned activities for the coming period;
- (g) Quality assurance;
- (h) Safety;
- (i) Interface coordination;
- (j) Status of variations, if any;
- (k) Design/construction coordination.

The Contractor's Project Manager must attend the Monthly progress meetings, other attendance shall be limited to the Contractor's Key Staff Nos. (ii) to (vii) as relevant, as listed in Clause A15 (8) (a) of this Section A.

#### **A18.6 Weekly Meetings**

Weekly meetings shall be held on Site to discuss detailed technical and construction issues plus the status of the Contractor's submittals. These meetings shall be chaired by the Engineer, who shall also prepare and distribute minutes. The Contractor's Key Staff shall attend this meeting with the exception of the Project Manager whose attendance is optional. Sub-Contractor's representatives shall also attend these meetings when requested to do so by the Engineer.

#### **A18.7 Other Meetings**

Interfacing Contractors, the Contractor's Key Staff, superintendents and Sub- Contractor's representatives shall attend other meetings as required with the Engineer.

## ATTACHMENT A1

### Required Number of Copies of Submittals and Format Requirements

Submittal	No. of Paper Copies			No. of Electronic Copies	Reference
	A1	A3	A4		
Initial Programme and Works Programme plus supporting information and narrative		6		2	
Monthly Programme Update		6		2	
Three Month Rolling Programme		6		2	
Three Week Rolling Programme		6		2	
Monthly Progress Report			6	2	
Preliminary and Definitive Designs	3	3		2	
Construction Reference Drawings	3	3		2	
Works Drawings	3	3		2	
Method Statements			6	2	
Interface Management Plan			6	2	
As built drawings	6			2	
Materials Submissions (documentation)			6	2	
Operation and Maintenance Manuals			6	2	
E&M Submissions			6	2	
Quality Plan			6	2	
Quality Control Register			4	2	
Reports of Quarterly Quality Audits			4	2	
Materials and Workmanship Test Results/Reports			6	2	
Safety Plan			6	2	
Environmental Plan			6	2	
Traffic Management Submissions			6	2	
Investigation and survey reports.			6	2	
Monitoring, protection and replacement proposal reports.			6	2	
All other submittals	6	6	6	2	As applicable

Notes:

- In case of any contradiction between the text and this table then the text shall prevail, unless otherwise instructed by the Engineer.
- Drawings to support A4 text documents shall be of A3 size.


**ATTACHMENT A2**  
**TRANSMITTAL FORM**

[illegible]

ATTACHMENT A3

Pune Phase - I Underground Section (Agriculture College to Swargate)

## DOCUMENT SUBMISSION REPORT (DSR) - STATUS SHEET



To, \_\_\_\_\_

**ORIGINATOR**

No of Contract: \_\_\_\_\_

Reference of Letter/Transmittal: \_\_\_\_\_

Reception date of Letter/Transmittal: \_\_\_\_\_

DSR Code: \_\_\_\_\_

Discipline: \_\_\_\_\_

Assessor: \_\_\_\_\_

Discipline Coordinator: \_\_\_\_\_

Prepared by Team Leader: \_\_\_\_\_

**SUBJECT:** \_\_\_\_\_

**List of documents submitted**

N°	Document reference	Revision	Date	Notification		
				A	B	C

**Notification**

Definition of notification:

A. Objection. A complete resubmission is required

B. No Objection with comments.

C. Notice of No Objection

Area of Deficiency	Comment Items No (Note)				
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Repeated Comments</th> <th style="width: 50%;">New Comments</th> </tr> </thead> <tbody> <tr><td> </td><td> </td></tr> </tbody> </table>	Repeated Comments	New Comments		
	Repeated Comments	New Comments			
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">No of Comments in PR</th> <th style="width: 50%;">No of Comments in NS</th> </tr> </thead> <tbody> <tr><td> </td><td> </td></tr> </tbody> </table>	No of Comments in PR	No of Comments in NS			
No of Comments in PR	No of Comments in NS				

PR=Partial Resubmission; NS=Next Submission

**Engineer :**

Printed Name	Position	Date:	Signature

Encl : \_\_\_\_\_

Cc : \_\_\_\_\_

- The comments are given to ensure the submission conforms to the Contract provisions.
- The issue of Notice of No Objection shall not in any way relieve the Contractor of his obligations under Contract, nor does it in any way imply any change to the Contract Price or Time for Completion.

[illegible]

# ***Maha Metro***



## **Tender Documents**

**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT  
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

### **PART II – EMPLOYER’S REQUIREMENT**

#### **Section VI – Employers Requirement**

##### **Section B - Functional**

June 2018

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## EMPLOYER'S REQUIREMENTS - FUNCTIONAL

### OBJECTIVE

The objective of the Contract is the design, construction completion, testing and commissioning of the permanent works by the Contractor, including without limitation, the design, installation and removal of the Temporary Works, and the rectification of defects appearing in Permanent Works, in the manner and to the standards and within the time stipulated by the Contract. 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.

### B1 GENERAL

- (1) The design and performance of the Permanent Works shall comply with the specific core requirements contained in these Employer's Requirements.
- (2) The design of the Permanent Works shall be developed in accordance with these Employer's Requirements - Functional, the Employer's Outline Design Specifications, the Employer's Outline Construction Specifications, as included in this Contract, other requirements of the Contract and the Contractor's Technical Proposals.
- (3) The Permanent Works shall be designed and constructed to the highest standards available using proven up-to-date good practice. The Contractor's Specification shall in any case not specify standards which, in the Engineer's opinion, are less than or inferior to those described in the Outline Design Specifications and Outline Construction Specifications, Section VII and VIII respectively, and shall be carried out employing the procedures established by the Contractor in his Quality, Safety and Environmental and Interface management plans.
- (4) The Contractor shall be responsible for obtaining all necessary approvals from the relevant agencies in the design and construction of the Works.

### B2 SCOPE OF WORKS

- (1) The Permanent and Temporary works shall comprise the Design and Construction of all Works and services necessary to complete the underground section from Northern end of Budhwar Peth Station to Swargate station (inclusive of two sliding NATM tunnels) of Pune Metro Underground Section, including waterproofing complete as per Contract Outline Design and Construction Specifications and other Contract documents, including, but not limited to, the following:
  - (i) Survey and Investigation including Soil/ground Investigations, Topographic Survey, Existing Building(EBS) Survey, Utilities Investigation, Existing Water Wells/bore wells Investigation as necessary, and
  - (ii) Site clearance, including tree felling, tree transplanting, and the fencing, barricading and securing of the site areas and works areas, and

- (iii) Pre-condition surveys and reports for, and instrumentation & monitoring and protection of Existing Building Structures(EBS), including rebuilding, strengthening/repairing or restoration of any adjacent structures; and
- (iv) The demolition and slicing (wherever required) of existing buildings, and other structures as necessary for the permanent and temporary Works and as approved by the Employer; and
- (v) The surplus excavated material (that cannot be used in the Works), shall be treated as Employers property.
- (vi) The muck/spoil that is acceptable and can be used at a later stage in the Works, shall be temporarily stockpiled in a dumpsite as proposed by the Contractor and agreed by the Engineer and the concerned regulating authorities. The surplus muck/spoil( soil/spoil/material/building debris), which is not acceptable or cannot be accommodated for use in the Works or cannot be made use of by the Contractor for his own purpose, shall be disposed of in approved dumping area(s) ,as per the Stipulations in Employer's Requirements and other Contract documents, including compaction to the desired levels to the satisfaction of the Engineer, and
- (vii) Twin Bored Tunnels of minimum dimensions as stipulated in the Contract for single track railway; and
- (viii) Cross passages complete with auxiliary services and builders works; and
- (ix) Cut and Cover Tunnel/station for crossovers, transitions; and
- (x) Laying first pour concrete and supplying/Providing & Fixing Shear Connectors for Installation of the Rail Track( Track work) in tunnels and station areas(complete Contract package length); and
- (xi) Maintenance walkways and railings and stairs/steps/ladders within tunnels and station areas including subways leading into stations ( wherever required) ; and
- (xii) Drainage channels, sumps, pipes and pumps with control panels within tunnels and cross passages and station areas; and
- (xiii) A total of three underground stations which include two mined stations at Budhwar Peth, Mandai and one Cut and Cover Station at Swargate ; , including Building Services, Architectural Builder's Works and Finishes etc. complete in all respects; and
- (xiv) Excavation (soil & rock) for Swargate station along with temporary retaining system (struts/anchors) will be done by UGC-04 Contractor. Whereas the Contractor shall maintain this system for the construction period of permanent station structure. Also the construction of pedestrian subways leading to Stations including excavation, temporary support system and the permanent RCC waterproofed wall will be done by UGC-04 Contractor. Contractor shall do the architectural finishesh, E&M works as well any ventilation requirements for the same.

- (xv) Construction of Swargate Station is in scope of this Contract, whereas, a excavation (including rock excavation) and temporary support system for the same will be done by UGC-04 Contractor.
- (xvi) Structural work for Pedestrian subways shown on Swargate station Tender drawings will also be done by UGC-04 Contractor. This includes excavation, support system and permanent wall construction for pedestrian subways. Whereas, Contractor will have to provide the architectural finishes, E&M and any ventilation requirements for the same.
- (xvii) Turn back/stabling sidind tunnels ( 2 No.) at southern end of Sawargate Station, Cross over section at Sawargate station built with NATM technic of construction including Building Services, Architectural Builder's Works and Finishes etc. complete in all respects; and
- (xviii) Entrances, entrance tunnels and subways leading into the stations, including underground and above ground structures, which will require detailed feasibility studies and approval(s) from statutory authorities; consultation/consent with/of Heritage Committee will be required for those structures which are to be located in the vicinity of heritage structures falling on alignment of this package ; and
- (xix) Swargate development plan shall be well integrated with Swargate underground station by means of subways/foot over bridges as shown in Employers Drawing along with the required Building Services ( the details of which shall be determined at the detailed design stage), Architectural Builder's Works and Finishes etc. complete in all respects including all provisions required for installation of ventilation system by the Ventilation and ECS Contractor, and
- (xx) Subways underneath roads, new and replacement (if any), including the provision of temporary at grade or elevated road crossings where necessary.
- (xxi) Underground and above ground ancillary structures/facilities including ventilation shafts, plant rooms (including that for chillers plants, Cooling towers, air-cooled chillers, DG sets, water tanks and pumps etc.)etc.; and
- (xxii) Location, diversion(both temporary and permanent), Protection, temporary support and reinstatement/relocation of charted and uncharted utilities to the satisfaction of the concerned Utility Company/authority and Engineer; and
- (xxiii) Traffic management and road works, both temporary and permanent including diversions of roads and footpaths, temporary decking, pedestrian walkways, subways and footbridges, and restoration of pavements and road facilities, etc.; and
- (xxiv) Identification, monitoring, protection and/or removal of existing water wells, ; and
- (xxv) Reinstatement of external works areas in accordance with Section D,

Clause D19; and

- (xxvi) All Temporary works necessary (including tunnel segment casting yard and batching plants) and equipment, including the tunnel boring machine etc.; and
- (xxvii) Water, sewer and drainage works at station as well as tunnels(including cross-passages) including channels, drains, sumps, pumps, ejector pumps, piping, floor traps and floor wastes and its accessories complete in all respects and as per the Contract stipulations; and
- (xxviii) Make all provisions for accommodating the requirements for LV and MV supply routes for Interfacing Contractors and cable galleries/cable ways/inserts to fix for all the cableways/cable trays, or equipment's at the stations and tunnels etc and as per the Contract stipulations; and
- (xxix) Supply, delivery, installation and functional testing of earth mat and embedded earthing cables etc; and
- (xxx) Water Supply at each station with alternative facilities (bore wells with pumping equipment, facilities etc.) to draw ground water whenever there is a short fall of authority water. The System shall include potable water system, water system for fire fighting, cooling water make up system(water requirement for ECS system), water supply system for plant and equipment, water supply system to toilets, storage tanks etc and as per the Contract stipulations; and.
- (xxxi) Supply, installation and testing of Pumps incl. sump pumps (including level controllers) and pipes for Plumbing, drainage/sewerage etc and as per the Contract stipulations; and
- (xxxii) ~~Design, manufacture, supply, install, testing and commissioning of LV switch board in Auxiliary Substations at both ends of the stations including Power factor correction equipment for U/G Stations, Incoming power supply arrangement from the secondary of the Transformer in ASS (Transformer shall be supplied under Power supply and Traction Contract) to the respective LV switchboards through bus ducts /cables which shall be rated to cater to 100% load of the entire station and the corresponding Tunnel Portion including termination of cables/bus duct at both ends-(this work in strikeout font in ASS room is under the scope of TVS/ECS Contractor) and as per all the Contract Stipulations; and~~
- (xxxiii) Design, manufacture, supply, install, testing and commissioning of Power supply arrangement from each LV Switchboard located in Auxiliary Substations( or as required) to their respective Main Distribution Board and to the sub-Main Distribution Board (located in MDB Rooms or as required) through cables/ bus duct on the other end of the platform in order to maintain 100 % redundancy supply, with each MDB designed to cater to

- 100% load of the station and the corresponding Tunnel Portion, including termination of cables/bus duct at both ends and as per the Contract Stipulations; (All LV switchboards in ASS room including Capacitor Panels is under the scope of TVS/ECS Contractor) and
- (xxxiv) ~~Design, manufacture, supply, install, testing and commissioning of Main Distribution Boards including built-in CO<sub>2</sub> trace tubing fire suppression System with dual incoming at both ends of the Platform ( or as required) suitable for 100 % redundancy supply and as per the Contract Stipulations; (this work in strikeout font in ASS room is under the scope of TVS/ECS Contractor) and~~
- (xxxv) ~~Design, manufacture, supply, install, testing and commissioning of Emergency Distribution boards including built-in CO<sub>2</sub> trace tubing fire suppression System located in MDB Rooms ( or as required) for Generator Power supply distribution with change over arrangements (this work in strikeout font in ASS room is under the scope of TVS/ECS Contractor), Generator back up power supply arrangement for essential loads; and~~
- (xxxvi) Design, manufacture, supply, install, testing and commissioning of Generators to be located at appropriate locations depending upon the land availability at street level or inside the station box, AMF Panels and Fuel tanks for essential loads and as per the Contract Stipulations ;and
- (xxxvii) Design, manufacture, supply, install, testing and commissioning of Incoming cables from the AMF panel of the Generators to Emergency Distribution Board located in MDB room ( or as required) and as per the Contract Stipulations; and
- (xxxviii) Design, manufacture, supply, install, testing and commissioning of Incoming power supply to MCCs / Control Panels / Control Desk (for Tunnel Ventilation and Station Smoke Extraction System, Chillers, Cooling Towers and other ECS Equipment, Fire Water and Fire fighting pumps, Station and Tunnel Drainage / Ejector System etc.) from the Main Distribution Board / Emergency Distribution Boards up to the incoming breakers / switches including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
- (xxxix) Design, manufacture, supply, install, testing and commissioning of Power supply arrangement to UPSs with dual Battery Banks from the Main Distribution Board / Emergency Distribution Boards up to the incoming breakers / switches including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations ;and
- (xl) Design, manufacture, supply, install, testing and commissioning of Un-interrupted Power Supply UPSs with dual Battery Banks and UPS DB and as

- per the Contract Stipulations; and
- (xli) Design, manufacture, supply, install, testing and commissioning of Power supply arrangement from UPSs to UPSs DB from the Main Distribution Board  
/ Emergency Distribution Boards up to the incoming breakers / switches including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
  - (xlii) Design, manufacture, supply, install, testing and commissioning of Normal / Emergency/ UPS Power supply to M&E SCADA , BMS SCADA , PST SCADA ( where applicable) and TVS SCADA Systems from the Main Distribution Board / Emergency Distribution Boards up to the incoming breakers / switches including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
  - (xliii) Design, manufacture, supply, install, testing and commissioning of Lighting, Power and other Sub-Distribution boards and as per the Contract Stipulations; and
  - (xliv) Design, manufacture, supply, install, testing and commissioning of Normal and Emergency Power supply arrangement for station services viz. Signages , hand rail guide lights (with UPS power supply) for Staircases, from the Main Distribution Board / Emergency Distribution Boards up to the incoming breakers / switches including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations ; and
  - (xliv) Design, manufacture, supply, install, testing and commissioning of Normal and Emergency Power supply arrangement for station (including subways leading into stations) Fresh Air system, Compressors of pneumatic air dampers etc. (MCC, Control panels, Compressors and AHUs are under the scope of TVS and ECS Contractor's scope of supply) from the Main Distribution Board / Emergency Distribution Boards up to the incoming breakers / switches including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
  - (xlvi) Design, manufacture, supply, install, testing and commissioning of Power supply to Leakage Detectors in the raised floor to detect condensation of water at rooms provided with raised floors in stations from the Main Distribution Board / Emergency Distribution Boards up to the incoming breakers / switches including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
  - (xlvi) Design, manufacture, supply, install, testing and commissioning of Normal

and emergency Power Supply to (excluding Distribution board/Control Panels feeding Power provided by respective Project/Systems Contractors) to Signal, Telecom, AFC equipment; Platform Screen Doors, including, power

and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations ; and

- (xlvi) Design, manufacture, supply, install, testing and commissioning of Power supply to Domestic water Pump system, motor control center including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations ; and
- (xlix) Design, manufacture, supply, install, testing and commissioning of Normal and Emergency Power supply to Lifts and Escalators (up to and including Isolators) including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
- (l) Design, manufacture, supply, install, testing and commissioning of Power supply arrangement for station Security equipment viz. Baggage scanners, Metal Detector System, Monitors and recording equipment's, Battery Charging facilities for Hand held scanners etc. at the Concourse entrances of all U/G Stations including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
- (li) Design, manufacture, supply, install, testing and commissioning of Low voltage cabling including termination at both ends up to switchboards / Motor control centers of Fire water supply and fire fighting pumps including, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
- (lii) Design, manufacture, supply, install, testing and commissioning of Lighting (100% during peak hours, 66% during off-peak hours and 33% after revenue hours) etc in Stations and Tunnels with 50% fed from redundant distribution boards, Emergency Lighting and emergency signage lighting (as per the Contract stipulations ) in Underground Stations (including subways leading into stations), backed by UPS supply , including, sub circuit wiring and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations ; and
- (liii) Design, manufacture, supply, install, testing and commissioning of Lighting control panel with all internal wiring and accessories for control provision of 100% during peak hours, 66% during off-peak hours, 33% after revenue

- hours and emergency lighting ( as per the Contract provisions) and as per the Contract Stipulations; and
- (liv) Design, manufacture, supply, install, testing and commissioning of Normal and Emergency Lighting in Tunnels and Intermediate Ventilation Shafts ( if applicable) c/w Fan rooms and Auxiliary substation backed by Power Pack fittings including, movement detectors, over riding switches etc., sub circuit wiring, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
  - (lv) Design, manufacture, supply, install, testing and commissioning of Light fixtures, wall fans, exhaust fans and other such electrical installations as per the Contract Stipulations ; and
  - (lvi) Design, manufacture, supply, install, testing and commissioning of system and equipment required for EMC and Step potential Mitigation and as per the Contract Stipulations; and
  - (lvii) Design, manufacture, supply, install, testing and commissioning of Earthing and Bonding System as per the Contract Stipulations; and
  - (lviii) Design, manufacture, supply, install, testing and commissioning of Lightning Protection System and as per the Contract Stipulations; and
  - (lix) Design, manufacture, supply, install, testing and commissioning of emergency signage including Illuminated Tunnel Evacuation Signage System (ITESS) / Cross Passage Evacuation System (XPES) sub circuit wiring, power and control cables of required length, Grade and size and cable containment including termination at both ends and as per the Contract Stipulations; and
  - (lx) Load flow, short-circuit and protective device coordination studies which shall be prepared by third party consultant engaged by the Contractor and as per the Contract stipulations; and
  - (lxi) Design, manufacture, supply, install, testing and commissioning of Provision of I/O points and accessories for the Electrical Services to Integrate with M&E SCADA and as per the Contract stipulations; , and
  - (lxii) Design, manufacture, supply, install, testing and commissioning of Emergency Power supply to Linear heat sensing cable (LHS) equipment for underground train ways (tunnel and turn back/stabling sidings) complete with all accessories and as per the Contract Stipulations ; and
  - (lxiii) Design, manufacture, supply, install, testing and commissioning of Cable containment systems (Brackets, hangers, cable tray, ducts) for Electrical and all System Contracts( Project Contractors) in tunnel portion including cross-passages and as per the Contract Stipulations; and
  - (lxiv) Design, manufacture, supply, install, testing and commissioning of Addressable Automatic Fire Alarm System c/w Smoke and Heat detectors

- complete with all accessories and as per the Contract Stipulations; Design, manufacture, supply, install, testing and commissioning of Hose reel System, Fire Hose cabinet and all accessories and as per the Contract stipulations; and
- (lxv) Design, manufacture, supply, install, testing and commissioning of Sprinkler System for non-public areas and non electrical rooms of the stations and Intermediate ventilation shaft fan rooms (if applicable) , complete with all accessories and as per the Contract Stipulations; and
  - (lxvi) Design, manufacture, supply, install, testing and commissioning of Wet riser system in Stations and Tunnels, c/w tanks and pumps, Piping and control, complete with all accessories and as per the Contract Stipulations; and
  - (lxvii) Design, manufacture, supply, install, testing and commissioning of Fire Extinguishers (Fire detection and suppression system )complete with all accessories including all other control and safety services within the tunnels and stations etc. and as per the Contract Stipulations; and
  - (lxviii) Design, manufacture, supply, install, testing and commissioning of Clean Inert Gas System for ~~ASS-Switch rooms~~(this work in strikeout font in ASS room is under the scope of TVS/ECS Contractor), Signal Equipment Rooms, Telecommunication Equipment Rooms and PSD Rooms and other rooms as required etc. complete with all accessories and as per the Contract Stipulations ; and
  - (lxix) Design, manufacture, supply, install, testing and commissioning of Breeching Inlet at the ground level station entrance complete with all accessories and as per the Contract Stipulations ; and
  - (lxx) Design, manufacture, supply, install, testing and commissioning of Power supply from MCCs / Control Panels to respective drives / instruments including power and Control cabling and accessories and as per the Contract Stipulations ; and
  - (lxxi) Design, manufacture, supply, install, testing and commissioning of Cable containment and accessories for Fire Protection system cables as per the Contract Stipulations ; and
  - (lxxii) Design, manufacture, supply, install, testing and commissioning of Main Alarm Panel and Repeater Panel, Sub-Alarm Panels and Mimic panels, Fireman's Plan Box as per the Contract Stipulations ; and
  - (lxxiii) Design, manufacture, supply, install, testing and commissioning of Addressable Manual Call Points Alarm bells, strobe lights, beacon lights and emergency signage Alarm bells, , high power illuminator, Visual notifications and emergency signage as per the Contract Stipulations ; and
  - (lxxiv) Water treatment plants for bore well water and
  - (lxxv) Water proofing systems inclusive of protective layers for all underground

structures, and

- (lxxvi) Design and construction interfacing for Air Conditioning and Mechanical Ventilation systems and tunnel/station(including subways leading into stations) ventilation systems including elements of the fire detection and fire fighting systems etc; and
- (lxxvii) Temporary ventilation, air conditioning, plumbing and lighting in stations(including subways leading into stations) , tunnels and ancillary structures etc, and
- (lxxviii) Monitoring systems for all equipment provided/supplied by this Contract.; and
- (lxxix) Design, manufacture, delivery and installation of signage systems; and
- (lxxx) Architectural works at Stations including finishes to Civil Works structures at each station for passengers, operating staff and equipment housing (such as screeding, blockwork, doors/fire doors, floor & wall finishes including handrails & balustrades etc. complete in all respects) and as per the Contract stipulations; and.
- (lxxxix) Provision of intermodal transport facilities, including bus bays and drop off areas and car and two /three wheeler parking at stations (wherever required), and
- (lxxxii) Survey instrumentation, ground treatment, ground and building(EBS) monitoring, risk analysis, settlement prediction, underpinning and protection to existing buildings and structures(EBS) wherever required, preventative and corrective actions, pre-conditional surveys of EBS and reports ; and
- (lxxxiii) Construction and maintenance of the site office for the Engineer's staff, complete in all respects as per the details given in the Employer's Requirements/Contract documents to the satisfaction of the Engineer and the location as suggested by the Employer/Engineer for the duration of Contract, including connection to mains electricity, water, sewerage, drainage, broadband and telephone, landscape, street furniture etc... ;and
- (lxxxiv) Construction and maintenance of new and existing roads and diversions, including restoration to original condition; and
- (lxxxv) Removal, storage and reinstatement of road furniture such as street lighting, traffic signals, bus shelters/stands, footpaths including stone kerbs, boundary walls, horticulture works, and any other work to restore the site to its original condition as stated in the Contract as per current standards and site requirements, as and when possible; and
- (lxxxvi) Retention of those utilities chosen by the Contractor or as approved/agreed by the utility authority and Engineer, , transportation and safe-keeping of retrieved material at the stores of utilities department,

trial pits or other investigations prior to diversion works and restoration of road prior to construction of stations

- (lxxxvii) Provisions for all Interfacing Contractors as stated in the Contract or as required.
  - (lxxxviii) Other works as stated or implied in the Employers Requirements, Outline Design and Outline Construction Specifications and Employer's Drawings etc.
- (2) The following are examples of works which are to be designed, supplied, installed, and commissioned by Interfacing/designated Contractors, with whom the Contractor shall co-ordinate all interface requirements at the design stage, during the construction stage and for integrated testing activities. However, making provisions for all their requirements, including, but not limited to, fixing points, openings/cut outs, etc., shall be in the scope of this Contract UGC-02.
- (a) **Design and Construction of Underground Stations at Budhwar Peth, Mandai and Swargate.** The Contractor will have three Stations and tunnels from northern end of Budhwar Peth station to Swargate station. The Contractor will have civil and MEP works interface with the adjacent Civil Contractor at Budhwar Peth Station. Contractor UGC-01 shall be allowed to retrieve the Tunnel Boring Machines from northern end of Budhwar Peth station. In which case the Contractor shall interface with each other, and UGC-02 shall design and construct the required facilities in the Budhwar Peth's station's temporary and permanent Works for this purpose such that all the enabling works and the designs and construction of Budhwar Peth station are fully coordinated for ensuring compatibility and meeting construction programmes of the two contractors and as approved by the Engineer. UGC-02 Contractor shall give access to UGC-01 for retrieving TBM as per the requirement of Noticed retrieval scheme.
- Further , the E & M equipment in the tunnel such as Tunnel Lighting, Illuminated Tunnel Evacuation Signage System (ITESS) / Cross Passage Evacuation System (XPES) sub circuit wiring , Tunnel fire hydrants etc are fed to half the length of the tunnel from either station in order to reduce the voltage drop / pressure loss and hence the Contractor shall have interface with the adjacent Civil contractor at Budhwar Peth station i. e. with the contract package UGC-02 (Design and Construction of Underground Stations at Budhwar Peth, Mandai and Swargate and Tunnels from Budhwar Peth to Swargate station). Cables and pipes from the tunnels (north of Budhwar Peth station) shall need to run upto the distribution board / pumps etc which are well inside the Budhwar Peth Station to be designed and constructed by the UGC-02 Contractor. Interfacing related to routing, spacing etc between the two adjacent contractors are critical; and
- (b) Design and construction of track works for the Corridor including

plinth/slab ballastless track, ballast, sleepers, rails, etc

- (c) Railway Electrification and power supplies, Traction Power including OHE fixtures and auxiliary substations and SCADA (HV).
  - (d) Design, manufacture, supply, install, testing and commissioning of Signalling and Train control, Communications and PSD systems.
  - (e) Design, manufacture, supply, install, testing and commissioning of automatic fare collections system.
  - (f) Design, manufacture, supply, installation, testing and commissioning of lifts and escalators, and associated systems.
  - (g) Design, manufacture, supply, installation, testing and commissioning of Ventilation and Air Conditioning systems (Tunnel Ventilation System and Environmental Control System). Procurement of Rolling Stocks including design, manufacture, supply, testing and commissioning of Electric Multiple Units (EMUs). Design, manufacture, supply, install, testing and commissioning of LV switch board (including built-in Clean agent based trace tube type Gas suppression system) in Auxiliary Substations at both ends of the stations including Power factor correction equipment for U/G Stations, Incoming power supply arrangement from the secondary of the Transformer in ASS (Transformer shall be supplied under Power supply and Traction Contract) to the respective LV switchboards through bus ducts /cables which shall be rated to cater to 100% load of the entire station and the corresponding Tunnel Portion including termination of cables/bus duct at both ends.
  - (h) Station Security Systems
  - (i) Any other designated/interfacing Contractor as decided by the Employer.
- (3) The Contractor will be required to provide access from ground level to track level and inside the underground stations as per the requirements of the Interfacing/designated Contractors which are to be determined by the Contractor. Storage and access will be required for various activities including unloading of; rails and other track materials, vehicles for laying track, pulling cables, installing Interfacing Contractors' equipment, etc.. Any openings are to be closed off by the Contractor on completion of the access as per the programme agreed with the Interfacing/designated Contractors and duly Noticed by the Engineer.
  - (4) The Contractor shall be responsible for obtaining approval for the designs of the stations and structures (both underground and above ground) by all relevant civic authorities including Heritage Committee having jurisdictional authority wherever required.
  - (5) The Contractor shall be responsible for obtaining relevant certificates or clearance from local civic Authorities including Maharashtra Fire Services, wherever required.

### **B3 ALIGNMENT**

- (1) The alignment shall be as shown in the Employer's Drawings. The alignment has been developed by the Employer to meet operational and technical criteria. The Contractor is not required to evaluate the alignment for compliance with these criteria, but shall review, verify and validate it with respect to his own design and construction proposals and shall also satisfy himself that there is no conflict with any existing structures (both underground and above ground) which are to be preserved. However, as a result of Contractor's detailed topographic survey, verification, staking and setting out of the alignment at site, any error/mismatch/conflict etc. is detected in Employer's alignment Drawings, the Contractor shall undertake the required modifications in the alignment as agreed by the Engineer and as stipulated in the sub-clauses below without any additional cost or implications to the Employer.
- (2) The Contractor is permitted to propose deviations in alignment to suit his construction proposals or rectify any error/mismatch/conflict etc detected in the Employer's Drawings, but he must demonstrate that any such deviations do not reduce the technical and operational performance. The Contractor needs to verify the Contract boundaries while proposing any change in vertical and/or horizontal alignment but such deviations shall require a Notice of No Objection from the Engineer subject to the following conditions:-
  - There is no extra cost to the Employer,
  - Changes proposed are absolutely essentially to suit the Contractor's specific design or rectify any error/mismatch/conflict etc detected in the Employer's Drawings.
  - There is no change at the Contract boundaries or if there is any, the same is agreed by the Interfacing Contractors including the Contractor of the adjoining section (Civil Contractor of the adjacent contract package) without any extra cost to the Employer.
- (3) The Contractor should note the existing land constraints outside of the station boundaries as shown on the drawings, and that no further land will be made available by the Employer.

### **B4 CLEARANCES**

- (1) The Permanent Works shall not infringe the Structure Gauge as shown on the drawings in the approved Schedule of Dimensions (SOD) of the project. Extra clearance shall be provided on curved alignment as per the approved Schedule of Dimensions. The draft SOD is appended in Appendix 18 of this Employers Requirement.
- (2) The Permanent Works shall provide for the installation by the Interfacing Contractors of operating equipment for the railway and without infringement of the Structure Gauge.
- (3) Railway clearances: Various clearances shall be provided as per the approved Schedule of Dimensions.

(4) Construction limits:

- (a) The limits of land for the Works are shown on the Employer's Drawings. The Contractor shall design the Works to be contained totally within these limits, respecting the regulations concerning construction and property boundaries of the local Authorities. In the event that the Contractor, having used his best endeavours, is unable to design the permanent works and utilities to be contained totally within these limits, then the Employer will obtain the necessary additional land or the Contractor may be required to redesign the structure as instructed by the Engineer, at no extra cost to the Employer.
- (b) The limits of land as shown in the Employer's Drawings may undergo changes after final survey and the Contractor shall make any adjustments necessary to the design to acknowledge the changes to the limits as then defined.

**B5 DESIGN LIFE**

The design life of the Permanent Works for civil engineering structures shall be 120 years.

**B6 DURABILITY AND MAINTENANCE**

- (1) The Permanent Works shall be designed and constructed such that, if maintained reasonably and in accordance with the Contractor's statement of maintainability contained in the Contract, they shall endure in a serviceable condition throughout their minimum lives as described in the Outline Design Specifications.
- (2) The Permanent Works shall be designed and constructed so as to minimise the cost of maintenance whilst not compromising the performance characteristics and ride quality of the railway.

**B7 OPERATIONAL REQUIREMENTS**

- (1) The Permanent Works shall be designed to permit the railway to operate satisfactorily at a maximum operating speed of 80km/hr (design speed being 90 Km/hr) where applicable.
- (2) The vertical and horizontal alignments for the main line trackwork shall comply with the conditions laid in Clause B3 (1) & (2) of these Employer's Requirements, Functional.
- (3) Particular attention shall be paid to locations where flooding could enter station or tunnel areas. In particular,
  - (a) Construction of surface water drainage systems including plinths and ducts shall be avoided in the vicinity of Auxiliary substations to obviate any risk of flooding of electrical equipment areas.
  - (b) Entrances and all other points of access to the station and tunnel areas shall be adequately protected against flooding.
  - (c) Equipment rooms and pits for lifts, escalators and other facilities shall be adequately protected against flooding.
- (4) During construction the Contractor shall be responsible for providing and maintaining adequate flood protection to ensure protection of the Works and for all adjacent areas, buildings and structures within the vicinity of the Works.

- (5) In the design and construction of the Works, the Contractor shall, as a fundamental objective and as a priority, ensure that passengers, staff and the public will, throughout the operational period of the Pune Phase – I underground section (agriculture College to Swargate) , and within the confines thereof, be provided with as safe an environment as is reasonably possible. The Contractor's attention is directed to Clause B18 of these Employer's Requirements – Functional, concerning the role of the Commissioner of Metro Railway Safety.
- (6) The design of the Works shall be such that the Forecast Passenger Flows, as approved by the Employer , can be met without congestion occurring and without risk to the safety of passengers or railway employees including during any emergencies. Exits and passages, in particular, should be suitably designed and provided.

#### **B8 FUNCTIONAL REQUIREMENTS OF STATION ECS/TVS SYSTEM**

- (1) The detailed design, layout, supply, installation and commissioning of Tunnel Ventilation System (TVS) and Environmental Control System (ECS) including system sizing shall be undertaken by another Project Contractor. The Environmental Control System shall include, as a minimum, the air-conditioning of station public areas, electronic and control rooms and other designated rooms; mechanical ventilation of plant rooms, toilets, stores etc., smoke control and extraction system in stations (including subways leading into stations) .
- (2) The Contractor shall be responsible for providing plant rooms, plinths, supports, anchors, delivery routes, system cable containment, power supplies, drainage connections and other provisions necessary for the installation of the Ventilation and Air Conditioning systems and associated systems(Tunnel Ventilation System and Environmental Condition System), by Interfacing Contractor(s).
- (3) The scope of the Contractor also includes the LV switch board (including built-in clean agent based trace tube type panel flooding system) in Auxiliary Substations at both ends of the stations including Power factor correction equipment for U/G Stations, Incoming power supply arrangement from the secondary of the Transformer in ASS to the respective LV switchboards through bus ducts /cables.

#### **B9 FUNCTIONAL REQUIREMENTS FOR POWER SUPPLY SYSTEM**

- (1) Auxiliary substation shall comprise of 33 KV distribution, switchgear and 33/415 V Transformer and these shall be supplied under Power supply and Traction Contract.
- (2) The Power Supply system in the scope of the Contractor shall be designed to provide a 415 V 3 phase 5 wire including earthed 240 V single phase power supply at all utility points, plant rooms and equipment. The Power Supply System shall be designed to supply power with a variation of  $\pm 6\%$  in the worst case including regulation of the transformer. The system arrangement must be designed for operation at a temperature of 40°C for normal cables and at a temperature of 950°C at two hours for fire survival cables feeding the

emergency circuits.

- (3) The power supply to the equipment required for emergency / very-essential/essential / semi-essential operation must have feeds from the two auxiliary sub-stations (ASS) so that failure of any ASS or single component will not result in a supply disconnection to the equipment. There shall also be a backup Diesel Generator set to meet these loads in emergency.
- (4) The emergency supply system feed through online UPS shall also be protected to withstand fire conditions in case of fires etc.
- (5) The distribution system shall withstand a short circuit in accordance with the design level.
- (6) The power supply scheme shall have a normal operation condition whereby designated loads shall be fed from a designated source only. In case of an ASS failure the supply shall be continuous from the other ASS. On resumption of supply the source condition shall revert back to the normal operation condition.
- (7) All individual components should be readily accessible for maintenance and repair.

#### **B10 FUNCTIONAL REQUIREMENTS OF PUMPING INSTALLATIONS**

- (1) Water pump installations with local control panel shall be designed for unmanned operation, controlled through liquid level controllers, capable of pumping the requisite amount of water to the utility or to the ground / over head tanks.
- (2) The pumping installation shall withstand the corrosive effects of normal water supply, seepage water and sewage and serve for the anticipated life of the equipment. The minimum and maximum discharge velocity for sewage / seepage pumping shall be 1.0 m/s and 2.4 m/s respectively.
- (3) The pipe line size should be such that the velocity head does not exceed the normal static head except for the fire pump which is governed by separate criteria. The valve controls and regulating mechanisms shall be designed for automatic operation.
- (4) The pumps shall have 100% standby arrangement. The centrifugal pumps shall be of self priming type. The efficiency of the pump set shall not be less than 95% of the maximum theoretical efficiency possible for that type of pump.
- (5) All interface provisions with SCADA systems

#### **B11 FUNCTIONAL REQUIREMENTS FOR FIRE PROTECTION SYSTEM**

- (1) Fire Protection shall generally be provided in accordance with the National Building Code of India and NFPA-2017 within the stations, tunnels, and service buildings/ancillary buildings and shall comply with the requirements of the Fire and Emergency Services Regulations.
- (2) The Contractor shall be responsible for the provision of the complete installation including but not necessarily limited to feeder supply storage tanks, fire pumps,

sprinklers, other suppression systems including automatic inert gas flooding system, hydrant and hose reel systems, pipe work, valves, brackets, fittings and sleeves.

- (3) The Contractor shall also be responsible for provision of fire detection equipment including but not limited to local fire panels heat & temperature fire detectors, alarms and linear heat detectors etc. with provision of output information to SCADA systems installed by others (Interfacing Contractors), local fire alarms, smoke detectors and fire shutter actuators.

## **B12 FUNCTIONAL REQUIREMENTS FOR LIFTS AND ESCALATORS.**

The Contractor shall be responsible for providing plant rooms, plinths, supports, anchors, delivery routes, system cable containment, power supplies, power terminal boards, water tapings for sprinklers, drainage connections and other provisions necessary for the installation of the lifts and escalators, and associated systems, by the Interfacing Contractor(s).

## **B13 AESTHETICS**

- (1) The Permanent Works shall be designed to achieve high aesthetic character and wherever possible utilise natural light and provide a 'column' free spacious environment utilising open voids.
- (2) Surface above ground structures shall share a common aesthetic that identifies them as component parts of the Phase-I underground section and conveys a civic dignity befitting the city of Pune.
- (3) Structures in areas of special historic/heritage interest shall be designed to integrate appropriately with existing site features and to convey the architectural theme of the area into the body of the Metro Structure.
- (4) Allowance shall be made to identify and implement a design commonality that includes, but is not limited to materials, finishes and components. .
- (5) For detailed requirements refer to Outline Design Specification.

## **B14 ENVIRONMENTAL CONSIDERATIONS**

The design of the Permanent Works shall be undertaken with high environmental standards as given in Appendix 20 of this Employers Requirement. During construction the requirements for Environmental Protection and Impact Mitigation are also given in Appendix 20.

## **B15 URBAN PLANNING FUNCTIONAL REQUIREMENTS**

- (1) The Station Site Plans shown in the Tender Drawings are based on the urban planning design carried out by the Employer and specific land acquisition plans have been submitted to the Government of Maharashtra State and to the Ministry of Railways for railway land, for approval. The land acquisition initiated to date is therefore based on the entrances, ventilation shafts, ancillary buildings and redevelopment of the site areas etc. as shown on the Employer's Drawings. The Contractor must therefore develop his layouts to suit the available land provided for the metro works.
- (2) Submissions for planning approval for underground, ground and above ground

metro works are to be made by the Contractor to all statutory bodies as applicable.

- (3) The Contractor shall submit applications for permanent connections for utility services i.e. sewerage and drainage and water supplies to PMC (Pune Municipal Corporation)
- (4) Fire clearance applications shall be made by the Contractor to The Maharashtra Fire Services..
- (5) Requests for temporary power supplies for the construction of the Works must be submitted, by the Contractor to The Maharashtra State Electricity Board (MSEB) or the relevant authority/agency. Alternatively separate power supplies may be arranged by the Contractor independent of these agencies , subject to compliance with any necessary statutes,
- (6) In addition a number of agencies are involved in the reinstatement works, permanent road accesses, temporary road accesses, refuse collection accesses, street lighting, traffic management and fire hydrant positions. The Contractor is responsible for obtaining the approvals for these other works.
- (7) The Contractor is responsible for obtaining the approval of applications from the relevant Authorities for the design and construction of works. The Employer will

provide all possible assistance in trying to obtain any permission.

#### **B16 SAFETY AND SECURITY**

##### **(1) Introduction**

The objective is to minimize the potential impact on passengers and minimize dependence on technology and equipment when formulating security and safety plans for each facility. Issues may include, but not be limited to, the following;

- (a) Station perimeter - definition of separation between station operating area and any adjacent structures.
- (b) Appropriate features to support life, safety and security strategy.
- (c) Conformance with appropriate fire and life safety codes
- (d) Provisions regarding sufficient areas and means of egress to facilitate safe movement of passengers and staff at peak times, disrupted conditions and/or emergencies.
- (e) Provisions regarding maintaining tenable conditions during tunnel and station evacuation in the event of an emergency
- (f) Provision of fire detection and alarm systems including fire detection systems, high power illuminator (HPI), or Visual Notification and audible & visible alarms and SCADA for monitoring from the OCC.
- (g) Provision of fire detection and suppression systems (both underground and above ground)
- (h) Access control systems
- (i) Central security control, monitoring and response

(j) Provision of water hydrants for fire safety in stations and tunnels.

(2) Safety Management Methods

Safety in the rail transit industry involves:

- (a) Hazard Identification and Management
- (b) Quantitative Risk Assessment (QRA)
- (c) Design Review
- (d) Traceability from Initial Design to Acceptance Testing (Safety Certification)
- (e) A Separate Safety Management and Reporting Function
- (f) Training of station staff in assessment and management of emergency conditions.

(3) Security

The station operating area and site which comprises the ingress and egress to the station needs to be identified as a separate distinct area within the overall station complex. Safety and security provisions shall be included in the design to address all sections of the separation of the station operating area from the remainder of the station complex and any non-station structure directly adjacent to station operating area.

(4) Station Site Perimeter Security

The boundary of the station operating area is typically at the street level where access is provided, and is determined by the separation of the station operating area from any adjacent structures. This shall be defined as the Station Perimeter. Security provisions for the Station Perimeter shall be as follows:

- (a) Station Entrance Protection – All station entrances and pedestrian access ways that are adjacent to vehicular pathways must be provided with vehicular barriers and high security screens that can be closed and secured.
- (b) Pedestrian access – All pedestrian access either from the street or other exterior areas/sections of the station complex shall be designed as to permit barrier separation from the station operating area in the event of an emergency.

(5) Path of Pedestrian Travel

Security provisions are required at each part of the passenger's movement through the station. The following are the features required at each juncture.

- (a) Station Entrance – provide adequate station information signage in such a way as to not result in passenger queuing at entrances.
- (b) Paid Area – provide in each access point to paid area, infrastructure provisions for at least one of the entrance gates to each access point in the direct area of passenger travel (not segregated into separate area) with the following:
  - Body scan machine, (by others); and
  - Luggage scanning machine (i.e. x-ray scanner on conveyor), by others.

- (c) Entrance to paid area is to be configured so as to permit the operation of this security point without impact on the movement of passengers at the other entrance gates.

(6) Awareness and Training

Public and station staff awareness of the security provisions and requirements of the station's operation is essential in maintaining a viable security program in large and dynamic public facilities like a station. During commissioning and initial operations the Contractor shall provide:

- (a) Awareness Program – Development and implementation of a public safety awareness campaign for staff and passengers at each station regarding the safety requirements and features of the new stations; and
- (b) Training – development and implementation of safety training plan that includes drills and the monitoring and response to life safety emergency conditions.

(7) Emergency Preparedness

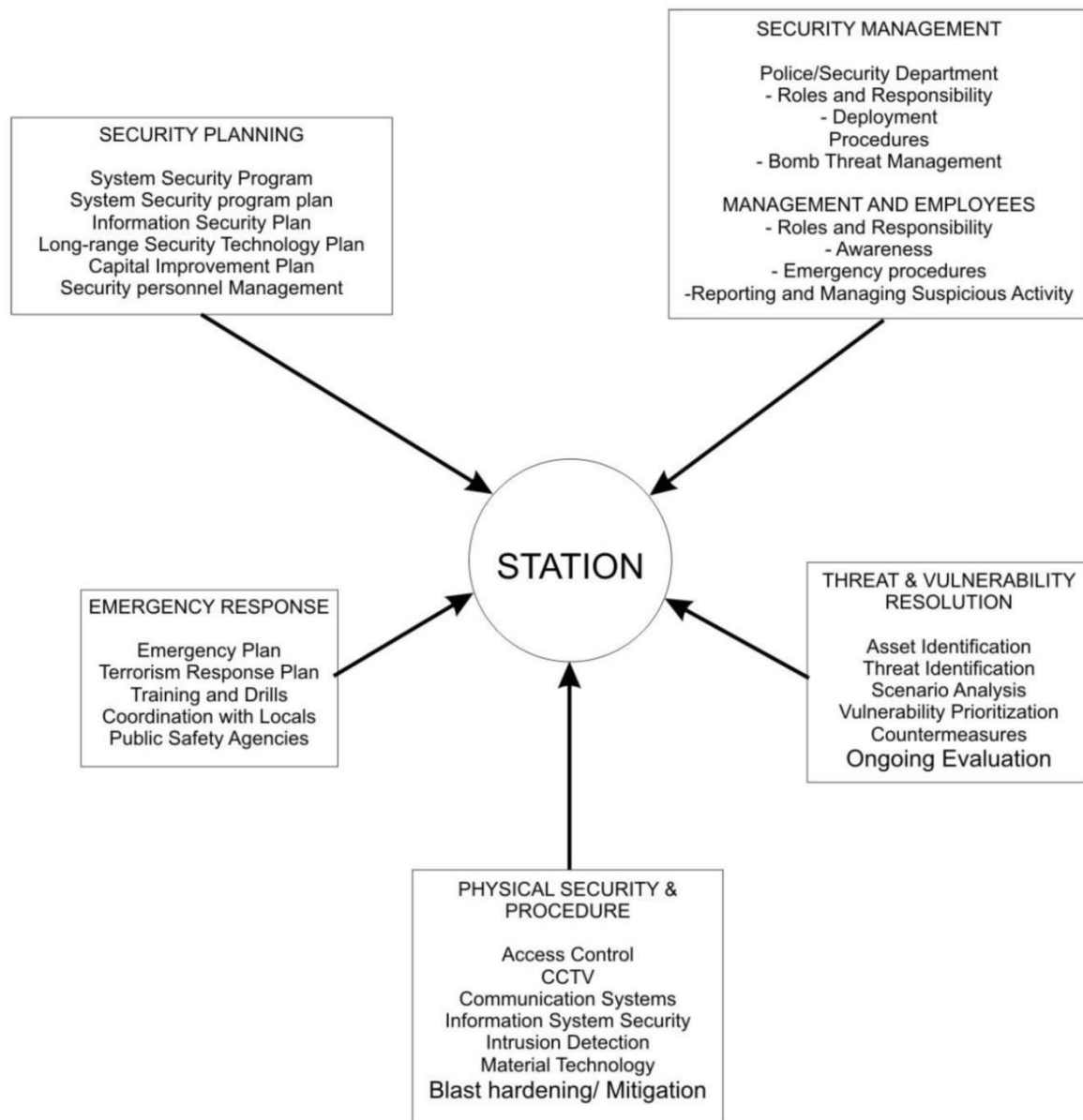
Dynamic temporary threats from non traditional sources also need to be incorporated into the stations emergency response plan. The approach to handling them begins with the definition of the potential threat and the critical assets (e.g. people, operational facilities) whose protection is necessitated by the threat. This is essentially a planning process that produces an emergency response plan. In some cases the analysis may result in physical infrastructure adjustments. However it depends primarily on the physical protection in place from the traditional safety protocols and features such as fire/life safety and an operational strategy that will effectively mitigate the threat. Critical steps in this analysis and planning are:

- (a) Threat assessment
- (b) Evaluation of Asset vulnerability
- (c) Assessment of existing safety and security capability both in physical plant and in existing operations (e.g. available staff at station, police and fire department response capabilities)
- (d) Implementation of additional protocols and physical features to address threat operationally and at physical plant.
- (e) Development of an operational emergency response plan that
  - Incorporates and coordinates existing response capabilities (police and fire) and provides for additional ones (e.g. chemical. Biological)
  - establishes new security procedures and protocols (e.g. training, ongoing planning and review by staff)
  - Define specific response roles for response group and population affected by threat during potential incident
- (f) Reference US Dept of Transportation (DOT) "The Public Transportation

## System Security and Emergency Preparedness Planning Guide”

As part of the planning and design process, the Contractor shall develop a security plan that addresses the static and dynamic security concerns identified by the metro system in conjunction with the PMC (Pune Municipal Corporation ) and other relevant Security agencies for the station and is responsive to the operational requirements of Metro Authority and any other government agencies having jurisdiction over the facility. Below is a diagram that highlights this process for a transit system.

**Figure B1 - Security and Emergency Preparedness Planning Guide**



(8) Mobility Impaired

Areas of refuge will be required on each level that the mobility impaired have access to. They shall be as follows:

- (a) Areas of refuge for the mobility impaired shall be provided within the protected emergency egress staircase enclosure that permits supervised evacuation.
- (b) Two-way communication systems by means of help-point intercom (HPI) in refuge areas.
- (c) Additional equipment such as evacuation chairs, to be provided to assist emergency personnel.
- (d) Tactile Braille signage complying with Handicap requirements shall be located at each door to an area of refuge.
- (e) Visual Notification to the Hearing Impaired

(9) Concessions

For the purpose of establishing fire safety requirements, Concessions shall be classified based on size and use. Small concessions are generally portable. Separated space with rolled down closure stands is generally applied to a fixed concession. Fire rated enclosures are generally required where the concession is a large area along the wall, adjacent to other ancillary rooms within the station requiring fire separation. Concession areas could be designed using concepts of compartmentation, separation and limitation of fire loads or localized extract.

(10) Management and Maintenance

The maintenance and testing of the station fire safety systems is a key factor in maintaining the tenability of the emergency capabilities of the station. Heavily used public facilities such as train station require that an effective maintenance program be developed and implemented to assure viability of equipment and controls. In conjunction with the maintenance, an ongoing training program also must be in place that keeps key station staff current on the management of the various systems that make up the fire and life safety protection for the station.

(11) Design

All electronic safety and security systems must be designed with provisions to facilitate maintenance of the systems. This requires that they have supervisory wiring and adequate monitoring and control. This ensures that every device can be individually tracked to determined status of operation and available power. In addition, in the event that a device fails it should not affect the remainder of the system and repairs and or replacement can be effected expeditiously.

(12) Maintenance

Protocols for the cleaning, repairs and replacement need to be established. It should ensure, adequacy of stock for all fire and life safety systems, detailed regular reporting on conditions of critical systems and identification of staff and outside vendor resources required to keep system in an acceptable state of repair.

Automated maintenance monitoring systems that are part of overall station maintenance should incorporate these requirements.

(a) Management

The management of the station should have a distinct program that addresses security and fire and life safety. There should be dedicated staff to oversee this operation that will ensure that:

- Extensive testing and monitoring and certification protocols for all equipment and systems are established
- All staff is adequately trained for the operation and assessment of this equipment and procedures
- Emergency preparedness plans are developed and maintained and that all appropriate staff is properly informed and hierarchy of responsibility is clearly defined in an emergency.
- Adequate communication channels are maintained with other METRO SYSTEM facilities and the local security and fire safety agencies that can respond in the event of an emergency.

(b) Training

Fire and life safety systems like all technically complex installations for this type of facility require trained personnel to operate. Just as the management of the trains requires specially trained staff that receives training refreshers to deal with changes in the system and or changes in technology. Initial training should be provided as part of the system installation costs and subsequent training should tie in to ongoing contracts to the vendors maintaining the equipment and systems for the station. The station management should make provision to include the cost of this training as part of their operating expenses.

## **B17 TRAFFIC MANAGEMENT**

The Contractor shall carry out the Works so as to minimise disruption to road and pedestrian traffic. The Contractor shall prepare his traffic management plan based on his proposed construction methodology in co-ordination with Engineer and in conjunction with Pune Traffic Police. He shall comply strictly with the approved plan during construction of his works.

The design shall provide for a minimum of two lanes of traffic in each direction or as agreed with the Engineer and the relevant Authorities, which may require temporary road decking where necessary, which must be fully maintained and safe at all times, and shall be approved by Pune Police Traffic Department. The traffic management plan shall also provide for a minimum of 2m of footpath (or as agreed with the Engineer and the relevant Authorities) adjacent to buildings or thoroughfares for all road diversion schemes.

The Contractor should take into account that the construction of the stations may have to be done in phases to ensure that the traffic management plan provides the minimum

requirement of traffic lanes and footpaths in each direction.

The wheels of all vehicles shall be washed before leaving site to avoid depositing mud and debris on the adjacent roads.

Also refer to Employers Requirement – Construction, Section D9.

#### **B18 SAFETY CERTIFICATION**

The Contractor shall note that the Commissioner for Metro Railway Safety (CRS) will inspect the Works from time to time for the purpose of determining whether the Pune Phase – I underground section (Agriculture College to Swargate) complies, in terms of operational and infra structural safety, in accordance with the Laws of India. The Contractor shall note that CRS approval is mandatory for commissioning the system. Notwithstanding other provisions of the Contract, the Contractor shall ensure that the Works comply with the requirements of CRS in terms of being constructed to the drawings, and shall assist the representatives of CRS in carrying out their inspection duties and also comply with their instructions regarding rectifying any defects and making good any deficiencies.

#### **B19 STANDARDS**

- (1) Equipment, materials and systems shall be designed, manufactured and tested in accordance with the latest issue of International and/or National codes and standards. The Contractor shall submit copies to the Engineer of all codes and standards he intends to use for the Works.
- (2) Reference to standards or to materials and equipment of a particular manufacturer shall be regarded as followed by the words “or equivalent”. The Contractor may propose alternative standard materials, or equipment that shall be equal to or better than those specified. If the Contractor for any reason proposes alternatives to or deviations from the specified standards, or desires to use materials or equipment not covered by the specified standards, the Contractor shall apply for a Notice from the Engineer. The Contractor shall state the exact nature of the change, the reason for making the change and relevant specifications of the materials and equipment in the English language. The decision of the Engineer in the matter of quality will be final.

# ***Maha Metro***



## **Tender Documents**

**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT  
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

### **PART II – EMPLOYER’S REQUIREMENT**

**Section VI – Employers Requirement**

**Section C -Design**

**June 2018**

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## C1 INTRODUCTION

- (1) The Employer's Requirements – Section - C Design, specifies the procedural requirements for the preparation of the design of the Permanent Works. These requirements are subdivided into: **Design Phase, Construction Phase and General Application.**
- (2) In addition to the express requirements herein, the Contractor shall, whenever the Engineer so requests, provide information and participate in discussions that relate to design matters.
- (3) The Contractor shall engage the Lead Detailed Designer who shall undertake and prepare the design of the Permanent Works and Temporary Works. The Contractor shall establish an office for his lead design team near the Site area in Pune. The lead design team shall function from this office and all meetings and discussions relating to design shall be held in this office.
- (4) The Contractor shall ensure that the Designer continues to be represented in Pune at all times by staff whose seniority and experience are to the satisfaction of the Engineer and whose representative is available on the Site as necessary or as required by the Engineer.
- (5) The Contractor shall engage staff from an external consulting firm as a Lead Design Checker. The Lead Design Checker shall not produce any of the design or temporary works designs nor work directly for or report to the Contractor's Project Manager.
- (6) The Contractor shall ensure that at the end of each month, the Lead Design Checker shall issue a written report to the Contractor's Site office, with a copy to the Engineer, covering the status of all designs checked during the preceding month. The format of the Design Checker's monthly reports shall be one to which the Engineer raises a Notice
- (7) The Lead Design Checker shall undertake design checks on the Contractor's designs. All design documents, drawings, plans, calculations and reports produced by the Contractor and Designer shall be checked by the Design Checker, accompanied by two original copies of a 'Design Certificate' as set out in Attachment C1, signed by all parties when the design is submitted to the Engineer.
- (8) The Contractor shall ensure that, as all designs being complex structures and having the potential to affect the safety, quality and durability of the Permanent Works, the Lead Designer shall approve in advance the Contractor's proposed materials and erection and removal procedures and the lead designer shall inspect all temporary works at Site before they are put into use
- (9) The Engineer, and such other parties as he shall give a Notice in writing, shall have full and unrestricted access to the Lead Design Checker, the Lead Designer, and to all persons carrying out the design and checking, and all their data, information, calculations, drawings and records

- (10) The Contractor shall submit his Design Quality Assurance Plan as required in Appendix 6 of this Employers Requirement, for the design required by the Contract.

## **C2 REQUIREMENTS DURING DESIGN PHASE**

- (1) The principal requirements of the Design Phase are the production of the Preliminary Design, production of the Definitive Design and the Construction Reference Drawings. It should be clearly understood that the Contractor's technical proposal which forms a part of this Contract, shall only form the basis for further design development into the preliminary and Definitive Design, subject to the compliance of the design with relevant regulations and standards and conforming to the Outline Design Specifications and all other provisions of the Contract.
- (2) Engineering studies and comparative evaluations shall be performed to ensure that the designs incorporate features to achieve optimum performance. In addition Building Services design, (excluding lifts, escalators, air conditioning and ventilation) shall be reliable, energy and cost efficient with due considerations to local climate and conditions, safety, ease of operation, maintenance, future replacements, etc...
- (3) Preliminary Design  
The Preliminary Design shall incorporate the Contractor's technical proposal which forms a part of this Contract, developed to sufficiently define the main structural elements. In addition general construction methods preliminary Interface Coordination and documentation needed to develop the Definitive Design shall be submitted.
- (4) Definitive Design shall accord with and incorporate the Preliminary Design and shall be the design developed to the stage at which all elements of the structures are fully defined and specified and in particular :
  - (a) calculation and analysis are complete;
  - (b) all main and all other significant elements are delineated;
  - (c) all tests and trials and all selection of materials and equipment are complete;
  - (d) shall take full account of the effect on the Permanent Works of the proposed methods of construction and of the Temporary Works.
  - (e) Interface Management Plan (IMP).
- (5) During the preparation of the Definitive Design, the Contractor shall complete all surveys, investigations and testing necessary to complete the design of the Permanent Works.
- (6) The Contractor shall sub-divide the proposed Definitive Design into Design Packages to be submitted in advance of the Definitive Design Submission and to be identified in the Design Submission Programme. The Design Packages are to relate to the significant and clearly identifiable parts of the proposed

Definitive Design and shall address the design requirements as described herein. The Design Packages shall facilitate the review and understanding of the Definitive Design as a whole and shall be produced and submitted in an orderly, sequential and progressive manner.

- (7) Separate Definitive Design Submissions may be prepared for those major elements to be procured by sub-contract and which sub-contracts include design. Where such work is to be procured by the Contractor on the basis of outline design, design briefs and performance specifications, such documents may be submitted as Definitive Design Submissions.
- (8) Upon issue of the Notice in respect of the Definitive Design Submission, the Contractor shall complete the design in all respects and produce the Construction Reference Drawings, the purpose of which is to illustrate all the Permanent Works and to be the drawings governing construction.
- (9) Construction Reference Drawings shall fully detail the construction of the elements covered by the Definitive Design and shall show in full the Works to be constructed.
- (11) The Contractor shall provide the BIM model developed by him to the system contractor for reference, updates and further 3d modelling of the respective Systems as per the BIM Implementation plan, BIM Execution plan and various BIM Modelling Guidelines (refer to Appendix 22) , necessary to make the system models required to extract working drawings and Asset Information Model for asset management purposes. The Civil contractors shall engage along with system contractor in ongoing 3D review process throughout the duration of the Project. The process may include regular meetings where both the BIM Coordinators from all parties and relevant design decision-making. The Project Manager may attend when necessary.
- (12) During Construction stage, the Final Design Model maintained by the Civil Contractors be issued to the system contractor(s) for reference and development of Asset management System Model at every issuance of revised working drawings, upon the Engineer's request or as per the BIM Execution plan or at least on a weekly basis if there are any changes within the week. As-built models of Architecture, Civil and Structure works as well as Building Services works under the Civil Contract developed, verified and finalized by the civil Contractors and submitted to the Engineer and the relevant system Contractors.
- (13) The Civil Contractor shall ensure that Asset management BIM Deliverables are required to meet the quality assurance guidelines as stated in the BIM Implementation plan, BIM Execution Plan and Various Modelling Guidelines given in appendix - 22. Any deviation of quality assurance guidelines shall be outlined in the BIM Execution Plan for the Engineer's review and acceptance. Civil contractor shall supply original one (1) license including manuals and approved training of all necessary software and any subsequent versions thereof at no extra cost. The software shall include but not limited to Revit, NavisWorks or equivalent.

### **C3 REQUIREMENTS DURING CONSTRUCTION PHASE**

- (1) The principal requirements relating to design during the Construction Phase are the production of Working Drawings, the preparation of technical submissions as

required under the Contract, the compilation of the Final Design and the production of the As-Built Drawings.

- (2) Working Drawings shall be prepared as required under the Contract. They shall be endorsed by the Contractor as being in accordance with the Construction Reference Drawings.
- (3) The Contractor shall endorse the submissions required under the Contract that “all effects of the design comprising the submission on the design of adjacent or other parts of the Works have been fully taken into account in the design of these parts.”
- (4) At least 3 months but not more than 6 months prior to the anticipated date of substantial completion of the Works, the Contractor shall submit the Final Design to the Engineer.
- (5) The Final Design is the design of the Permanent Works embodied in:
  - (a) the latest revisions of the documents comprised in the Definitive Design, taking account of comments in the schedules appended to Notices of No Objection;
  - (b) the latest revisions of the Construction Reference Drawings;
  - (c) the calculations (see Clause C11 herein); and
  - (d) co-ordinated interfaces and such other documents as may be submitted by the Contractor at the request of the Engineer to illustrate and describe the Permanent Works and for which a Notice has been issued.
- (6) The Contractor shall maintain all records necessary for the preparation of the As-Built Drawings. Upon completion of the Works or at such time as agreed to or required by the Engineer, the Contractor shall prepare drawings which, subject to the Engineer's Notice, shall become the As-Built Drawings. All such drawings shall be endorsed by the Contractor as true records of the construction of the Permanent Works and of all temporary works that are to remain on the site. The Contractor shall also show the locations of utilities exposed, relocated, diverted, new or retained.

#### **C4 DESIGN INTERFACES WITH INTERFACING CONTRACTORS**

- (1) The Contractor shall co-ordinate all design and installation work with the various Interfacing Contractors as described in Appendix 19 of this Part 2, section VI.
- (2) The Contractor shall note that a Master Interface Matrix and Interface Coordination Sheets refer Appendix 19, have been developed for the Phase-I underground section. The matrix identifies the lead Interfacing Contractor who shall coordinate the interfaces for all Interfacing Contractors, and the Interface Coordination Sheets describe the details of the interfaces.
- (3) Appendix 19 contains the requirements of the Interface Management Plan (IMP) to be prepared and implemented by the Contractor. The IMP will identify the mechanism by which the Contractor and the Interfacing Contractors will work together to coordinate the design, and construction, of the various elements of

the Project works. The Contractor shall review and update the IMP on a monthly basis.

- (4) The Employer and Engineer will hold Project Quarterly Review Meetings (QRM), at three monthly intervals. The Contractor shall attend these QRM and shall report the progress of his works and the state of his interface with other Interfacing Contractors and shall provide the Engineer with the necessary assistance and information for conducting the QRM. Refer to Clause A18 of this Employer's Requirements - General

## **C5 DESIGN SUBMISSIONS**

### **C5.1 PRELIMINARY DESIGN SUBMISSION**

#### **General**

The Preliminary Design submission shall provide initial design documents for review and shall be sufficiently detailed to show the main elements of the design and documents required for preparation of the definitive design. It shall also include:

- a) the quality assurance plan for design
- b) a review of the outline design criteria
- c) the submission of design manuals
- d) the submission of proposed software
- e) the preliminary equipment layouts and details
- f) the preliminary maintenance analysis
- g) the preliminary off site testing recommendation
- h) the submission of specifications proposed for the Work
- i) the identification of design codes and standards
- j) the CAD procedures
- k) preliminary station layout and sizing
- l) preliminary bored and NATM tunnel sizing
- m) an alignment review
- n) the preliminary construction methodology
- o) the design submission programme (update)
- p) the preliminary traffic management plan
- q) the utility diversion plan
- r) proposed site surveys, existing building surveys and other field surveys
- s) a review of permanent land requirement
- t) the preliminary ground treatment proposal
- u) the preliminary building and structure protection proposal
- v) the preliminary water well monitoring, protection and replacement proposal
- w) the preliminary monitoring plan
- x) the preliminary geological model
- y) an additional ground investigation proposal
- z) the preliminary reinstatement drawings.

### **C5.2 DEFINITIVE DESIGN SUBMISSION**

## **(1) General**

The Definitive Design Submission shall be a coherent and complete set of documents properly consolidated and indexed and shall fully describe the proposed Definitive Design. In particular, and where appropriate, it shall include, but not be limited to, the following:

- (a) the dimensions of all major features, structural elements and members;
- (b) all materials;
- (c) potential forces and movements due to all possible loadings and actions on the structures, and their accommodation;
- (d) all second order effects;
- (e) the layout and typical details of reinforcement in structural concrete members;
- (f) the locations and nature of all relevant joints and connections and details thereof;
- (g) standard details;
- (h) location, geometry and setting-out of all station main elements and features;
- (i) provisions and proposals for construction interfacing with the Interfacing Contractors;
- (j) utilities to be diverted /supported/protected;
- (k) TBM specification, details and erection methods for bored tunnel
- (l) construction sequence and details of NATM tunnels ;
- (m) proposed methods of predicting the ground movements due to work and adjacent to the excavations; and
- (n) predictions of effect on structures due to ground movements and the proposed protective measures to limit the effects to a degree not exceeding the limit as defined under the Outline Design Specifications (Design Criteria).
- (o) Traffic or other civic services affected.
- (p) Cross Passage and Sump arrangements.
- (q) Construction method statement and details for tunnelling under existing structures including removal of obstruction and any necessary underpinning.

## **(2) Drawings**

The Definitive Design Submission shall include drawings that shall illustrate the proposed Definitive Design and in particular shall include, but not be limited to, the following;

- (a) general arrangements of all required rooms and facilities of the stations(including subways leading into stations), including a Finishes Schedule for all rooms and spaces for doors, windows, etc.. and details of all architectural parts necessary to describe design condition and methods of application and construction.
- (b) elevations and perspectives and landscaping;

- (c) layouts and details of structural elements;
- (d) associated fittings;
- (e) slopes and earthworks;
- (f) structural and surface drainage;
- (g) access roads and temporary road works;
- (h) pumping systems
- (i) electrical plant rooms such as UPS, DG set etc.;
- (j) provisions for railway works, electrical and mechanical services and equipment;
- (k) existing and proposed utilities;
- (l) road works and works related to traffic management including decking.
- (m) SEM drawings
- (n) embedded items
- (o) Consolidated Design Drawings
- (p) Tunnel Boring Machines (TBMs) and Back-up Equipment.
- (q) Cross passage and Sump arrangements
- (r) Drawings of tunnelling beneath existing structures
- (s) Cut and cover tunnel and other tunnelling method arrangements

### **(3) Documents**

#### **Contract Specification**

The Specification included in the Contractor's Technical Proposals together with the Outline Design Specification and Outline Construction Specifications shall be amplified so as to specify comprehensively the design and construction of the Permanent Works.

#### **Design Manual**

The Design Manual shall incorporate all design requirements, standards, codes, loading cases, permissible movements and deflections, limit states, design stresses and strains, material properties and all other documents or matters which are relevant to and govern the design. The Design Manual shall refer to all materials, codes and standards used, making clear their specific applications.

The Design Manual shall be produced so that it can be used by those involved in the preparation or review of the design of the Permanent Works as a comprehensive reference text and efficient working document. In addition a Durability Approach and Assessment Report (DARR) as per the provisions in the Outline Design Specification shall form part of the Design Manual.

#### **Interface Design Report on Interfacing Contractors**

This will include the following:

Details of the design and construction of the Works adjacent to other contracts. Details of provisions for the Interfacing Contractors, indicating arrangements for accesses, fixings, casting-in, openings, supports, plinths, decks, manholes, trenches and the like; updated interface management plan relating to design integration and co-ordination.

### **Testing and Commissioning Report**

Details of proposals for testing and commissioning procedures for all relevant elements and equipment contained in the Permanent Works.

### **Maintenance Report**

A report updating the Statement of Maintainability in the Contractor's Technical Proposals and detailing maintenance routines necessary for the achievement of the required lives of the various elements of the Works.

### **Station Planning Report**

The report shall outline the basic characteristics of the station planning adopted by the Contractor, highlighting them in the order of importance. The report shall include the specific characteristics of each station. The report shall also include, but not be limited to, the following:

- A set of CAD 3 dimensional simulated photographs/views for each station showing platforms, concourse and various passenger handling elements of station.
- A 1:250 scale model of each station so made that it can show the interior details of station through various sectional views.
- A computer simulated passenger flow model showing the peak flow, delayed and emergency conditions, for each station. The software shall be able to simulate level of service at platform, concourse, staircases and in queuing areas showing passenger handling from the point of arrival of train on a platform to the next arrival and finally to the exit of station. It should be able to locate the critical areas of the station for expected overcrowding and conflicts in passenger flows.

This software shall be a computer graphic presentation of the station planning done by the Contractor from the point of view of passenger handling and for simulation of emergencies and evacuation it shall be treated as a supplement to the design calculation.

## **(4) SUPPORTING DOCUMENTS**

The Definitive Design Submission shall be accompanied by the following documents, which will be considered by the Engineer in his assessment of the Definitive Design Submission. Where relevant or required, these documents shall be accompanied by a design note stating clearly how information has been used in the design of the Permanent Works.

### **Geotechnical Interpretative Report**

A report including site investigation results and covering the geotechnical interpretation of site investigation work including that undertaken by the Contractor in sufficient detail to confirm and justify parameters used in the tunnel, station and geotechnical designs. The report shall include the full borehole logs and descriptions of confirmatory boreholes drilled by the Contractor.

### **Survey Report**

A report on all survey work undertaken by the Contractor, including checks on mapping, survey stations, co-ordinates and setting-out. Updated topographical and survey drawings shall also be included.

### **Pre-conditional Survey of Existing Buildings**

A report giving a review of the general condition of all existing buildings and structures within the zone of influence, as per the provisions in the Outline design specification shall be made.. The structural record surveys on the buildings and structures within this zone shall be included in this report. Refer to Clause D8(9) of this Part 2, section VI for further details.

### **Existing Buildings and Structures Impact Assessment Report**

An assessment on the risk of damage to the buildings, structures and utilities within the influence zone, as per the provisions in the Outline Design Specification, due to the proposed works shall be included in the report. The possible protective measures that can be deployed shall also be given.

### **Utilities Report**

A report giving details of arrangements and working methods in respect of the existing utilities, including protection measures, support measures, diversions, reinstatements and programme allowances.

### **Water Well Protection and Replacement Report.**

A report giving details of arrangements and working methods in respect of the existing water wells along and adjacent to the alignment, including anticipated zone of influence, protection measures, removals, replacements and programme allowances.

### **Temporary Works Design Report**

A report which provides sufficient information on the design of the Temporary Works to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the assessment of the Definitive Design.

### **Construction / Installation Analysis Report**

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

### **Construction Method Statement**

Various reports which provide sufficient information on the methods of construction and Contractor's Equipment to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the assessment of the Definitive Design.

### **Works Programme Review**

- (i) The Contractor shall, prior to submitting the Definitive Design Submission, review the Works Programme against the current version of the Design Submission Programme.

- (ii) In the event that the Contractor considers that there are any discrepancies or inconsistencies between the Design Submission Programme and the Works Programme, the Contractor shall submit with the Definitive Design Submission his proposed revisions to the Works Programme such that the discrepancies or inconsistencies are removed.
- (iii) The Contractor shall provide details of submissions of the Construction Reference Drawings and the proposed Working Drawings and their anticipated timing during the Construction Phase and shall identify information required from or actions to be undertaken by the Engineer or others which are necessary to permit the completion of the design of the Permanent Works and the Working Drawings. Desired Dates for the receipt of such information or for the completion of such actions required by the Contractor shall be included with appropriate justification.

#### **Report on the Use of Works Areas**

A report updating the proposals from those contained in the Contractor's Technical Proposals for the use of Works Areas, site security and their reinstatement, detailing the station accesses and access facilities.

#### **Report on Tunneling Method**

A report which provides sufficient information on the proposed methods of tunneling, including underneath existing buildings and structures.

### **(5) NOTICES ON DEFINITIVE DESIGN SUBMISSION**

The Contractor may make Definitive Design Submissions and seek separate Notices in respect of:

- (a) The temporary works (e.g. including temporary working shafts) for construction of the underground works.
- (b) All works related to the lengths or sequence of lengths of bored tunnel which will be driven from one location together with any intervening works.
- (c) All works related to each of the underground stations.
- (d) Major elements as identified under Clause C2(6) herein.

The issue of such separate Notices under (a), (b), (c) and (d) above shall be conditional upon the Contractor having demonstrated, to the satisfaction of the Engineer, that the effect of each structure on other structures, utilities, etc., has been fully accommodated in the design.

## **C6 DESIGN SUBMISSIONS - CONSTRUCTION REFERENCE DRAWING SUBMISSIONS**

- (1) The Construction Reference Drawings shall be derived directly from the Definitive Design and shall detail and illustrate in full the Permanent Works. The Construction Reference Drawings shall form part of the Working Drawings to be used for construction purposes.
- (2) Prior to any Construction Reference Drawings Submission, the Contractor shall prepare a full list of Construction Reference Drawings in order to demonstrate,

to the satisfaction of the Engineer, that such Construction Reference Drawings will be sufficient in extent to cover the construction of the whole of the Permanent Works.

- (3) Unless otherwise required by the Engineer, the Construction Reference Drawings need not include bar bending schedules, bar reference drawings, fabrication or shop drawings as well as other schedules or erection drawings which are to be provided by the Contractor during the Construction Phase.
- (4) The Construction reference Drawings shall include Combined Services Drawings, Structural Electrical and Mechanical (SEM) Drawings and Consolidated Design Drawings which shall clearly define the scope, interrelationships and provisions for of all aspects of the Works.

#### **C7 DESIGN SUBMISSIONS - CONSTRUCTION PHASE**

- (1) On the issue of a Notice in respect of the Construction Reference Drawings the Contractor shall produce the proposed Working Drawings. The Working Drawings shall include the Construction Reference Drawings, which may be supplemented by further drawings developed in accordance with the Construction Reference Drawings such as site sketches, bar bending schedules, bar reference drawings, fabrication and shop drawings, construction erection sequences, finishes material list with accompanying specification, and the like. All such drawings shall comply with the requirements of the Contract.
- (2) Prior to submission of the proposed Working Drawings, the Contractor shall endorse the appropriate original paper drawings as "Good for Construction". If the Engineer so requires, the endorsed original shall be submitted to the Engineer who shall, if he has no objection to the contents of the submission, further endorse the original by stating that he has no objection to the proposed Working Drawings. On the endorsement by the Engineer, the original will forthwith be returned to the Contractor as the Working Drawings. Contractor.
- (3) Only the Working Drawings endorsed as in C7 (2) above or those that the Engineer has expressly stated as not requiring his endorsement shall be issued to the Site. The Construction of the Works shall be strictly in accordance with these Working Drawings.
- (4) The Contractor shall finalise details of the proposed method of construction and submit such finalised details to the Engineer for a Notice. The proposed method shall have no adverse effects on the partially completed Permanent Works and shall ensure the Works are statically and, if appropriate, aerodynamically stable.
- (5) The Contractor shall undertake and submit a stage by stage construction sequence and the effect of any Temporary Works and the Contractor's Equipment on the Permanent Works. This analysis shall be in sufficient detail to demonstrate that the Contractor's proposals are safe and have no adverse effects upon any parts of the Permanent Works.
- (6) Hard copies of the As-Built Drawings, endorsed by the Contractor, shall be submitted to the Engineer for a Notice of No Objection in accordance with

Clause 5.6 of GCC and in electronic format using a commercially available CAD program.

## **C8 DESIGN SUBMISSIONS - ASSESSMENT PROCEDURES**

- (1) Submissions of Design Data shall be made and assessed by the Engineer within 28 days of the date of submission, or as otherwise stated in Section VII. The form and detail of the assessment shall be as determined by the Engineer and will not release or remove the Contractor's responsibility for the design under the contract.
- (2) The issue of a Notice shall be without prejudice to the issue of any future Notices.
- (3) The Contractor shall, prior to the submission of the Design Data, obtain all required statutory approvals that relate to that submission including, where appropriate, the approval of the Concerned Government Authorities and utility undertakings, and demonstrate that all required approvals have been obtained.
- (4) All submissions shall be accompanied by two original copies of a 'Design Certificate' as set out in Attachment C1 hereto and signed by the Contractor, the Lead Designer and the Lead Design Checker.

## **C9 DESIGN SUBMISSION PROGRAMME**

- (1) The Contractor shall prepare the Design Submission Programme which is to set out fully the Contractor's anticipated programme for the preparation, submission and review of the Design Packages, Preliminary Design Submissions, the Definitive Design Submission and the Construction Reference Drawings Submissions along with interface Drawing design development of preliminary/definitive/ construction phases and for the issue of Notices in relation thereto.
- (2) The Design Submission Programme shall:
  - (a) be consistent with and its principal features integrated into the Works Programme, and show all relevant Key Dates;
  - (b) identify dates and subjects by which the Engineer's decisions should be made;
  - (c) make adequate allowance for periods of time for assessment by the Engineer and other review bodies;
  - (d) make adequate allowance for the design and development of specialist works;
  - (e) include a schedule identifying, describing, cross-referencing and explaining the Design Packages into which the Contractor intends to divide the Definitive Design and Construction Reference Drawings; and
  - (f) indicate the Design Interface and Co-ordination periods for the Project and Interfacing Contractors during all the 3 stages of design including preliminary, definitive and CRD..
- (3) The Contractor shall submit the Design Submission Programme to the Engineer

within thirty (30) days of the Commencement Date and thereafter up-dated versions thereof at intervals of not more than one (1) month throughout the Design Phase.

#### **C10 PROGRAMME FOR SUBMISSIONS DURING THE CONSTRUCTION PHASE**

In accordance with Clause A4 of Section A of the Employer's Requirements - General, the Contractor shall identify submissions required during the Construction Phase.

#### **C11 CALCULATIONS**

- (1) Unless otherwise required by the Engineer, calculations relevant to the Preliminary Design, Definitive Design and Construction Reference Drawings shall be submitted for assessment with the respective Design Packages or Submissions. The above calculations shall have been certified by the Contractor's Lead Designer and Lead Design Checker before submitting to the Engineer. The Engineer may require the submission of applicable software including in-house software programmes/ worksheets developed by the Contractor and/or designer, computer input and programme logic for his assessment prior to the acceptance of the computer output.
- (2) The Contractor shall prepare and submit a comprehensive set of calculations for the Preliminary and Definitive Design in a form acceptable to the Engineer. Should the design of the Permanent Works be revised thereafter and such revision renders the calculations as submitted obsolete or inaccurate, the Contractor shall prepare and submit the revised calculations.
- (3) Similarly, the Contractor shall submit such further calculations as have been prepared in connection with the Construction Reference Drawings.
- (4) Calculations to be included as part of the submission herein shall comprise the up-to-date calculations in respect of the Preliminary and Definitive Design, the Construction Reference Drawings and such further calculations which the Contractor has prepared during the production of Working Drawings.
- (5) Copies of EXCEL spreadsheets and computer model data files sufficient to regenerate the model and re-run the analysis should be submitted together with the calculations to the Engineer.
- (6) The Contractor shall submit all calculations necessary to support proposals relating to the construction methods.

#### **C12 DOCUMENT REQUIREMENTS**

- (1) Drawings shall be prepared generally to A1 size, but to ISO AO size where appropriate. Appendix 7 of this Employers Requirement defines the Drawings and CAD Standards required for drawing preparation and submittal.
- (2) The Contractor shall submit 6 copies of his design and/or drawings for assessment by the Engineer. After the receipt of a Notice of No Objection from the Engineer, the Contractor shall submit 6 copies of design and/or drawing for the use of the Engineer.
- (3) The submission of drawings may be by CAD Media files and Appendix 7 of this

Employers Requirement specifies the drawing submission requirements for CAD Media files.

## ATTACHMENT C1

### DESIGN CERTIFICATE

**This Design Certificate refers to Submission No. .... which comprises:**

**[\*Design Package No. .... /the Definitive Design Submission/Construction Reference Drawings Submission No. .... /Technical Submission No. ....] in respect of:**

*[description of the Permanent Works to which the submission refers]*

The contents of this submission are scheduled in Section A below.

The documents scheduled in Section B below, for which a Notice of No Objection has been issued, are of relevance to this submission.

### LEAD DESIGNER'S STATEMENT

We certify that:

- (a) the design of the Permanent Works, as illustrated and described in the documents scheduled in Section A below, complies with the Employer's Requirements, Outline Design Specifications, Outline Construction Specifications & other Contract provisions, local regulations and standards and ..... *[see note 1 below]*;

*OR (in the case of a Definitive Design Submission in respect of those elements identified under Clause C2(6) of the Employer's Requirements - Design):*

- a. the outline designs, design briefs and performance specifications of those elements of the Permanent Works as illustrated and described in the documents scheduled in Section A below comply with the Employer's Requirements , Outline Design Specifications, Outline Construction Specifications & other Contract provisions and ..... *[see note 1 below]*;

*OR (in the case of a submission of documents that do not strictly comply with previous documents for which a Notice of No Objection has been received):*

- a. the design of the Permanent Works, as illustrated and described in the documents scheduled in Section A below, complies with the Employer's Requirements , Outline Design Specifications, Outline Construction Specifications & other Contract provisions and ..... *[see note 1 below]* except in the following respects:

(i) ..... (to be completed by Contractor/Designer)

(ii) ..... (etc.)

- (b) A detailed review and design check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the Permanent Works as illustrated and described in the documents scheduled in Section A below;
- (c) all necessary and required approvals relating to the design of the Permanent Works, as illustrated and described in the documents scheduled in Section A below, have been obtained and copies of such approvals are annexed in Section C below;
- (d) all effects of the design comprising the submission on the design of adjacent or other parts of the Works have been fully taken into account in the design of those parts.

Signed by 'Authorised Representative'

(for Designer)

Name

Position / Designation

Date

#### **LEAD DESIGN CHECKER'S CERTIFICATION**

We certify that the Work described in Section A of this certificate has been checked by us, and meets all the requirements of the Contract.

Signed by 'Authorised Representative'

(for Design Checker)

Name

Position / Designation

Date

#### **CONTRACTOR'S CERTIFICATION**

This Certifies that all design has been performed utilising the skill and care to be expected of a professionally qualified and competent designer, experienced in work of similar nature and scope. This further certifies that all works relating to the preparation, review, checking and certification of design has been verified by us and that the design meets all the requirements of the Contract and has been accepted by us vide Clause 4.1 of GCC

Signed by 'Authorised Representative'

(for Contractor)

Name

Position/Designation

Date

#### **Note 1**

*The Contractor shall insert one of the following, as applicable:*

- (i) the Contractor's Technical Proposals
- (ii) the Contractor's Technical Proposals and Design Packages Nos. .... for which a Notice of No Objection has been issued.
- (iii) Design Packages Nos. .... for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.
- (iv) The Definitive Design

## Section A

Submission no. .... comprises the following:

Drawings: *(Title, drawing number and revision)*

Documents: *(Title, reference number and revision)*

Others:

## Section B

Documents for which a Notice of No Objection has been issued and which are of relevance to this Submission No. ....

Document:

submitted with

[\*Design Package No. .... / ..... ) *The Contractor is required to*

the Definitive Design Submission No..... / ..... ) *provide this information in*

Construction Reference Drawings Submission No. .... / ..... ) *respect of each document in*

Technical Submission No. .... / ..... ) *Section B*

Date of Issue of Notice of No Objection )

*(\* Delete as appropriate)*

## Section C

*[Contractor to attach copies of necessary and required approvals of the Municipal Authorities).*

# ***Maha Metro***



## **Tender Documents**

**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT  
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

### **PART II – EMPLOYER’S REQUIREMENT**

**Section VI – Employers Requirement**

**Section D - Construction**

June 2018

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## **D1 CONTRACTOR'S SUPERINTENDENCE**

- (1) The Contractor shall submit a Staff Organisation Plan to the Engineer in accordance with Clause A15 , Employers Requirement - General. This plan shall be updated and resubmitted whenever there are changes to the staff. The plan shall show the management structure and state clearly the duties, responsibilities and authority of each staff member.
- (2) The Project Manager and his site team shall have experience and qualifications appropriate to the type and magnitude of the Works. Full details shall be submitted of the qualifications and experience of all proposed staff to the Engineer for his Notice, which shall be as a minimum those given in Clause A15 of this Employers Requirement - General.

## **D2 CHECKING OF THE CONTRACTOR'S TEMPORARY WORKS DESIGN**

The Contractor shall, prior to commencing the construction of the Temporary Works, submit a certificate to the Engineer, based on the 'Design Certificate' enclosed as Attachment C1 of this Employers Requirement - Design., signed by the Lead Designer and the Lead Design Checker, certifying that the Temporary Works have been properly and safely designed and checked, and that the Contractor has checked the effect of the Temporary Works on the Permanent Works and has found this to be satisfactory.

## **D3 THE SITE**

- (1) Works Areas are those areas identified in Appendix 2A, of this Employers Requirement and on the Employer's Drawings.

### **Use of the Site**

- (2) The Site or Contractor's Equipment shall not be used by the Contractor for any purpose other than for carrying out the Works, except that, with a Notice from the Engineer, the Site or Contractor's Equipment such as batching and mixing plants for concrete and bituminous materials may be used for the Work in connection with other Contracts under the Employer.
- (3) Rock crushing plant shall not be used on the Site.
- (4) The location and size of each stockpile of materials, including excavated materials, within the Site shall be as permitted by the Engineer. Stockpiles shall be maintained at all times in a stable condition.
- (5) Entry to and exit from the Site shall be controlled by 24 hour security and shall be only available at the locations for which the Engineer has given a Notice. Notice will only be given after the Contractor has provided evidence that he has obtained the necessary approvals from the relevant authorities.

### **Access to the Site**

- (6) The Contractor shall make his own arrangements, subject to a Notice from the Engineer, for any further access required to the Site.
- (7) In addition, the Contractor shall ensure that access to every portion of the Site is continually available to the Employer and the Engineer.

- (8) Following the handover of the Works to the Employer, the Employer will be responsible for all matters relating to security and safety therein. Access to the Site by the Contractor shall be in accordance with any procedures, requirements and conditions defined in Appendix 9 of this Employers Requirement.
- (9) The Contractor shall be responsible for ensuring that any access or egress through the Site boundaries are controlled such that no disturbance to residents or damage to public or private property occurs as a result of the use of such access or egress by its employees and sub-Contractors.

#### **Survey of the Site**

- (10) A survey shall be carried out of the Site to establish its precise boundaries and the existing ground levels within it, as detailed in Clause D4 of this section. This survey shall include a photographic survey sufficient to provide a full record of the state of the Site and adjacent areas/buildings before commencing the Works, with particular attention paid to those areas where reinstatement will be carried out later on. The survey shall be carried out before the site clearance and in any case prior to the commencement of work in any Works Area. The survey shall be carried out by the Contractor and will require a Notice from the Engineer.

#### **Barricades and Signboards**

- (11) The Contractor shall erect barricades with gates around his areas of operations to prevent entry by unauthorised persons to his Works and/or Site Areas and necessary identity cards /permits should be issued to all of his workers and staff by the Contractor. The Contractor shall submit a proposal for barricades/gates around the complete perimeter of all Works areas for which the Engineer shall give a Notice. Generally barricade of 2m height with plain MS sheet , with steel frame, painted (including primer of Noticed quality) with synthetic enamel paint of approved color, quality and brand, with logo of Pune Metro and adequate blinking light to allow warning during night Contractor shall carry out re-painting of the entire barricades on an annual basis or sooner as required by the Engineer.

No work shall commence in any Works Area until the Engineer has issued a Notice signifying that he is satisfied that the barricades installed by the Contractor are sufficient to prevent, within reason, unauthorised entry. Project signboards shall be erected not more than four (4) weeks, or such other period as the Engineer has given his Notice, after the date for commencement of the Works.

The types, sizes and locations of project signboards shall be agreed with the Engineer before manufacture and erection. Other advertising signs shall not be erected on the Site.

- (12) A Notice of No Objection from the Engineer shall be obtained before hoardings, fences, gates or signs are removed. Hoardings, fences, gates and signs which are to be left in position after the completion of the Works shall be repaired and

repainted as instructed by the Engineer.

- (13) Hoardings, barricades, gates and signs shall be maintained in clean and good order by the Contractor until the completion of the Works, whether such hoardings, fences, gates and signs have been installed by the Contractor or by others and ownership transferred to the Contractor during the period of the Works. All the fencing, hoardings, gates and signs etc. shall be mopped a minimum of once a week and thoroughly washed once a month.
- (14) All hoardings, barricades, gates and signs installed by the Contractor shall be removed by the Contractor upon the completion of the Works, unless otherwise directed by the Engineer.
- (15) Hoarding/ barricades can be reused after removing from one place to other locations / sites provided they are in good condition and a Notice is issued by the Engineer.
- (16) Damaged/worn-out barricades /hoardings shall be replaced by the Contractor within 24 hours. The Engineer's decision regarding need for replacement shall be final and binding.

#### **Clearance of the Site**

- (17) All Temporary Works which are not to remain on the Site after the completion of the Works shall be removed prior to completion of the Works or at other times as instructed by the Engineer. The Site shall be cleared and reinstated to the lines and levels and to the same or better condition as existed before the Works started except as otherwise stated in the Contract.

#### **Casting Yard**

- (18) The Employer will provide no land for the casting yard. The Contractor shall make his arrangement at his own cost, which is deemed to be included on lump-sum price for the Contract. The Contractor shall submit the proposal for the casting yard site within 14 days from commencement date, and shall comply with the key date provided in Appendix 2B.
- (19) The Contractor shall be responsible for formation of site to desired level, clearing the site of all debris, vegetation and buildings, providing access into the site and providing any utilities or services which may be required for the Contractor's operations
- (20) Contractor upon completion of the Contract the area of land shall be cleared of all debris, structures made by the Contractor, RCC footings and rafts, rubbish and debris, etc... and returned to its original condition before being handing back to the Employer, at no extra cost to the Employer.
- (21) The final Interim Payment Certificate shall only be released to the Contractor after all structures, debris, rubbish, etc.. have been removed from the casting yard/works area and the area returned to its original condition.
- (22) A Mechanical Type Washing Plant shall be installed by the Contractor for the use of all vehicles leaving the casting yard area to avoid any contamination or spillage on the connecting roads. The Contractor shall be responsible for providing access into the sites, clearing the sites of vegetation, removing

unsuitable materials and placing disposal material with suitable compaction.

**Disposal of Excavated Material (muck/spoil from tunnelling and station excavation):**

- (24) The surplus excavated from the station and NATM tunnels (including cross over, siding tunnel, cross passages ) shall be treated as Employers property. Whereas, muck generated from the tunneling operation to be carried out by Tunnel Boring Machine shall be treated as Contractors Property. Method of handling, transportation , place of storage , any processing/reprocessing at a plant(including its location) and its end use shall comply with all the rules and regulations in force including that pertaining to Occupational Health, Safety & Environment (OHS&E) etc and as approved by the Engineer. The Contractor shall submit a detailed proposal to the Engineer for seeking the Engineer's approval for the same.
- (25) The muck/spoil that is acceptable and can be used at a later stage in the Works, shall be notified to Engineer and as directed by him shall be temporarily stockpiled separately in a dumpsite
- (26) The surplus muck/spoil (soil/spoil/material/building debris), which is not acceptable or cannot be accommodated for use in the Works, shall be disposed of at the dumping area(s) only duly fulfilling all the Contract stipulations including compaction to the desired levels to the satisfaction of the Engineer.
- (27) The Employer has identified a muck disposal site located at \*\*\* with a disposal volume capacity adequate to dispose of the spoil/muck generated on this Contract package. This site can be utilized by the Contractor for disposing of surplus muck/spoil.
- (28) For disposing of the spoil/muck at a muck-disposal the Contractor shall take, but not be limited to, the following measures to ensure proper muck/spoil disposal and adequate site rehabilitation:
  - The muck disposal site shall be ecologically restored to the maximum extent possible duly ensuring that the water quality, air quality and the soils and vegetation of surrounding areas are not contaminated.
  - The adequate precautionary measures shall be implemented by the Contractor at disposal site to ensure that there is no possibility of soil erosion and other impacts of loose soils on the local water bodies. ,
  - The Contractor shall ensure that the muck disposal site will be free from active landslides or creeps and will not have a possibility of toe erosion related slope failure.
  - The Contractor shall ensure that disposal of muck/spoil at muck dumping site shall not lead to flooding being caused in the surroundings.
  - The dumped muck shall be mechanically compacted in layers and properly levelled with suitable safe slopes duly ensuring that proper drainage is provided for to eliminate problems being caused due to lack of or improper drainage. In this respect the Contractor shall submit a detailed method statement to the Engineer for obtaining a Notice of No Objection.
  - To protect the dump from getting disturbing by human and domestic

animals activities, fencing shall be provided at the perimeter of the muck/spoil disposal site. The Contractor shall also establish temporary wind barrier around the dump areas to eliminate air pollution being caused due to wind blowing over the dumping site.

- In addition to the measures as stipulated in the Contract elsewhere, the following measures shall also be taken by the Contractor for lorry movement/operations carrying muck/spoil to and from the muck disposal site:
  - All dumpers and trucks shall be well maintained and equipped with tarpaulin sheets and hooks for covering of the loose spoil properly during its transportation.
  - The vehicle speeds on unpaved roads shall be restricted to 25 Kmph.
  - The Contractor shall maintain valid PUC – Pollution under Control certificates and maintain proper maintenance records for their fleet ;
  - Wheel wash system shall be installed and operated at the exit of the muck/spoil disposal , so that the muck on the tyres of the trucks is cleaned properly before they move on the roads to prevent dirtying of the public roads.
  - To control fugitive dust emissions arising during material handling, the heights from which muck/spoil is dropped shall be reduced to a practical minimum height.
  - Dumping shall be avoided during the high speed wind, so that suspended particulate matters (SPM) level could be maintained to the acceptable level.

- (29) The Contractor shall note that the muck disposal site location designated for this Contract package falls in the semi urban area with reasonable road access. However, if good motorable conditions lack either within the disposal site or its approaches during the course of muck-disposal, any attention needed to these roads to make them worthy of Lorries' movement shall be the Contractor's responsibility.
- (30) The Contractor is responsible for obtaining the requisite approvals from the concerned local authorities for his Lorries' movement plan and their operation.
- (31) Any Octroi, Royalty, statutory payments/levies or any other charges etc. payable on the spoil/muck (generated from the tunnel boring machine operation) for its disposal shall have to be paid by the Contractor.
- (32) Whereas, any Octroi, Royalty, statutory payments/levies or any other charges etc. payable on the spoil/muck (generated from the station, NATM tunnel – as explained above) for its disposal shall also be paid by the Contractor, and will be reimbursed in totality by Employer upon the submission of receipts and necessary documents.

#### **D4 SURVEY**

- (1) The Contractor shall establish his own site grid including the benchmarks,

Traverse points, primary and secondary survey control points in the vicinity of the Site areas and relate the construction of the Works to the Grid. The Contractor shall also coordinate and interface with the adjacent Contractors (Civil Contractor(s) of adjacent contract packages for the Project) to ensure that there is no discrepancy of alignment ( both horizontal and vertical) caused due to survey control points, bench marks or coordinate system at contract boundaries with the adjacent Contractors for compatibility.

- (2) Before the Contractor commences the setting out of the Works, the Engineer will provide a drawing showing the position of each survey reference point and bench mark, together with the co-ordinates and/or level assigned to each point, that were used in developing the Employer's Drawings, for information only. The Contractor shall carry out detailed survey to check the proposed alignment maintaining vertical and horizontal clearances. In case of any differences from the Employer's drawings or data, the Contractor shall bring these to the Notice of the Engineer immediately and submit his proposals for correction. The Engineer shall either, issue a Notice, modify or ask the Contractor to resubmit the proposals within a period of 14 days. The Contractor shall satisfy himself that there are no further conflicts between the data given and the survey control/reference points & bench marks established by him and all the conflicts (including with the survey data of adjacent Contractors) have been satisfactorily resolved. All such proposals for correction prepared by the Contractor and all such rectification works undertaken by the Contractor to resolve/eliminate all such differences/discrepancies/conflicts in survey data of the Employer/adjacent contractor and the Contractor shall not entitle the Contractor for any claims or extension of Contract schedules and all the necessary works in this regard shall be done by the Contractor without any cost or time implications to the Employer. The Contractor shall also establish and provide all subsidiary setting out points, monuments, towers and the like which may be necessary for the proper and accurate setting out and checking of the Works.
- (3) The Contractor shall carefully protect all the survey reference points, bench marks, setting out points, monuments, towers and the like from any damages and shall maintain them and promptly repair or replace any points damaged from any causes whatsoever. The Contractor shall recheck every three months, the position of all setting out points, bench marks and the like, for a Notice by the Engineer.
- (4) The setting up of the accurate Contractor survey reference points and maintaining them shall be the responsibility of the Contractor. The Contractor shall check the survey reference points every three months to ensure that these survey points continue to remain consistent with the bench marks.

## **D5 OCCUPATIONAL HEALTH SAFETY AND ENVIRONMENTAL REQUIREMENTS**

The Contractor shall comply with the conditions and requirements stipulated in the Occupational Health, Safety & Environment (OHS&E) Plan contained in Appendix 20 of

this Employer's Requirements and in Part 4, Reference Documents.

#### **D6 OTHER SAFETY MEASURES**

- (1) The Contractor shall take all reasonable precautions and select appropriate tools, equipment and installation methods to avoid causing a nuisance arising from his operations and shall minimise inconvenience to the public.
- (2) The Contractor shall prevent dust from rising as a result of his activities and shall take all necessary dust control and suppression measures.
- (3) All Contractor's Equipment used on the Contract shall be fitted with a means of suppressing radio and television interference and shall be operated and maintained in such manner so as to minimise the emission of smoke and obnoxious fumes.
- (4) The Contractor shall be responsible for the security of the Site at all times during the term of this Contract. The Contractor shall control all entry and exit to and from the Site for his personnel, personnel from the Employer, Engineer, Interfacing Contractors, Sub-Contractors and suppliers, by pedestrians and for all vehicles. All of the Contractor's personnel shall be required to carry an identity/security card or pass which provides a positive photo identification and they shall be required to show the pass when entering or leaving the Site. This shall apply to all personnel on the Site including, but not limited to, the Contractor's staff, all Interfacing Contractors, Sub-Contractors staff, Suppliers, Consultants, etc.. and the staff of the Employer and Engineer. Provision shall be made for issue of visitors' passes for other personnel authorized to enter the Site as visitors. Visitors on Site shall be escorted by appropriate Site based personnel at all times.
- (5) The Contractor shall be deemed to have made allowance in his price and programme for the impact on the Works as a result of any delay due to the provision of access to, and through the site generally, for Interfacing Contractors, relocation of temporary works, provision of security, lighting, signage, barriers, trackwork crossings, complying with all government and local authority regulations, etc...
- (6) No tunnel boring machine shall be used without a Notice of No Objection being issued by the Engineer.
- (7) The Contractor shall prepare a detailed specification for the operation of each tunnel boring machine for submission to the Engineer for a Notice.

#### **D7 CARE OF THE WORKS**

- (1) Unless otherwise permitted by the Engineer all work shall be carried out in dry conditions.
- (2) The Works, including materials for use in the Works, shall be protected from damage due to water. Water on the Site and water entering the Site shall be promptly removed by temporary drainage or pumping systems or by other methods capable of keeping the Works free of water. Silt and debris shall be

removed by traps before the water is discharged and shall be disposed of at a location or locations to which the Engineer has given Notice.

- (3) The discharge points of the temporary systems shall be as per the Notice of the Engineer. The Contractor shall make all arrangements with and obtain the necessary approval from the relevant authorities for discharging water to drains, watercourses, etc. The relevant work shall not commence until the approved arrangements for disposal of the water have been implemented.
- (4) The methods used for keeping the Works free from water shall be such that settlement of, or damage to, new and existing structures does not occur.
- (5) Measures shall be taken to prevent settlement, damage, floatation, etc.. to new and existing structures.

#### **Protection of the Works from Weather**

- (6) Work shall not be carried out in weather conditions that may adversely affect the Works unless proper protection is provided to the satisfaction of the Engineer.
- (7) Permanent Works, including materials for such Works, shall be protected from exposure to all weather conditions that may adversely affect such Permanent Works or materials.
- (8) During construction of the Works storm restraint systems shall be provided to ongoing construction works, where appropriate. These systems shall ensure the security of the partially completed and ongoing stages of construction in allweather conditions. Such storm restraint systems shall be installed as soon as practicable and shall be compatible with the right of way, or other access around or throughout the Site.
- (9) The Contractor shall, at all times programme and order progress of the Works and make all protective arrangements such that the Works can be made safe in the event of storms.

#### **Protection of the Work**

- (10) The finished works shall be protected from any damage that could arise from any activities on the adjacent site/ works.

### **D8 DAMAGE AND INTERFERENCE**

- (1) Work shall be carried out in such a manner that there is no damage to or interference with:
  - (a) watercourses or drainage systems;
  - (b) utilities;
  - (c) structures (including foundations), roads, including street furniture, or other properties;
  - (d) public or private vehicular or pedestrian access;
  - (e) monuments, trees, graves or burial grounds other than to the extent that is necessary for them to be removed or diverted to permit the execution of the Works, as approved by statutory authorities, etc.

- (f) Heritage structures (wherever applicable) shall not be damaged or disfigured on any account.

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

- (2) Items which are damaged or interfered with as a result of the Works and items which are removed to enable work to be carried out shall be reinstated to the satisfaction of the Engineer and to the same or better condition as existed before the work started and with minimum time loss.

#### **Utilities**

- (3) Refer to Appendix 12 of this Employers Requirement.

Any claims by Utility Agencies due to damage of utilities by the Contractor shall be borne by the Contractor.

#### **Structures, Roads and Other Properties**

- (4) The Contractor shall immediately inform the Engineer of any damage to structures, roads or other properties at handover of the site(s) or during the Contract duration.

#### **Access**

- (5) Alternative access shall be provided to all premises if interference with the existing access, public or private, is necessary to enable the Contractor's Works to be carried out. The arrangements for the alternative access shall be as agreed by the Engineer and any concerned agency or building management. Unless agreed otherwise, the permanent access shall be reinstated as soon as practicable after the Work is complete and the alternative access shall be removed immediately when it is no longer required, and the ground surfaces reinstated to the satisfaction of the Engineer. Proper signage and guidance shall be provided for the traffic / users regarding diversions.

## **Trees**

- (6) The felling of trees in the Maharashtra (Urban Area) is governed by the Section 8 of the Maharashtra (Urban Area) Protection and Preservation of Trees Act 1975, with all its amendments.
- (a) The Contractor is not permitted to cut or fell any trees without first obtaining approval from the appropriate authorities and then obtaining a Notice from the Engineer. The Contractor shall identify all trees that require cutting or felling and make applications to the appropriate authorities and the Engineer for the necessary works at least 6 months in advance of the required date for the cutting or felling works.
- (b) Tree cutting outside permanent works areas should be avoided as far as possible and specific justification needs to be submitted for approval from the appropriate authorities and for Engineer for a Notice before cutting trees in these areas.
- (c) Trees which are found suitable for transplanting, as decided by the Engineer, need to be replanted in an area near to the site at locations determined by Engineer.
- (d) Maintenance of trees transplanted outside the Works areas will become the responsibility of the Employer.

## **Removal of Graves and Other Obstructions**

- (7) If any graves and other obstructions are required to be removed in order to execute the Works and such removal has not already been arranged for, the Contractor shall draw the Engineer's attention to them in good time to allow all necessary arrangements and authorisations for such removal, and the Contractor shall not remove them without first obtaining approval from the appropriate authorities and then obtaining a Notice from the Engineer.

## **Protection of the Adjacent Structures and Works**

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

## **Pre-Construction Surveys of Adjacent Buildings and Structures**

- (9) The Contractor shall submit details of the measures he intends to take to protect those buildings or structures, as identified in the reports compiled under Clause C5.2(4) of this Employers Requirement – Functional , as potentially susceptible to damage during the construction of the Works, to the Engineer for a Notice for the proposed measures. The Employer will make available to the Contractor, for information only, the Building Condition Survey information available with him in Reference Document. The Contractor shall supplement this information, by way of carrying out his own Building condition Survey, to the extent necessary to ensure compliance with the Employer's Requirements, Specifications and Conditions as set out in the Contract.

The Contractor shall determine the potential influence zones for his Works as per the stipulations contained in Outline Design specifications and prior to commencing any work within the zone of influence of the buildings and structures (EBS),

The Existing Building Survey Report as available with the Employer is contained in Reference Document and is for information only.

Prior to commencing any work within the zone of influence measured 50m from center line of twin tunnel and twice the depth of cut & cover excavation from the periphery of permanent wall structure, the Contractor shall complete a pre-construction survey to identify and record any existing defects in the building structure and fabric. A separate pre-construction survey report shall be prepared for each building/structure, in a format given a Notice by the Engineer. The report shall include sufficient key plans, sketches and photographs to enable easy location of existing defects and comparison with possible future ones. Two coloured copies of all of the pre-construction survey reports shall be provided to the Engineer, and a further copy of the appropriate pre-construction survey report shall be issued to the building/structure owner for their information and a signed receipt form/letter acknowledging the owners receipt of such shall be retained by the Contractor.

Also refer to Outline design Specification Clause 3.4 and all its sub-clauses

## **D9 WORK ON ROADS**

### **Traffic Management Plan**

- (1) The Contractor shall develop a detailed Traffic Management Plan for the Work under the Contract. The purpose is to develop a Traffic Management Plan to cope with the traffic disruption as a result of construction activities by identifying strategies for traffic management on the roads and neighbourhoods impacted by the construction activities, which shall be submitted to the Pune Traffic Police for their approval and to the Engineer for his Notice of No Objection. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract and shall comply strictly with the approved plan during the construction of his works. Also See Outline Construction Specification, sub-section 1.3 Road Works Requirements and Specifications.

All costs associated with Traffic Management shall be paid as detailed in the Pricing Document of this Contract and this shall include for the construction of diversion routes, or upgrading of existing roads for diversions, and the maintenance, including cleaning, of the same and the existing roads within 150m of the Works for the duration of the Contract.

### **Principles for Traffic Management**

The basis for the Plan shall take into consideration eight principles:

- To minimise the inconvenience of road users and the interruption to surface traffic through the area impacted by the construction activities;

- To ensure the safety of road users in the impacted area;
- To facilitate access to the construction site, and to maintain reasonable construction progress.
- To ensure traffic safety at each construction site.
- To make the most efficient use of the restricted area available, whilst minimising disturbance to the general public.
- The design shall provide for a minimum of two lanes of traffic in each direction or as approved by the relevant authorities and the Engineer, which may require temporary road decking where necessary, which must be maintained at all times, shall be approved by Pune Police Traffic Department.
- The traffic management plan shall provide for a minimum of 2m of footpath (or as agreed with the relevant authorities and the Engineer) adjacent to buildings or thoroughfares for all road diversion schemes.
- The Contractor should take into account that the construction of the stations may have to be done in phases to ensure that the traffic management plan provides the minimum number of two traffic lanes (or as approved by the relevant authorities and the Engineer) in each direction.

#### **Integrated Traffic Management Plan**

The Contractor shall prepare an integrated plan showing the arrangements to be made for accommodating road and pedestrian traffic, at individual construction sites and continuously along the alignment, including arrangements being implemented by other Contractors, to smooth traffic operations and for the safety of both construction workers and road users. The Plan shall consider different measures such as:

- The use of suitable construction sequences and methods at station sites to reduce the period of disruption to road users;
- proper phasing and timing of traffic signals;
- modifications to intersection geometry;
- changes in lane usage;
- parking prohibitions;
- re-location of bus stops;
- maintenance of existing roads within the vicinity of the Works areas;
- reducing width of footpaths and median;
- right-turn prohibition;
- work site access management;
- minimising the duration of any road closure;
- reversible lane operations;
- modification of roadway alignment affected by the construction, which shall be in conformance with the requirements and regulations defined by the relevant authorities;
- other engineering traffic measures as may be applicable.

#### **Mitigation of Traffic Disturbances**

- (2) The Contractor shall manage the vehicular and pedestrian right of way during the period of construction. The Contractor shall take account of the need to maintain essential traffic requirements, as these may influence the construction process.

The Contractor shall include local traffic diversion routes and assess traffic impacts caused by the construction in the affected areas. Signage layout shall be included to ensure that adequate motorist information will be provided for traffic diversions.

Where it becomes necessary to close a road or intersection, or supplementary lanes are required to satisfy the traffic demands, traffic diversion schemes to adjacent roadways shall be developed with quantitative justifications. The Contractor shall co-ordinate with all relevant authorities.

Other considerations include:

- The minimum lane widths for fast traffic and mixed traffic shall follow the regulations of the different authorities.
- The design shall provide for a minimum number of two traffic lanes in each direction (or as agreed with the relevant authorities and the Engineer), with a minimum of 2m of footpath (or as agreed with the relevant authorities and the Engineer) adjacent to buildings or thoroughfares.
- Any roads or intersections that have no alternative access shall not be fully closed for construction.
- Emergency access to all properties shall be maintained at all times.
- The type, size, lighting, painting, etc.. requirements for barricades, hoardings and fencing shall be as detailed in Section VIII or as required by the Engineer.
- Access to business premises and property shall be maintained to the extent that normal activities are not seriously disrupted.
- Minimum footpath width shall be 2m (or as agreed with the relevant authorities and the Engineer), unless otherwise indicated. The footpath shall be separated from vehicle traffic and not necessarily immediately adjacent to vehicle traffic;
- Where existing footbridges and underpasses are demolished or closed, provisions shall be made for pedestrian crossing to minimise the conflicts between a traffic lane.
- Construction traffic shall be separated from other traffic wherever possible;
- Any traffic related facilities (bus stops, parking, etc.) which are affected by the construction works shall be maintained or relocated to appropriate locations;
- Motorists, pedestrians, workmen, plant and equipment shall be protected from accident at all times;
- The Contractor's temporary traffic management plan shall be coordinated

with the Works and traffic arrangements of other Contractors where these interface with this Contract.

- Roadway designs, traffic management schemes, and installation of traffic control devices shall be in conformance with the requirements and regulations defined by the relevant authorities; and
- Where applicable, utility diversions shall be incorporated in the traffic management plan.

#### **Approval for Temporary Traffic Arrangements and Control**

- (3) The Contractor shall make all arrangements with and obtain the necessary approval from the transport authorities and the Pune Police Traffic Department for temporary traffic arrangements and control on public roads. In the event that the Contractor, having used its best endeavours, fails to secure the necessary approval from the transport authorities and the Pune Traffic Police Department for temporary traffic arrangements and control on public roads, then the Employer will use its best endeavours to assist the Contractor to secure such approval but without responsibility on the part of the Employer to do so.

#### **Temporary Traffic Arrangements and Control**

- (4) Temporary traffic diversions and pedestrian routes shall be surfaced and shall be provided where work on roads or footpaths obstruct the existing vehicular or pedestrian access. The relevant work shall not be commenced until the approved temporary traffic arrangements and control have been implemented.
- (5) Temporary traffic arrangements and control for work on public roads and footpaths shall comply with the requirements of the Pune Traffic Police. Copies of documents containing such requirements shall be kept on the Site at all times. Contractor has to effect the necessary changes suggested by Pune Traffic Police from time to time for management of traffic.
- (6) Temporary traffic signs, including road marking, posts, backing plates and faces, shall comply with the requirements of the Pune Traffic Police and should be in accordance with the requirements of Ministry of Surface Transport. All overhead traffic management signs that are fixed to bridges and gantries shall be illuminated at night. Pedestrian routes shall be illuminated at night to a lighting level of not less than 50 lux.
- (7) Adequate number of traffic marshals shall be deployed for smooth regulation of traffic.
- (8) Temporary traffic arrangements and control shall be inspected and maintained regularly, both by day and night. Lights and signs shall be kept clean and legible. Equipment which are damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced promptly.

#### **Particulars of Temporary Traffic Arrangements and Control**

- (9) The following particulars of the proposed temporary traffic arrangements and control on public roads shall be submitted to the Engineer for his Notice of No Objection, at least 28 days before the traffic arrangements and control are

implemented:

- (a) details of traffic diversions and pedestrian routes;
  - (b) details of lighting, signage, guarding and traffic control arrangements and equipment;
  - (c) any conditions or restrictions imposed by Pune Traffic Police or any other relevant authorities, including copies of applications, correspondence and approval.
- (10) Where concrete barriers are used to separate flows of traffic, the barriers shall be in a continuous unbroken line. No gaps shall be left between any section of the barrier. Contractor has to liaise with and agree with the adjacent business proprietors and residents regarding the access to the property and the traffic arrangements.
- (11) Site perimeter fencing and barriers along the roadway, shall have flashing amber lights positioned on the top of them every 50 metres apart and at every abrupt change in location. Directly below the flashing light shall be fixed, in the vertical position, a white fluorescent light with a waterproof cover.

#### **Use of Roads and Footpaths**

- (12) Public roads and footpaths on the Site in which the Work is not being carried out shall be maintained in a clean and passable condition.
- (13) Measures shall be taken to prevent the excavated materials, silt or debris from entering gullies on roads and footpaths; entry of water to the gullies shall not be obstructed.
- (14) Surfaced roads on the Site and leading to the Site shall not be used by tracked vehicles unless protection against damage is provided.
- (15) Contractor's Equipment and other vehicles leaving the Site shall be loaded in such a manner that the excavated material, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted. The wheels of all vehicles shall be washed when necessary before leaving the Site to avoid the deposition of mud and debris on the roads.

#### **Reinstatement of Public Roads and Footpaths**

- (16) All street furniture, including signs, stone kerbs, boxes, lights, traffic lights, etc., that has to be removed due to the Contractor's works or temporary traffic arrangements whereby the Contractor shall arrange for their storage, either in the relevant Government Departments or at the Contractor's own works area(s), for which an agreed inventory, including a photographic record, shall be submitted to the Engineer for a Notice. Existing street furniture shall be reused wherever possible, and any street furniture that can't be reused shall be agreed in writing with the Engineer.
- (17) Temporary diversions, pedestrian access and lighting, signage, guarding and traffic control equipment shall be removed immediately when they are no longer required. Roads, footpaths, street furniture and other items affected by temporary traffic arrangements and control shall be reinstated to their original

condition as existed before the Work started or as permitted by the Engineer immediately after the relevant work is complete or at other times as permitted by the Engineer. '

The Contractor shall submit his design for the reinstatement to the relevant authorities and obtain their prior approval to carrying out the Work. Reinstatement works shall include, but not be limited to, the following:

- Parking bays
- Footpath and kerbs
- Road Signage
- Street Lighting
- Landscaping
- Traffic Lights and Control Cable
- Road painting

## **D10 SITE ESTABLISHMENT**

### **Engineer's Site Accommodation**

- (1) Within 30 days of the Commencement Date, the Contractor shall provide and maintain site accommodation for the Engineer's staff as set out in Appendix 13 and at a location given a Notice by the Engineer. The accommodation shall be retained until 90 days after the issue of a Taking-over certificate for the Works by the Engineer.
- (2) The Contractor shall submit details of the site accommodation layout to the Engineer for a Notice, prior to establishing the accommodation.
- (3) The accommodation shall be cleaned and serviced daily and security shall be provided 24 hours a day, 7 days per week. Full capacity stand-by power shall be available during periods when main power is unavailable. The Contractor shall also provide Uninterrupted Power Supply equipment to the computer facilities provided by the Engineer in the site accommodation.

### **Site Laboratory**

- (4) The Contractor shall provide, erect and maintain in a clean, stable and secure condition a laboratory, equipped for the routine testing of concrete, soil and rock samples and for the storage and curing of concrete cubes or cylinders . This laboratory shall be located at the Contractor's principal work site or at a location issued a Notice by the Engineer. Detailed requirements for this laboratory are set out in Appendix 14 of this Employers Requirement.

### **Contractor's Site Accommodation**

- (5) The Contractor shall provide and maintain its own site accommodation at locations issued a Notice by the Engineer. Offices, sheds, stores, mess rooms, garages, workshops, latrines and other accommodation on the Site shall be maintained in a clean, stable and secure condition and shall comply with the requirements of Attachment D1 of this section. Under no circumstances is

living accommodation to be provided on the Site. The Contractor shall comply with the requirements of Appendix 8 of this Employers Requirement.

#### **Latrines and Wash places**

- (6) The Contractor shall provide latrines and wash places for the use of its personnel and all persons who will be on the Site. The size and disposition of latrines and wash places shall accord with the numbers and dispositions of persons entitled to be on the Site, which may necessitate their location on structures and, where necessary there shall be separate facilities for males and females. The capacities and layout shall be subject to a Notice from the Engineer. The Contractor shall arrange regular disposal of effluent and sludge in a manner that shall be in accordance with local laws/regulations.
- (7) The Contractor shall be responsible for maintaining all latrines and wash places on the Site in a clean and sanitary condition and for ensuring that they do not pose a nuisance or a health threat. The Contractor shall also take such steps and make such provisions as may be necessary or directed by the Engineer to ensure that vermin, mosquito breeding etc. are at all times controlled.

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

- (8)
  - (a) The Contractor shall be responsible for providing water, electricity, telephone, sewerage and drainage facilities for the Engineer site accommodation, Contractor's site offices, structures and buildings and for all site laboratories and all such services that are necessary for satisfactory performance of the Works. The Contractor shall make all arrangements with and obtain the necessary approval from the relevant civil and utility authorities for the facilities.
  - (b) The Contractor shall note the requirements for the supply and provision of power and water services for all Interfacing Contractors, as noted in Appendix 19 of this Employers Requirement.
  - (c) The Contractor shall be responsible for provision of power supply for his works including for tunnelling machines and the like. The Employer cannot guarantee provision of adequate, continuous power supply, however assistance will be given in trying to obtaining the necessary permissions for site generators and the like.
- (9) Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, acceptable and stable condition. For lengths of roadway longer than 100 m and where vehicle movements exceed one hundred (100) movements/day and heavy commercial vehicle are to ply the Contractor shall provide paved surfacing of adequate thickness and quality to the satisfaction the Engineer.
- (10) Any operation of the Works that interferes with the inspection of the Works and/or the checking of lines and levels shall be temporarily suspended at the request of the Engineer until the checking is complete.

#### **Submission of Particulars**

- (11) The following particulars shall be submitted to the Engineer for his Notice of No Objection not more than fifty six (56) days after the Commencement Date of the Works :
- (a) drawings showing the formation works and the layout within earmarked area for the Contractor's offices, project signboards, principal access and other major facilities required early in the Contract, together with all service utilities;
  - (b) drawings showing the details to be included on the project signboards and diversion boards.
- (12) Drawings showing location of stores, storage areas, concrete batching plants and other major facilities and their access roads/paths shall be submitted to the Engineer for his Notice as early as possible but in any case not less than twenty eight (28) days prior to when such facilities are intended to be constructed on the Site.

#### **D11 SECURITY**

- (1) The Contractor shall be responsible for the security of the Site for the full time the Site is in its possession, except for the specific cases as described under Clause D3(8) of these Employer's Requirements – Construction (Sub-division D) and defined in Appendix 9 of these Employer's Requirements. The Contractor shall set up and operate a system whereby only those persons entitled to be on the Site can enter the Site. To this end, the Contractor shall , with a Notice from the Engineer, erect a security fence/barricade, with a minimum height of 2m, around the site areas , with only specific points at which entry through the fence/barricade can be effected, and shall provide gates or movable barricades at such points of entry and thereby maintain a twenty four hours a day , seven days a week security guard and such other security personnel and patrols elsewhere as necessary to maintain security.
- (2) The Contractor shall maintain all site boundary fences in a first class condition, and shall so arrange site boundary fences and security measures that the drainage arrangement is not affected. . Notices shall be displayed at intervals around the Site to warn the public of the dangers of entering the Site.
- (3) During the progress of the Works the Contractor shall maintain such additional security patrols over the areas of the Works as may be necessary to protect his own and his Sub-Contractor's work and equipment and shall co-ordinate and plan the security of both the Work under this Contract and the Work of others having access to and across the Site and the Works.
- (4) In order to operate such a security system it will be necessary to institute the issue of unique ID passes to personnel and vehicles entitled to be on the Site, and which may need to be separately identifiable according to the shifts being worked on Site. The Contractor shall at the outset determine, together with the Engineer, a system and the design of ID passes to suit the requirements of the

foregoing and to suit the methods of work to be adopted by the Contractor. The Contractor shall at all times ensure that the Engineer has an up to date list of all persons entitled to be on the Site at any time. The Contractor shall also introduce a system for issuing passes to any visitors or persons/vehicles belonging to agencies other than Employer/ Engineer/Interfacing Contractors who may have to visit the site in connection with work

- (5) The Contractor shall liaise with the Contractors responsible for the other Projects and other Interfacing Contractors and ensure that co-ordinated security procedures are operated, in particular in respect of vehicles permitted to pass through the Site and/or the adjacent sites .
- (6) Security and checking arrangements as felt necessary shall be provided with advice and help of the Police.

## **D12 TESTING**

### **General**

- (1) The Contractor shall provide and perform all forms of testing procedures applicable to the Works and various components and the interfacing of the Works with the other project works and shall conduct all necessary factory, site and acceptance tests.
- (2) All testing procedures shall be submitted at least thirty (30) days prior to conducting any Test. The Testing procedures shall show unambiguously the extent of testing covered by each submission, the method of testing, the Acceptance Criteria, the relevant drawing (or modification) status and the location.
- (3) The testing Procedures shall be submitted, as required, by the Contractor during the duration of the Contract to reflect changes in system design or the identification of additional testing requirements.
- (4) The Engineer shall have the facilities for monitoring all tests and have access to all testing records. Ample time shall be allowed within the testing programmes for necessary alterations to equipment, systems and designs to be undertaken, together with re-testing prior to final commissioning.
- (5) The Contractor is reminded that at some point, the High Voltage Power Supply system will be energised and the additional precautions for the safety of staff and co-ordination of activities after power-on shall be anticipated.
- (6) All costs associated with the Testing shall be borne by the Contractor, unless otherwise specified, including the services of any specialised personnel or independent assessors. The Contractor shall also bear any expenses incurred due to resetting caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.
- (7) Unless a Notice is issued by the Engineer, the personnel engaged on testing shall be independent of those directly engaged in the design or installation of the same equipment.

- (8) All testing equipment shall carry an appropriate and valid calibration labels.

#### **Batches, Samples and Specimens**

- (9) A batch of material is a specified quantity of the material that satisfies the specified conditions. If one of the specified conditions is that the material is delivered to the Site at the same time, then material delivered to the Site over a period of a few days may be considered as part of the same batch if in the opinion of the Engineer there is sufficient proof that the other specified conditions applying to the batch apply to all of the material delivered over the period.
- (10) A sample is a specified quantity of material that is taken from a batch for testing and which consists of a specified amount, or a specified number of pieces or units, of the material.
- (11) A specimen is the portion of a sample that is to be tested.

#### **Samples for Testing**

- (12) Samples shall be of sufficient size and in accordance with relevant Standards to carry out all specified tests.
- (13) Unless agreed otherwise by the Engineer samples taken on the Site shall be selected by, or taken in the presence of; the Engineer and shall be suitably marked for their identification. An identification marking system should be evolved at the start of works in consultation with the Engineer.
- (14) Samples shall be protected, handled and stored in such a manner that they are not damaged or contaminated and such that the properties of the sample do not change.
- (15) Samples shall be delivered by the Contractor, under the supervision of the Engineer, to the specified place of testing. Samples on which non-destructive tests have been carried out shall be collected from the place of testing after testing and delivered to the Site or other locations as instructed by the Engineer.
- (16) Samples which have been tested may be incorporated in the Permanent Works provided that:
- (a) the sample complies with the specified requirements;
  - (b) the sample is not damaged; and
  - (c) the sample is not required to be retained under any other provision of the Contract.
- (17) Additional samples shall be provided for testing if in the opinion of the Engineer:
- (a) material previously tested no longer complies with the specified requirements; or
  - (b) material has been handled or stored in such a manner that it may not comply with the specified requirements.

#### **Testing**

- (18) The Contractor shall be responsible for all on-site and off-site testing and for all in-situ testing. All appropriate laboratory tests shall be carried out in the

Contractor's laboratory, unless otherwise permitted or required by the Engineer. Where the laboratory is not appropriately equipped and/or staffed for some tests, or if a Notice has been issued by the Engineer, tests may be carried out in other laboratories provided that:

- (a) they are accredited for the relevant work to a standard acceptable to the Engineer; and
  - (b) particulars of the proposed laboratory are submitted to the Engineer for a Notice.
- (19) Unless agreed otherwise by the Engineer in-situ tests shall be done in the presence of the Engineer.
- (20) Equipment, apparatus and materials for in-situ tests and laboratory compliance tests to be carried out by the Contractor shall be provided by the Contractor. The equipment and apparatus shall be maintained by the Contractor and shall be calibrated before the testing starts and at regular intervals as permitted by the Engineer. The equipment, apparatus and materials for in-the situ tests shall be removed by the Contractor as soon as practicable after the testing is complete.
- (21) The Contractor shall be entitled in all cases to attend the testing carried out in the Employer's or other laboratories, to inspect the calibration certificates of the testing machines and to undertake the testing on counterpart samples. Testing of such samples shall be undertaken in laboratories complying with Clause D12(18) above and particulars of the laboratory proposed shall be submitted to the Engineer for his Notice of No Objection prior to the testing.
- (22) Attendance on tests, including that by the Engineer, Contractor and Designer, shall be as laid down in the Quality Assurance procedures.

#### **Compliance of Batch**

- (23) The results of tests on samples or specimens shall be considered to represent the whole batch from which the sample was taken.
- (24) A batch shall be considered as complying with the specified requirements for a material if the results of specific tests for the specified properties comply with the specified requirements for the properties.
- (25) If additional tests are permitted or required by the Engineer but separate compliance criteria for the additional tests are not stated in the Contract, the Engineer shall determine if the batch complies with the specified requirements for the material on the basis of the results of all tests, including the additional tests, for every property.

#### **Records of Tests**

- (26) Records of in-situ tests and laboratory compliance tests carried out by the Contractor shall be kept by the Contractor on the Site and a report shall be submitted to the Engineer within seven (7) days, or such other time stated in the Contract or in the Quality Assurance Programme, after completion of each test. In addition to any other requirements, the report shall contain the

following details:

- (a) material or part of the Works tested;
  - (b) location of the batch from which the samples were taken or location of the part of the Works;
  - (c) place of testing;
  - (d) date and time of tests;
  - (e) weather conditions in the case of in-situ tests;
  - (f) technical personnel supervising or carrying out the tests;
  - (g) size and description of samples and specimens;
  - (h) method of sampling;
  - (i) properties tested;
  - (j) method of testing;
  - (k) readings and measurements taken during the tests;
  - (l) test results, including any calculations and graphs;
  - (m) specified acceptance criteria; and
  - (n) other details stated in the Contract.
- (27) Reports of tests shall be signed by the Project Manager or his assistant, or by another representative authorised by the Contractor.
- (28) If requested, records of tests carried out by the Employer's staff or by the Engineer shall be given to the Contractor.

#### **Production Tests (At Factory)**

- (29) Should the Works include any equipment not previously proven in service the Contractor shall undertake a thorough testing of the same at pre-production stage to the satisfaction of the Engineer. The Contractor shall identify any equipment in this category, or equipment that differs significantly from that already in service elsewhere.
- (30) All materials, components, sub-assemblies, unit assemblies (including software, cables and wiring) shall be subject to testing and certification. Notification of these tests shall be submitted to the Engineer thirty (30) days in advance of carrying out any tests. The Engineer will then determine which items, if any, may be accepted based on previous supply or experience.
- (31) Factory Tests shall include but not be limited to:
- Physical inspection
  - Dimension check
  - Electrical check
  - Calibration
  - Output check
  - Operational performance
  - Full Load test
  - Flash-over test
  - Insulation test
  - Soak test

- Non-destructive test to assess integrity or strength of parts

(32) Where processor based equipment is to be used then the Manufacturing Test shall include also verification of software used in this application.

#### **Post Installation Tests (On Site)**

(33) During and on completion of the installation, the Contractor shall undertake testing of all cables, wiring and equipment, instrumentation and protection devices, in a progressive sequence and in accordance with the overall testing programme. These tests shall culminate in functional tests to verify the correct operation of all apparatus and, where appropriate, correct response to the respective control commands or monitored function.

(34) Following satisfactory completion of these Tests, the Contractor shall prepare the installation for official demonstration in the presence of the Engineer.

#### **Acceptance Tests**

(35) The Contractor shall prepare and organise a comprehensive programme of acceptance Tests to demonstrate to the Engineer that all systems, sub-systems and apparatus defined under the Contract meet the specified performance requirements in all respects.

(36) These Tests shall be conducted by the Contractor in the presence of the Engineer.

#### **Integrated System Tests**

(37) The Contractor shall submit to the Engineer requirements and procedures, in respect of the Contractor's scope of work for Integrated System Tests in conjunction with the Interfacing Contractors to demonstrate that the complete system provided under the Contract is fully operational and meets the specified performance criteria. The conducting of these Integrated System Tests, by the Contractor and the Interfacing Contractors, shall include a period of Test running.

#### **Trial Running**

(38) Following satisfactory completion of the acceptance Tests and the Integrated System Test the Employer will commence an extended period of trial running to prove all technical systems in time table operation, to the satisfaction of the CRS, and to allow all technical systems to settle and to train staff in working procedures.

(39) The Contractor shall allow for attendance in respect of the Contractor's scope of work over the whole of this period, which may be expected including maintenance and repair activities and also further opportunity for technical staff training.

### **D13 RECORDS**

#### **Drawings Produced by the Contractor**

(1) Drawings produced by the Contractor including drawings of site layouts, Temporary Works, etc., for submission to the Engineer shall generally be to ISO A1 size. They shall display a title block showing the information detailed in

Appendix 7 of this Employers Requirement.. The number of copies to be submitted to the Engineer shall be as stated in the Contract, or as required by Engineer.

### **Progress Photographs**

- (2) The Contractor shall provide monthly progress photographs which have been properly recorded to show the progress of the Works to the Engineer. The photographs shall be digital and taken on locations agreed with the Engineer to record the exact progress of the Works. The number and size shall be as required in Appendix 5 of this Part 2, section VI.
- (3) The Contractor shall mount each set of each month's progress photographs in a separate album of a type to which the Engineer has given a Notice, and shall provide for each photograph two typed self-adhesive labels, one of which shall be mounted immediately below the photograph and one on the back of the photograph. Each label shall record the information detailed in Appendix 5 of this Employer's Requirements.
- (4) All photographs shall be taken by a skilled photographer using a digital single-lens reflex camera of at least 6 megapixels, whose name and experience shall be submitted to the Engineer for his Notice of No Objection. Processing shall be carried out by a competent processing firm to the satisfaction of the Engineer.
- (5) The Contractor shall ensure that no other photography is permitted on the Site without a Notice from the Engineer. The Contractor should be aware of the local regulations and conditions with regard to Photography in some "RESTRICTED AREAS" in Pune.

### **Records of Wage Rates**

- (6) The Contractor shall keep monthly records of the average, high and low wage rates for each trade/tradesman employed on the Site and records shall be made available to the Engineer during inspection.

## **D14 MATERIALS**

- (1) Materials and goods for inclusion in the Permanent Works shall be new unless the Engineer has issued a Notice otherwise. Preference shall be given to local materials where available. Approved Manufacturers/Suppliers of few important items have been given in Appendix 10 of this Employers Requirement. These materials shall be procured only from these Manufacturers/Suppliers.
- (2) Certificates of tests by manufacturers which are to be submitted to the Engineer shall be current and shall relate to the batch of material delivered to the Site. Certified true copies of certificates may be submitted if the original certificates could not be obtained from the manufacturer.
- (3) Parts of materials which are to be assembled on the Site shall be marked to identify the different parts.
- (4) Materials which are specified by means of trade or proprietary names may be substituted by materials from a different manufacturer which have received a

Notice from the Engineer, provided that the materials are of the same or better quality and comply with the specified requirements.

- (5) Samples of materials submitted to the Engineer for information or Notice shall be kept on the Site by the Contractor in a secure dry storage room and shall not be returned to the Contractor or used in the Permanent Works unless the Engineer has issued a Notice of No Objection. The samples shall be used as a means of comparison which the Engineer shall use to determine the quality of the materials subsequently delivered. Materials delivered to the Site for use in the Permanent Works shall be of the same or better quality as the samples which have received a Notice.

#### **Provision of Earthworks Material and Disposal including Waste**

- (6) The Contractor shall be responsible for the provision of all classes of earthworks material required for the Works, whether sourced from the excavations within the Contract or obtained from any other sources, which are located outside the Site, for which the Engineer has given a Notice. A Notice of No Objection will only be given after the Contractor has provided evidence that the Contractor is legally authorized to extract material from the source.
- (7) For fill or dumping sites, the Contractor shall prepare a land plan with details of surface drainage requirements, final formation levels, spreading and compaction of the fill during dumping acceptable to the Engineer. The Contractor shall also provide security for such sites. The dumping sites to be used by the Contractor shall be identified and provided by the Contractor and with the approval of the relevant authorities and having obtained a Notice from the Engineer.
- (8) All excavated material, excluding waste material, bentonite fluid and bentonite contaminated material shall be disposed of at appointed/approved sites only. This material shall be placed and compacted in accordance with the Construction Specification for Earth Works or as otherwise directed by the Engineer.
- (9) The disposal of waste material, bentonite fluid and material contaminated with bentonite shall be the full responsibility of the Contractor and these materials shall be disposed of by the Contractor in a location approved by relevant authorities. The dumping sites provided by the Employer shall not be used for disposal of waste material, bentonite fluid or material contaminated with bentonite.

#### **D15 PROVISIONS FOR INTERFACING CONTRACTORS**

- (1) The Contractor shall carry out all reasonable civil, structural and building works necessary for the project as required by the Interfacing Contractors. These works shall include, but not be limited to, forming holes, casting plinths and trenches, casting in components and forming holes in pre-cast elements, etc...

- (2) The Contractor shall make all reasonable provisions to accommodate the fastenings, fittings and fixings of the Interfacing Contractors. Such provisions will be notified by the Interfacing Contractors and the Engineer during design interface. The interface responsibilities of the Contractor and the Interfacing Contractors are identified at Appendix 19 of this Part 2, section VI.
- (3) Contractor
  - (a) Prior to handing over areas of the site to the Interfacing Contractors who have requested such, the Contractor shall perform the following tasks:
    - i. Identify all the Interfacing Contractors requesting areas of the site and meet with each of them to collect and agree on their request (area size, duration required, services, special requirements, access to track, access to road, etc...) Refer to Part 2, section VI appendix 2A for minimum requirements.
    - ii. Prepare the areas of the site as necessary, including fencing.
    - iii. Provide at each end and at the midpoint of each station, at both concourse and platform levels, and at agreed locations along the tunnel, 415V three phase/230V single phase power supply, suitably earthed and each with sockets capable of receiving three (3) electric plugs of the size and type used for hand-held construction equipment
    - iv. Water supply at one location only within each station building.  
The Contractor shall not be responsible for the following services/tasks;
    - v. Erection of office or workshop buildings for the Interfacing Contractors;
    - vi. Routing and connection of power supply and water services to end points, except as noted in (3)(a)(iii) and (iv) above.
  - (b) Each Interfacing Contractor shall take over responsibility of the safety and security of its own work area as well as buildings erected within.
  - (c) The Interfacing Contractors will be responsible for reimbursement to the Contractor of the utility charges for the consumption of power and water by the Interfacing Contractors, which will be individually metered for each Interfacing Contractor. The Contractor will charge the Interfacing Contractor for consumption of power and water at the same unit rates as paid by the Contractor to the authorities for such utilities.
  - (d) The Contractor shall provide power, water, electric lighting, etc.. to a standard which shall facilitate safe working conditions for his works and all works by the Interfacing Contractors..
- (4) The Employer and Engineer will hold Project Quarterly Review Meetings at three monthly intervals. The Contractor shall attend these QRM and shall report the progress of his works and the state of his interface with other Interfacing Contractors and shall provide the Engineer with the necessary assistance and information for conducting the QRM. Refer to Clause A18 of these Employer's Requirements -General.

## **D16 RESTORATION OF AREAS DISTURBED BY CONSTRUCTION**

- 1) Unless otherwise directed by the Engineer, any areas disturbed by the construction activity, either inside or outside the Project Right of Way or Site Areas, shall be reinstated as follows:
  - a) All areas affected by the construction work shall be reinstated to their original condition, or better, with new materials, including but not necessarily limited to, sidewalks, parking lots, access roads, adjacent roads, adjacent properties and landscaping. Grass cover shall be provided for any bare earth surface areas, along with proper provisions for surface drainage.
  - b) Landscaping design must be submitted to the relevant authorities and match the remaining areas. In addition the Contractor shall carry out the design and construction of landscaping for all works areas and will submit his proposals to the relevant authorities, having obtained approval before commencement of landscaping works

## **D17 TUNNEL BORING MACHINES**

The Contractor shall deploy sufficient number of Tunnel Boring Machines (as a minimum two shield TBMs shall be deployed For this Contract) in robust and sound condition, complete with all back-up equipment and spares to compete the Works within the Key Dates and completion time.

The Tunnel Boring Machines should have, as a minimum, the following facilities:

### **General**

- (1) Tunnel shields supplied by the Contractor shall be truly circular, strong enough to avoid distortion during driving, and suitable for building the tunnel linings as shown on the Approved Drawings.
- (2) The Contractor shall supply, erect, drive, maintain, dismantle and remove the shields, which shall remain the property of the Contractor upon completion.
- (3) The machine design shall make adequate provision for the safety of the Workmen and the application of safe methods of tunnelling.
- (4) The machines shall be shop manufactured in units of convenient size, suitable for field erection, dismantling and reassemble under the site conditions of the Contract.
- (5) The machines shall be of suitable design, capable of efficient excavation and installation of support, meeting the desired requirements for expected geological, site, ground and hydro-geological conditions and Contract time schedules. For example the cutter drive system shall be equipped with appropriate power for delivering the required rotational torque and rotational speed of the cutter head and the cutter head having an appropriate housing arrangements for disk cutters/picks etc.
- (6) The machines shall be equipped with shove rams of sufficient capacity to move it through all materials/ground conditions encountered, to the lines and grades

as applicable for the Works under the Contract . The rams shall be capable of simultaneous and individual actuation, controllable individual pressure and variable extension.

- (7) Rams shall be fitted with proper shoes so placed that the reaction of the rams will be safely distributed against the tunnel linings.
- (8) The machines shall be equipped with a tunnel lining erector system capable of placing each lining segment safely into its final position along the periphery of the ring being erected.
- (9) The machine design shall permit removal of the structure from within the skin that may be left in place at the completion of the tunnel drive.
- (10) During the tunnelling operation, the Contractor shall provide and maintain CCTV systems with 2 cameras placed strategically within the tunnels. The CCTV system shall be linked to the office of the Engineer and the 2 cameras shall move in tandem with the shield.
- (11) Hand held extinguishers should be sited at suitable locations on the shield and the shield back up.
- (12) The Contractor shall use a hydraulic oil in the machines which will minimise to the utmost the risk of an oil fire.
- (13) The Contractor shall provide a backup power supply systems for tunnelling machines and emergency case hydraulic pressure control systems.
- (14) Where slurry system TBMs are proposed, the slurry treatment plant shall be designed such that the residual soil/spoil after treatment is suitable for filling and compaction in accordance with the Earthworks section of the Construction Specifications.

#### **Design Requirements - TBM and Closed Face Machines**

- (15) The cutter head of TBM and closed face machines shall be capable of clockwise and anticlockwise rotation and shall only be able to excavate the ground whilst the hydraulic rams are being actuated. The design of the machine shall ensure that the cutter head can be retracted back from the unexcavated ground to minimise the risk of the machine jamming and to facilitate maintenance.
- (16) The cutting head discs/picks shall be able to be renewed from the rear of the cutter head and be interchangeable.
- (17) Where boulders could occur on the tunnel face, the machine head shall permit a minimum 300 mm boulder to be pushed through the cutter head. The machine shall have the capability to handle, break up as required and remove such boulders through the screw conveyor or slurry discharge aperture without special procedures.
- (18) The machine tailskin shall be fitted with an adequate tail seal to prevent the ingress of water and/or grout. The tail seals shall be replaceable from within the tunnel. A grout seal, located at the rear of the tail shield, shall be considered to limit grout migration along the shield towards the cutter head.

- (19) The machine shall be designed to allow forward drilling through the cutter head for the purpose of probing ground conditions and to carry out ground treatment to the face.
- (20) The machines shall be designed to enable the void behind the segments to be grouted from the shield continuously as the shield is propelled forward by synchronised operation. The design shall enable the control of the grouting volume and pressure, and for the pipes to be cleaned in the event of a blockage. Grout pipes shall be integral within the thickness of the tail skin and a minimum of 4 separate pipes shall be provided. External grout pipes will not be permitted.
- (21) Provisions shall be made throughout the length of the machine and back up facilities for the detection and automatic suppression of fires. The system shall be maintained in an efficient operating condition at all times.
- (22) All closed face machines shall be designed to maintain pressure on the excavated ground at all times. The pressure shall at least balance the in-situ soil and hydraulic pressures making up the total overburden pressure and shall be capable of varying the face pressure as the overburden pressure changes. The design shall also take into account the soil/ground type, density, gradation, strength and abrasion. A minimum of six (6) pressure sensors shall be provided at the bulkhead and three (3) at the screw conveyor.
- (23) Slurry and EPB Machines shall be designed for and equipped with a supplemental ground stabilisation system. This system shall comprise regularly spaced grout ports built into the shield for grouting the ground ahead of the tunnel face. The location and number of ports shall be adequate for implementation of face stabilisation measures needed for access to the face in all ground conditions. All ports shall be readily accessible and fitted with valves.
- (24) All closed face machines shall incorporate a two-compartment air lock for man access to the cutter head and face. A complete compressed air installation, including compressor, chiller and medical lock shall also be provided and commissioned prior to the commencement of tunnelling in soft/mixed ground. Work carried out under compressed air condition shall comply with international standards and local safety regulations.
- (25) An independent backup system of closing the gate to the screw conveyor shall be provided in case of hydraulic failure.
- (26) The machine operation panel shall monitor and where appropriate control the following :
- a) Forward thrust.
  - b) Ram pressure and location used.
  - c) Main bearing grease and oil lubrication pressure flow and temperature.
  - d) Alignment and attitude of shield and segment
  - e) Electrical load characteristic and supply source
- Depending on the type of machine chosen the following items shall be monitored:

- f) Face pressure
- g) Slurry pressure, gravity and flow rates
- h) Earth pressure in the screw conveyor and opening ratio of gate.
- i) Compressed air pressure in module.
- j) Volume of soil/spoil removed correlated with forward advance of the shield.

(27) Please also refer the Outline Design and Construction Specifications of the Contract in this respect.

The Employer/Engineer may inspect the fabrication of TBM and witness the fabrication and factory testing at the offshore location(s). The cost of these visits will be borne by the Employer. The Contractor shall provide all necessary assistance to facilitate the Employer/Engineer's inspection and witnessing of the TBM fabrication and testing.

#### **D18 DEMOLITION OF EXISTING STRUCTURES.**

- (1) The Contractor shall be provided the site areas free of legal encumbrances to access, fencing and the undertaking of the Works. The Works shall include the demolition of all structures necessary for the construction of the stations, tunnels and ancillary structures required by the Contract Documents. The structures to be demolished include buildings, boundary walls, water sumps, water wells, bus stops etc.
- (2) The Contractor shall be responsible for obtaining the necessary permits and approvals for undertaking the demolition works. These will require the Contractor to undertake a structural inspection of all structures and prepare a demolition method statement. This report should detail the protective hoarding works required prior to the commencement of demolition, the sequence of demolition and any temporary strengthening/protective works required to be added to the structures during the demolition. The Contractor should pay particular attention to the demolition of cantilever structures.
- (3) The Contractor shall ensure that all utilities, drainage and sewerage are properly disconnected before commencing demolition.
- (4) Foundations and underground structures of the existing structures should be broken down to 2 m below ground level, and voids under this level are to be filled with suitable compacted material.

#### **D19 REINSTATEMENT OF EXTERNAL AREAS**

- (1) The Contractor shall reinstate the external areas as affected by the Works to same condition as at the date of hand over. The extent of reinstatement shall be at least 150m in all directions from the edge of the station, tunnel, shaft structure or ancillary buildings. At the commencement of Works the Contractor shall take an inventory of affected features including a photographic/video record covering the area that will be affected which shall be submitted to the Engineer for Notice. The

details of the reinstatement works shall be agreed with the appropriate Authorities and receive a Notice from the Engineer before the reinstatement works commence.

- (2) Reinstatement works shall include;
  - i. Road, footpath and landscape area pavements,
  - ii. Kerbs, medians, railings, safety rails and other road furniture,
  - iii. Road signage,
  - iv. Road marking,
  - v. Traffic lights,
  - vi. Street lighting,
  - v. Bus stops,
  - vi. Hard Landscaping including furniture,
  - vii. Soft Landscaping, and
  - vii. Boundary walls.
- (3) Except where shown otherwise the reinstatement of the following are not included in the Works;
  - a. Buildings,
  - b. Water wells,
  - c. Water sumps, and
  - d. Trees.
- (4) Contractor should provide assistance to others to transplant or reinstate trees within the Works area.

## **ATTACHMENT D1**

### **CONTRACTOR'S LABOUR CAMP**

#### **1. EMPLOYER WILL NOT PROVIDE QUARTERS FOR CONTRACTOR'S LABOUR**

The Employer will not provide living accommodation for the use of the Contractor or any of his staff or labour employed on the Works. Living accommodation shall not be established on any land provided to the Contractor by the Employer.

#### **2. PROVISION OF LABOUR CAMP**

If necessary 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 the Engineer. No labour camp shall be allowed at any work site or any unauthorised 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 may 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 experience, and number 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 illuminated 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 preservation of the peace and protection of the inhabitants and security of 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, who refuse to accept protective inoculation and vaccination when called upon by 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 a Notice from 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 must be avoided.
- (c) The minimum height of each unit shall be 2.10m and shall have separate cooking place.
- (d) Suitable number of common toilets/bath facilities 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 potable 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 of plastic, metal or masonry shall be provided. The Contractor shall also at his expense make arrangements for the provision and laying of water pipelines from the existing mains wherever available and shall pay for all the fees and charges therefore.

#### **6. DRAINAGE**

The Contractor shall provide efficient arrangements for draining away spillage 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.

# ***Maha Metro***



## **Tender Documents**

**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT  
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

### **PART II – EMPLOYER’S REQUIREMENT**

#### **SECTION – E. MANUFACTURE, INSTALLATION AND TESTING**

June 2018

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## MANUFACTURING, INSTALLATION AND TESTING

These Employer's Requirements establish the overall procedures for the Contractor to follow for the Work that is related to the Mechanical and Electrical works that form part of the Design and Construction Contract. These requirements relate to manufacturing procurement and delivery of plant and equipment and the requirements for testing and commissioning.

### E1. MANUFACTURING

#### E1.1. Management

The Contractor shall establish procedures and controls that govern the procurement, integration, manufacture and testing, quality assurance and delivery of plant, equipment and spares to be supplied under the Contract. This shall include the administration and supply of spare parts and warranty in accordance with the Contract. The Contractor's Manufacturing Management Plan shall be submitted to the Engineer for a Notice within 180 days of the Date of Commencement.

#### E1.2. Procurement and Subcontract Management

The Contractor's management systems and procedures shall establish and employ a procedure for materials procurement and Sub-contracting, sufficient to assure technical, administrative, quality and contractual controls consistent with those of this Contract. The Contractor's management system shall be auditable for materials sources, lot numbers, serialized equipment, etc. Sub-contract amendments shall be employed whenever contractual changes are made either bilaterally or unilaterally by the parties involved. Prior approval of the Employer/Engineer shall be taken for the make of all equipment and accessories.

#### E1.3. Manufacturing and Production Management

The Contractor's manufacturing and production management system shall encompass all points of receiving, raw material and components processing, fabrication, assembly, test and all points of in-process inspections. The Contractor's Manufacturing Management Plan shall contain:

- a brief description of all inspection hold points and test points, and a correlation with the Program Schedule;
- a list of all Sub Contractors; and
- a delivery schedule of each item of equipment to match installation plan, together with

Manufacturer's Qualifications: The equipment manufacturer shall show at least ten years of continuous and current experience in the design, assembly, and testing of similar equipment as being offered complying with the Contract Specifications.

#### E1.4. Testing

A comprehensive testing plan and program shall be provided by the Contractor that shall include the complete equipment, their subsystems and components and material to assure conformance with the Specifications. The purpose of the comprehensive testing plan and program shall be to:

- substantiate design and performance characteristics;
- ensure operational compatibility;
- complete equipment verification and acceptance requirements;
- complete all reliability, maintainability and safety demonstration requirements; and
- Integrated testing with all other rail systems and system-wide Contracts of the Project.

#### **E1.5. Quality Assurance and Controls**

The Contractor's management systems shall emphasize quality assurance and controls. The program shall be adequate to ensure an acceptable level of quality of the equipment supplied. The concept of total quality assurance shall be based on the principle that quality is a basic responsibility of the Contractor's organization, and shall be evidenced by:

- producible and inspectable designs;
- firm procurement and job performance specifications;
- firm procedures for transmission of information and data to Sub-Contractors ensuring their compliance;
- adequate testing to ensure repetitive product conformity to design requirements; and
- total program of surveillance and verification of physical performance and configuration accountability.

Adequate records shall be kept by the Contractor to provide evidence of quality and accountability. These records shall include results of inspections, tests, process controls, certification of processes and personnel, unacceptable material and other quality control requirements.

Inspecting and testing records shall, as a minimum indicate the nature of the observations made, and the number and types of deficiencies found and action proposed to correct deficiencies. Also, records for monitoring work performance and for inspecting and testing shall indicate the correction of deficiencies. All the records shall be submitted to the Engineer.

#### **E1.6. Shipping**

The Contractor's Manufacturing Management Plan shall provide for the proper inspection of materials and equipment to ensure satisfactory completion of manufacturing and testing / check prior to shipment. All shipments shall be adequately prepared to preclude damage during shipment. The Contractor's quality control personnel shall verify the inspection and preparation for shipment.

#### **E1.7. Handling Storage and Delivery**

The Contractor's Manufacturing Management Plan shall provide for adequate work and inspection instructions for handling, shipping, storage, preserving, packaging, packing, marking and shipping to protect the quality of the materials and equipment and to prevent damage, loss, deterioration, degradation or substitution thereof.

Handling procedures shall include the use of special crates, boxes, containers,

transportation vehicles, equipment and facilities for materials handling and lifting tools. Means shall be provided for protection against deterioration or damage to equipment in storage.

## **E2. INSTALLATION**

### **E2.1 Installation Plan and Program**

The Installation Plan shall show how the Contractor proposes to organize and carry out the installation and complete the whole of the Works by the given Key Dates. The Contractor shall submit the Plan for a Notice from the Engineer 90 days prior to the start of installation on Site.

The Contractor shall attend weekly planning meetings with the Engineer to finalize the Work detail, commencing 4 weeks prior to the start of installation on Site. The complete installation is to be carried out as per Coordinated Installation Program (CIP) agreed by all interfacing Contractors and approved by the Engineer.

### **E2.2 Method Statement**

The Method Statement shall be submitted to the Engineer for a Notice at least 30 days prior to the installation activity commencing on-Site. This shall show in particular the loadings and modes of transport of the items of equipment and the routing used as they are taken to their final locations.

Prior to proceeding with installation, the Contractor shall submit for the Engineer Notice, six copies of detailed drawings showing all installations including dimensions, supports, hardware, installation methods, and all other pertinent data.

The manufacturer's rigging or erection instructions shall be carefully followed. The Contractor shall make certain that the installation of all supports, gaskets, hardware, etc., are accomplished with precision and ensure exercise of extreme care so as to assure safe, accurate and trouble-free installation. Installation shall be undertaken in the presence of the Manufacturer's Field Service Representative.

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

### **E2.3 Contractor's Resident Staff**

The Contractor shall ensure that a qualified Representative of the manufacturer is available on-Site for the duration of the on-Site Works during normal working hours and installation period and on-call to arrive on Site within 30 minutes at all other times. The manufacturer's Representative shall support the Contractor's Representative during the Installation and Testing phase of the Works.

The Contractor's Representative shall have sufficient authority to progress the Contractor's work on Site. The Contractor's Representative shall be competent and qualified to act on behalf of the Contractor, and provide upon request information that may include:

- current progress of the Works;
- planned work for the next 5 weeks;

- audit and inspection reports;
- health and safety information; and
- documents and records pertaining to the Works.

## **E2.4 Drawings and Records**

### **(1) General**

The Contractor shall provide 6 copies of all drawings in A3 size, bound into circuit books. The Contractor shall ensure that, at each equipment location, an as-built copy of the Site documentation is provided. This documentation shall include as a minimum:

- circuit wiring book;
- equipment mode tables; and
- operation and maintenance manuals.

### **(2) Circuit Wiring Book**

The circuit wiring books shall include as a minimum the following information:

- cubicle and rack profiles;
- room layout;
- interface and boundary schedules with Interfacing Contractors;
- through circuits;
- power supply arrangement;
- earthing & bonding arrangement; and
- cable circuit information.

### **(3) Cable Records**

The Contractor shall ensure that the as-built cabling infrastructure is fully documented and accurate at the time of substantial completion of the Section. The documentation shall include:

- schematic of the cable routes;
- location of cable joints;
- cable types;
- installed dates;
- test data before and after installation; and
- core plan indicating the circuit and function of each core.

The Contractor shall be responsible for adding to all of the Combined Services Drawings the cable installation details and the timely supply of these marked up drawings to the Engineer for overall co-ordination.

## **E2.5 Earthing**

The Contractor shall provide at each equipment room earth bars/strips that shall be connected to the earthing system provided under the Contract. Two separate and visually different earthing points shall be provided, one for chassis and one for signal reference. The earth bars/strips shall be used as common points for all earthing in that location.

## **E2.6 Asset Identification**

The Contractor shall submit an asset database for a Notice by the Engineer. The database

shall contain the complete asset listing for all the Mechanical and Electrical Services.

The database shall be designed with a minimum of the following information:

- as set details;
- failure history;
- date installed; and
- date(s) tested.

All equipment and software, down to the line replaceable unit, shall have a unique identification number that is capable of being identified electronically and manually.

### **E3 TESTING AND COMMISSIONING**

#### **E3.1 General**

The Contractor shall perform all forms of test procedures applicable to the system and shall conduct factory, site installation and acceptance tests.

The commissioning activity shall include a period of Integrated System Testing along with BMS/SCADA and other rail systems, followed by a period of Trial Running for staff training and familiarization and timetable proving purposes, refer to Appendix 21 of this Part 2, section VI.

#### **E3.2 Test Programs and Procedures**

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

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

All Test reports shall be signed by the Contractor.

The Contractor shall present a comprehensive Testing and Commissioning Program to ensure a completely safe and operable system within 6 months from the Commencement Date of works.

All Test procedures shall be submitted at least 30 days prior to conducting any Test. Test procedures shall show the extent of testing covered by each submission, the method of testing, Acceptance Criteria, the relevant drawing (or modification) status, and the location,

Test Procedures shall be amended, as required, by the Contractor during the currency of the Contract to reflect changes in system design or the identification of additional testing requirements.

The Employer, the Engineer and/or any of their staff shall have the facility to monitor all Tests and have access to all Test records. Ample time shall be allowed within the testing programs for necessary alterations to equipment, systems and design to be undertaken, together with re-testing prior to final commissioning:

All costs associated with Testing shall be borne by the Contractor, and unless otherwise specified, the Contractor shall also bear any expenses incurred due to re-testing caused by defects or failure of equipment to meet the requirements of the Contract in the first

instance.

In the event of any tests being performed in countries other than India, the Contractor shall give sufficient Notice to the Engineer for witnessing the tests. The cost of the Engineer overseas visit shall be borne by the Employer.

The Contractor is reminded that, at some point, the traction system will be energized and that additional precautions for the safety of staff and co-ordination of activities after "power-on" shall be anticipated in his installation, testing and commissioning programs.

### **E3.3 Sequence of Tests**

The sequence of tests shall be:

- type tests;
- factory acceptance tests (FAT) or works test;
- Preinstallation tests
- installation tests; and
- partial acceptance tests (PAT):
- functional tests;
- integration tests; and
- dynamic tests;
- system acceptance tests (SAT);
- tests on completion.

Prior to opening for Public Services, the Employer or the Engineer will conduct Integrated System Tests in conjunction with System wide / Interfacing Contractors to demonstrate that the complete system comprising the Project is fully operational. The Contractor shall be in attendance as a requirement during the Defects Liability.

### **E3.4 Type Tests**

Should the Contract include any equipment not previously proven in service or of any modified design the Contractor shall undertake thorough testing of pre-production units to the satisfaction of the Engineer.

Type tests including prototype shall be performed prior to full production and before FAT.

Type testing shall be used to confirm that the proposed equipment is fit for purpose in the environmental conditions specified and meets the requirements of the Specification.

### **E3.5 Factory Acceptance Tests (FAT)**

Works Tests shall include but not to be limited to:

- Dimension check
- Electrical check
- Calibration
- Output check
- Operational performance
- Full Load test
- Flash-over test
- Insulation test

- Soak test
- Any other test required as per relevant standards or codes

A Factory Test Plan shall be submitted for a Notice from the Engineer within 6 months from the Date for Commencement of the Works.

All materials, components, sub-assemblies, unit assemblies (including software, cables and wiring) shall be subject to testing and certification. Notification of these Tests shall be submitted to the Engineer 30 days in advance of carrying out any Test. The Engineer will then determine which, if any, items may be accepted based on previous supply or experience

The FAT shall demonstrate that each subsystem and the System meets its functional specification.

No equipment or software shall be delivered to the Site until the Contractor has demonstrated to the satisfaction of the Engineer that the equipment or software conforms to the Specification by carrying out the FAT.

Where necessary, interfaces shall be represented by simulation.

Where processor based equipment is to be used, the Works Tests shall include also verification of software used in this application.

### **E3.6 Installation Tests**

#### **A. Prerequisites for Installation**

- Prior to installation, the Contractor shall ensure that equipment delivered to Site has not been damaged in transit and ensure for their dimensional accuracy.
- Designs for the Sections under test shall be completed and submitted to the Engineer for a Notice prior to Installation.

#### **B. Inspection**

- The inspection shall verify that equipment has been installed to the procedures and design that have been given a Notice of No Objection by the Engineer and that equipment is correctly located and labelled.
- The inspection shall verify that any false feed, temporary wiring and redundant items have been removed and that equipment is correctly protected against interference, damage and deterioration.
- The Contractor shall maintain inspection records to demonstrate that each item of equipment has been inspected and found to be satisfactory, and attach to this record a detailed list of any discrepancies found and remedial work carried out.
- As defects are rectified, these shall be recorded on the appropriate inspection record.

#### **C. Installation Tests**

Installation tests shall be carried out by the Contractor for each subsystem following Installation but before Functional Tests to demonstrate that the installation has been carried out correctly and equipment is properly housed and

fixed.

During and on completion of installation, the Contractor shall undertake testing of all cables, wiring and equipment, instrumentation and protection devices, in a progressive sequence and in accordance with the overall-testing programs.

These tests shall culminate in Functional Tests to verify the correct operation of all apparatus and, where appropriate, correct response to the respective control commands or monitored function.

D. Partial Acceptance Tests (PAT)

Prerequisites for PATs are;

- Installation work shall be completed and inspection records submitted to the Engineer for assessment before the commencement of each PAT.
- The PAT Plan shall be submitted for the Engineer's Notice at least 120 days before the commencement of each PAT.

E. Functional Tests

The functional tests of the PAT shall be carried out on installed equipment before System Acceptance Tests (SAT) to demonstrate that the Section of the Works operates correctly in accordance with the Specification.

The functional tests shall sequence through all required operations to prove that the System performs in accordance with the Specification and that the local configuration data (for example, control tables) is correct.

Where necessary, input conditions shall be simulated. The functional tests shall be specified and carried out by Contractor's personnel independent of design and installation.

F. Integration Tests

Partial Acceptance Test (PAT) shall include integration tests to integrate the various subsystems of the System and demonstrate correct operation of all internal and external interfaces.

Following satisfactory completion of these Tests the Contractor shall prepare the installation for formal demonstration in the presence of the Engineer.

G. System Acceptance Tests (SAT)

The Contractor shall prepare and organize a comprehensive program of Tests to demonstrate to the Engineer that all systems, sub-systems and apparatus defined under the Contract meet the specified performance requirements in all respects.

Prerequisites for SAT

The requirements that shall be satisfied before the commencement of the System Acceptance Tests (SAT) are:

- All documentation for the Safety Report shall be submitted to the Engineer for Notice.
- All PAT shall be completed and test records submitted to the Engineer for Notice.
- Operator's staff shall be given a training course in the System as defined in the

Section on Training herein.

- Facilities for the maintenance of the System shall be in place.
- The SAT Plan shall be submitted to the Engineer for Notice at least 120 days before the commencement of the SAT.
- Any test specifically requested by the Authorities from whom clearances /approvals are required to be obtained.

### **E3.7 Integrated System Test**

The Contractor shall submit to the Engineer requirements and procedures for Integrated System Tests in conjunction with Interfacing Contractors to demonstrate that the complete system comprising the Project is fully operational and meets the specified performance criteria. The conducting of these Integrated System Tests shall include a period of Trial Running.

It is a requirement of the Contract that the Contractor is in attendance for the System wide Testing and Commissioning of the Project. A tentative schedule is included in the document 'Transit System Testing and Commissioning', as attached to Appendix 21 of this Part 2, section VI.

### **E3.8 Trial Running**

Following satisfactory completion of the System Acceptance Tests and the Integrated System Tests the Employer will commence an extended period of Trial Running to prove all technical systems in time table operation, to allow all technical systems to settle and to train staff in working procedures.

Trial running shall include:

- the regular circulation of a full complement of trains as required for 24 hours of scheduled service, including peak demand. Intentional disruption of the service shall be included (e.g., extended dwell times, vehicle, power systems, ATP, ATO, point operation and train detection failures) in order to check operational stability and safety of the system and the effectiveness of the supervisory control software employed in reducing the effect of such disruptions;
- the determination of the actual headway achieved at each station for all specified routes and including intermediate reversing movements and movements into and out of the depot.

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

### **E3.9 Samples for Testing**

Samples that have been tested may be incorporated in the Works provided that:

- the sample complies with the specified requirements;
- the sample is not damaged; and
- the sample is not required to be retained under any other provision of the Contract.

Additional samples shall be provided for testing if in the opinion of the Engineer

- material previously tested no longer complies with the specified requirements; or
- material has been handled or stored in such a manner that it may not comply with the specified requirements,

Unless agreed otherwise all Tests shall be carried out by the Contractor in the presence of the Employer, the Engineer and/or their authorized representative.

Attendance on Tests, including that by the Employer, the Engineer and/or their authorized representative, and the Contractor, shall be as laid down in the Quality Assurance procedures contained in Appendix 6 of this Part 2, section VI.

### **E3.10 Records of Tests**

Records of Tests carried out shall be kept by the Contractor and a report and all Test results shall be submitted to the Engineer no later than 15 days after completion of the Test. In addition to any other requirements, the report shall contain the following details:

- material or part of the Works tested;
- location of the part of the Works;
- place of testing;
- date and time of tests;
- technical personnel supervising or carrying out the tests;
- equipment used and method of testing;
- readings and measurements taken during the tests;
- test results, including any calculations and graphs;
- specified acceptance criteria;
- other details stated in the Contract.

## **E4 MAINTENANCE**

The Contractor shall provide a maintenance support plan that shall include such items as:

- procedures for maintaining each item, unit/equipment including routine inspection, periodical overhaul and test running,
- technical manuals,
- initial provision of spares, facilities, test equipment; tools, software, jigs and fixtures,
- training requirements,
- procedures for removal and replacement of components,
- Periodic running of equipment and machines which would otherwise deteriorate because of non-operation for 'more than a week',
- Manpower plan required for maintenance,

On completion of Trial Running the Contractor shall deliver up to the Engineer copies of all manufacturing drawings, schedules and software for all components, as well as all As Built Drawings.

On commencement of Revenue Service the Contractor shall deliver up to the Employer copies of all such manufacturing drawings, schedules and software for all components,

as well as all such As Built Drawings, as shall have been amended or updated since the completion of Trial Running of the Contract.

## **E5 MANUALS**

The Contractor shall produce manuals for all equipment and systems supplied. These shall include, but may not necessarily be limited to the following:

- System Manuals - A comprehensive description of all system principles at block diagram level.
- Operating/User Manuals - broken into as many sub-sections as may be necessary and providing sufficient information to enable non-technical staff to exploit fully the facilities of each system.
- Workshop Manuals - installation and circuit descriptions, full schematics, circuits, wiring diagrams, mechanical construction drawings and itemized parts list to enable all maintenance rectification and setting-up to be carried out.
- Software System Manuals - for each software package and each piece of equipment which incorporates programmable devices and for which bespoke software has been prepared specifically for this application. Source code listings with comprehensive comments shall be provided for all bespoke software together with configuration listings for all configured standard software packages.
- Equipment Room Manuals - all wiring diagrams and circuits, equipment layout, terminal and cable listing and including such external equipment as may be necessary for completeness.
- Maintenance and Servicing Manuals - to specify requirements, procedures and servicing intervals for planned preventative maintenance and in addition to convey sufficient information on equipment principles and practice to enable first line fault diagnosis and rectification by technician staff.

The Operating/User Manuals and a summary (suitable for use at technician level) of the Maintenance and Servicing Manuals shall be prepared in English, Hindi and Marathi language. Other technical manuals shall be supplied in the English language only.

The Contractor shall submit all Manuals for a Notice by the Engineer prior to Factory Acceptance Tests.

The Contractor shall provide 6 controlled copies of all Manuals for the use of the Engineer.

The Contractor shall maintain all Manuals in an up-to date condition throughout the Contract Period.

## **E6 SPARES, SPECIAL TOOLS AND TEST EQUIPMENT**

### **E6.1 General**

During the Contract Period, the Contractor shall provide free of cost all materials including consumables, unit exchange spares and emergency spares required for maintenance (routine and breakdown) of the Electrical, Mechanical and Plumbing Systems (EMPS). The Contractor shall supply the spares, materials, jigs and fixtures not later than 6 (six) weeks before the commissioning of revenue services.

If these spares are not consumed during the Contract Period, these shall become the property of the Employer at the end of Contract Period.

### **E6.2 Tools and Test Equipment**

The Contractor shall provide free of cost, at least six weeks prior to the start of trial running, all special tools and test equipment which are essential for day to day use in both corrective and preventative maintenance and for workshop use in the overhaul of all modules and units likely to be required over the full service life of the installation.

### **E6.3 Spares List**

The Contractor shall submit within 6 months from the Commencement Date, a schedule of spare parts required for EMPS duly indicating, for each item of spares, its description, part number, drawing number, lead time, shelf life and number of units required for ten years beyond the Contract Period, as well as for the expected life of EMPS, principal as well as secondary sources of supply and also the unit price of each spare with escalation clause, for the Engineer's Notice.

This schedule shall include all types of consumable, unit exchange and emergency spares. The Contractor shall also advise upon recommended inventory having regard to the lead time of the respective items.

The Employer shall, during a period of ten years from the date of issue of the Taking-over Certificate for the whole of the Works, purchase as many parts as required by him, at the rates indicated in this schedule.

If during the period of ten years, the Contractor intends to discontinue the manufacture of spare or replacement parts for the EMPS the Contractor shall immediately give Notice to the Employer of such intention. The Employer shall be given the opportunity of ordering at reasonable prices such quantities of such spare or replacement parts as the Employer shall reasonably require in relation to the anticipated life of the EMPS.

In the event of Contractor failing to supply the spare parts in accordance with this Clause, he shall in respect of each item of spare, furnish free of cost to the Employer, the drawings, specifications, patterns and other information to enable the Employer to make or have made such spare parts. The Employer shall be entitled to retain the aforesaid drawings, etc. for such time only as is necessary for the exercise by the Employer of his rights under this Clause and the drawings, and if the Contractor so requires, they shall be returned by the Employer to the Contractor in good order and condition (fair wear and tear accepted).

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

The Contractor will, so far as he is reasonably able to, bind his Sub-Contractors to conform with the requirements of this Clause and shall, prior to entering into any Sub-contracts, provide the Employer with full details of any Sub-Contractor who will not so

conform in which event the Employer may direct the Contractor to seek an alternative Sub-Contractor.

If the Contractor fails to provide spare or replacement parts as described in this Sub-clause and these are available from the Contractor's Sub-Contractor, the Employer shall have the right to obtain such spare and replacement parts from the Sub- Contractor or any other supplier and any additional cost incurred by the Employer shall be recoverable from the Contractor.

The Employer may require the Contractor to enter into a Maintenance Contract with the Employer for the EMPS provided under the Contract under terms and, conditions to be mutually agreed.

If due to upgrading or advance in technology any new type of models, versions or design of spare parts are developed in future, the same shall be plug compatible and space compatible with regard to original design and installation of EMPS.

Where the Contractor considers that any equipment that would be supplied, and which he considers cannot be economically or technically maintained by the Employer, e.g. computer processors, then such items shall be identified and proposals made for the maintenance of such equipment through OEM's.

All spare parts as mentioned in this Clause E6 shall be provided by the Contractor at least six (6) weeks prior to commencement of trial running.

The Contractor shall submit to the Engineer for a Notice, the following:

- a list of spares required for the life of the System.
- base the spares calculations on the reliability and availability data and the criticality of the equipment.
- the calculations and spares list.
- a Cardex system, or similar, for easy identification of spares.

The Spares list shall:

- be grouped by subsystem, test equipment and special tools, as applicable for stocking identification.
- have detailed description with drawing references and correlation with the maintenance manuals.

#### **E6.4 Secondary Sourcing**

The Contractor shall identify principal and secondary source suppliers that can supply the systems and sub-system spares listed. The Contractor shall submit the secondary source supplier information to the Engineer for a Notice, at the time of submission of the final design.

#### **E6.5 Long Lead Items**

The Contractor shall identify the lead times for all spare parts. Parts with long lead times shall be identified as such to the Engineer in the spares list.

#### **E6.6 Routine Change**

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.

#### **E6.7 Shelf Life**

In the event that any of the spares identified have a particular shelf life or special storage requirement, this shall be made known to the Engineer with the submission of the spares list, including the necessary action for disposal or storage.

#### **E6.8 Identification and Configuration Control**

All spare equipment identified on the spares list, shall conform to Identification and Configuration Control requirements established by the Contractor for the equipment provided under the Contract.

#### **E6.9 Testing of Spares**

The Contractor shall ensure that all spares are correctly calibrated, tested and labelled prior to their delivery. Test certificates for each equipment shall be submitted to the Engineer.

#### **E6.10 Delivery**

Approved spares, special tools and test equipment shall be supplied prior to commissioning.

### **E7 EQUIPMENT IDENTIFICATION**

All equipment and materials supplied shall be indelibly labelled or otherwise identified to show its identity, type, version, function, location, rating or limitation as appropriate. Removable modules shall have the same indelible labelling on the fixture to which the module is attached. The label shall be adjacent to the module or prominently marked on the module and shall not be obscured.

Labels shall conform to a unified system and shall require a Notice from the Engineer. Where any hazardous situation could arise due to fluctuating voltage level, air pressure, maladjustment, miss-operation etc, then prominent and permanent warning labels shall be provided to denote this.

In general, all labels shall be in English, Hindi and Marathi language. Where appropriate, such labels shall conform to accepted National or International Standards or as agreed by the Engineer.

### **E8 TRAINING AND TRAINING AIDS**

#### **E8.1 Training Objective**

The Contractor shall be required to arrange technology transfer to the Employer's staff in respect of design, manufacture, construction, handover, operations and maintenance of the plant and equipment provided under, the Contract. These staff will include the Employer's management, operation, technical and instructional staff. The Contractor shall train, or shall arrange training for, the Employer's staff who shall be nominated by the Employer. The Contractor shall train the Employer's Staff as follows:

- in sufficient detail so that the staff can appreciate, understand and monitor the technical, operational, maintenance, management and business aspects of the

system.

- thoroughly so that the staff can operate, maintain and manage the system.

The Contractor shall train or shall arrange training for the Employer's staff at all levels, covering all aspects of the operation, maintenance and management of the System. Of primary importance is the training of Employer's Training Staff, whose responsibility will be to provide support to the Training Instructors during the in-depth start-up training that will take place prior to and during initiation of trial running. These Employer's Training Instructors will also be responsible for implementing on-the-job training and skill enhancement training programs for the Employer's staff after commencement of trial running.

### **E8.2 Training Periods**

The Contractor shall propose appropriate man-months of training to be provided. All training courses will be conducted in English and/or Marathi.

### **E8.3 Training Instructors**

The training instructors provided by the Contractor shall be fully qualified and experienced electrical and mechanical engineers, who have a good knowledge of the English language. They will have had experience of training Engineers or technicians of the level stated on similar topics and will be fully familiar with the Equipment supplied or installed.

Before any of the Contractor's training instructors is appointed the Contractor shall submit a detailed curriculum vitae for each training instructor for a Notice from the Engineer.

Should, in the opinion of the Engineer, any of the Contractor's training instructors not be considered to be competent or not to have a suitable qualification, experience and attitude or aptitude for carrying out the training courses for whatever reason, the Contractor shall remove the said person and replace him as soon as possible with an acceptable substitute.

Where the Employer's staff are attached to the Contractor (or his Sub-Contractors) for the purposes of training, all such trainees shall be properly supervised and monitored by a qualified training supervisor to ensure that each trainee has the best opportunity to benefit from the theoretical and practical experience.

### **E8.4 Training Courses**

The Contractor shall be responsible for the safety, health and welfare of trainees when under training. Accordingly an explanation of the safety rules and codes shall form part of a general induction course to be given by the Contractor and where necessary the

Contractor shall issue a rule book for which the trainee shall sign indicating his acceptance and understanding thereof.

The training courses shall be programmed in phases with the progress of manufacture and installation to ensure that trainees are present during all stages of the manufacture, installation and commissioning of the Plant and Equipment that is the subject of the training. The Contractor shall ensure that the courses fully encompass all aspects of the

basic design, manufacture, installation, commissioning and maintenance of the Plant and Equipment with maximum effort being directed at instruction in the maintenance of the installations.

The training shall be structured in modular format, each module shall be capable of being delivered independently or together with other modules of a similar theme.

The Contractor shall provide a training plan that shall include as a minimum:-

- (1) schedule of training course;
- (2) objectives;
- (3) syllabus;
- (4) format of course;
- (5) training facilities required or to be provided;
- (6) list of training materials and documentation;
- (7) examination procedures; .
- (8) Training Instructors' qualifications; and
- (9) course evaluation methods.

The Contractor shall make full and appropriate use of multi-media and computer techniques in the design and delivery of training packages. This shall include all necessary teaching aids as well as technical literature, manuals, photographs, drawings, video and films, models and all other instructional materials as may be necessary for the training of the personnel. Such materials, other than videos, films and reproducible materials prepared specifically for the trainees, shall be retained by the Contractor at the end of each training program.

The Contractor shall provide all training material that shall include as a minimum:-

- course agenda;
- objectives;
- lesson plans;
- outline presentations;
- Equipment Software manuals.
- training aids including that on the video film media; and
- computer based training requirements.

### **E8.5 Training Equipment**

In general, the Contractor shall use Equipment specifically set aside for training purposes. However, he may use, for the training of the Employer's staff, subject to a Notice from the Engineer, Equipment being installed, tested or commissioned when no other such Equipment is available. The Contractor shall not use for this purpose spare parts from assemblies.

Any special or protective clothing required by the trainees shall be provided by the Contractor, free of charge.

Personal items of clothing shall be of new issue and may be retained by the trainee on completion of the training course.

## **E8.6 Monitoring**

Throughout the training programs, the Employer and the Engineer shall have free access to all training sessions to monitor the progress of the trainees and the Contractor's training instructors.

To ascertain that the objectives of the courses have been achieved, the Contractor shall set periodical theoretical and practical tests for the trainees. The results of these tests together with a report on the trainees' general attitude, ability, technical knowledge, aptitude and attendance record shall be forwarded at regular intervals to the Employer, who may also require the submission of additional reports in special cases.

Methods for monitoring progress shall include; but will not necessarily be limited to:

- (a) theoretical tests and systems of assessment;
- (b) practical test pieces and objective systems of assessment;
- (c) progress reports.

Records of the progress of trainees shall be kept up-to-date and shall be made available to the Employer for examination when required.

Copies of the records of individual trainees showing all test results and reports of progress, shall be sent to the Engineer on completion of each training course.

## **E8.7 Training Location and Facilities**

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 places of manufacture, assembly or testing, or at such other locations as may be necessary. All places of training shall be subject to the Engineer's Notice. Details of the facilities to be provided shall be included with the detailed training programs submitted by the Contractor.

## **E8.8 Administration**

The Contractor shall:

- (a) be responsible for the reception of, and hotel and travel arrangements for the Employer's and Engineer's monitoring staff and each trainee whether in India or any other country.
- (b) be responsible for the general welfare of trainees under his control.

## **E9 PACKAGING AND STORAGE OF PLANT AND –MATERIALS**

### **E9.1 Shipping and Storage**

The Contractor shall be responsible to prepare, protect and store all equipment and materials so as to safeguard them against loss or damage from repeated handling, climatic influences and all other hazards arising during shipment or storage on or off the site.

The Contractor shall provide secure and covered storage for all equipment and materials except as otherwise agreed by the Engineer as being suitable for open storage:

### **E9.2 Crating**

Each case, crate or package shall be, of robust construction and suitable for the

intended purpose. Packaging materials that are likely to suffer a deterioration in quality as a result of exposure to environmental conditions likely to be met during transit from the factory of origin to the Site shall not be used. The contents of each case, crate or package shall be protected against the harmful effects of ingress of water by enclosing within a heavy duty waterproof membrane, and adding a suitable desiccant substance (e.g. silica gel) to the case, crate or package.

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

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

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

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

Details of cases, crates, packages, containers, etc., intended to hold important or delicate items of equipment or materials shall be submitted to the Engineer for a Notice.

### **E9.3 General Precautions**

Spare parts shall be suitably packed for storage over an indefinite period without deterioration and shall be clearly identified, showing full name and part number, without any need to unwrap packaging. Electrical and other delicate items or equipment shall be cocooned.

Cable ends, cable entry points into equipment and other similar terminations and openings shall be sealed or blanked off to prevent the ingress of dirt or moisture.

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

Particular care shall be taken to prevent damage to, or corrosion of, shafts and journals where they rest on timber or other supports that may contain moisture. At such points wrappings impregnated with anti-rusting compositions shall be used of sufficient strength to resist chafing under the pressures and movements likely to occur in transit.

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

#### **E9.4 Packaging Procedures**

All Packaging procedures shall be submitted to the Engineer for a Notice.

The Contractor shall remove all empty cases, crates, or packages from the site within 1 month of their being emptied and dispose of them in an environment friendly manner.

#### **E10 EQUIPMENT PROTECTION**

All equipment shall be capable of short term continuous operation, without the benefit of air conditioning or forced cooling, at the extremes of environmental conditions likely to be encountered. All equipment shall be capable of continuous operation in its normal environment and achieve its stated service life.

It is a basic requirement that the minimum of equipment shall be mounted on the line side. Any line side equipment shall be limited to essential rail connected apparatus such as track circuit termination units or point equipment. All other equipment shall in general be mounted in equipment rooms provided at each station or in easily accessible plant rooms.

Equipment and location cases shall be fully protected against the ingress of dust, water and the accumulation of moisture due to condensation.

The Contractor shall be responsible for ensuring that his equipment and systems are not adversely affected by the modified environmental conditions caused by the localized heat or vapor emissions or moisture of other adjacent equipment whether provided under the Contract or otherwise.

#### **E11 ELECTROMAGNETIC PROTECTION**

All equipment and systems supplied shall be able to withstand without fault, power supply surges, interference and transients as may be caused by lighting circuits, power and traction supplies, switching effects, and lightning. The Contractor shall provide anti-surge devices and any other protective devices required to fully protect the Equipment and the system against such effects.

The Contractor shall make due allowance and provision in his design for the high magnetic and electric fields likely in the vicinity of train traction and power supply systems; for the high magnetic and electric fields likely, due to high voltage (non-railway) power supply cables running parallel and near to the track and stations, and any other effects to be expected.

The Contractor shall provide shielding and filtering of Equipment so as to ensure that any conducted or radiated interference is eliminated or reduced below the level of susceptibility of other equipment or domestic or industrial appliances in the vicinity of the railway which have been designed, manufactured and operated in accordance with current recognized standards.

The Contractor shall declare the emission standards proposed for use in the installation. The emission standards shall be maintained whilst the equipment is in normal operational mode and additionally whilst being maintained or under test. For

example, access doors that are normally closed but opened to permit maintenance, testing or adjustment, shall not form part of any essential electromagnetic screen,

The Contractor, shall, be responsible for ensuring that the operating frequency of any Equipment supplied under the Contract is compatible with any frequency used or planned for use by existing railways connecting with or adjacent to the new installation.

The system shall comply with relevant National and International standards with respect to electromagnetic compatibility.

## **E12 POWER SUPPLIES AND EARTHING**

Power supply will be drawn from the 100 kV supply (or as decided at the time of detailed design of Power Supply works by Power Supply and Traction Contractor) at a main receiving station and distributed by a 33 kV ring main (or as decided at the time of detailed design of Power Supply works by Power Supply and Traction Contractor). Traction sub-stations will supply nominal 25 KV to the OHE system. Auxiliary sub-stations located in each passenger station and in the Depot will supply power at 415V AC.

Earthing electrodes and an earthing busbar will be provided at the main receiving station and at all traction and auxiliary sub-stations. The 33 kV(or as decided at the time of detailed design of Power Supply works by Power Supply and Traction Contractor) ringmain armouring will be connected to all electrodes/earth bars forming a System Earth (SE).

All Mechanical and Electrical services shall be earthed to the SE bus bar at the appropriate station. Earth connections shall not be made to any other point or to the return rails. Earth connections shall be arranged so as to ensure that circulating currents cannot flow. The metallic sheaths and armouring of all cables emanating from equipment rooms shall be earthed to the earth system for that room but otherwise shall be insulated from earth throughout their length. Enclosures and frames of equipment shall be earthed to the armouring or metallic sheath of the cables supplying them or to a separate insulated earth cable.

All metallic boxes, or similar, installed in the underground section shall be insulated from any metallic structural elements.

On station platforms, mechanical and electrical equipment shall be kept outside a 2.5m range of the trains. Where this is not possible, double insulated unearthed equipment shall be provided. To avoid touch potential problems at platforms the surface of the station platforms within 2.5m of the edge of platform will be insulated from ground earth by insertion of an insulating membrane.

## **E13 MAINTAINABILITY**

Systems shall be designed to maximize their availability during traffic hours.

Systems architecture and technology shall be such as to minimize the amount of maintenance required and to facilitate rapid fault rectification. To this end, designs shall in general, permit and confine these activities to three levels only, namely:

- First level, with all main Sub-systems exchangeable on a unit or modular replacement basis.
- Second level, at the Workshop for overhaul or repair of non-exchangeable items.
- Third level, component repair. However, in general, equipment shall be modularized to the level where it is more economical to dispose of a faulty module than to repair it.

The location of a faulty unit or module shall, where at all feasible, be self-revealing through built-in monitoring/indicating features.

The replacement of a unit or module in the field shall not require any compensating adjustment to associated equipment to secure the specified performance.

The average failure diagnostic time after arrival of maintenance personnel on site shall not exceed 15 minutes.

The average failure repair and check-out time after replacement parts are available on site shall not exceed 15 minutes or such longer period as may be agreed by the Engineer.

In consideration of the above, preference will be given to system concepts which minimize the amount of failure prone equipment which may be located remote from central facilities and/or be difficult to access.

Where built-in indicators or meters are provided for maintenance or fault location purpose, then any associated adjustments of controls shall be located so that they can be manipulated and the results observed by one person simultaneously.

Any test points or facilities for adjustments involving safety critical functions shall be protected against unauthorized access.

#### **E14 SCADA INTERFACES**

Monitoring of all electrical and mechanical equipment shall be carried out by the SCADA system supplied by Interfacing Contractors. Interfacing between the various system components and the SCADA system shall be coordinated with the respective Interfacing Contractors. The Contractor shall liaise with the Interfacing Contractors to ensure the interfacing between the mutual systems meets their joint and individual specification requirements.

Volt-free contacts, operated by the equipment to be monitored, shall be provided wherever status monitoring is specified for interrogation by the SCADA System. Status contacts shall be rated to permit a wetting current of 2mA typically at a contact voltage of between 12V and 110V DC, for the design life of the equipment. Contacts shall be configured to be fail-safe such that the contact is open when the equipment is in the unsafe or abnormal condition. Equipment requiring positive indication in both states shall be fitted with independent volt-free contacts, one to represent each state.

Transducers for measured operational parameters (i.e. analogue signals) shall provide an output of 4-20 mA output over the full operating range of the input variable. Particular attention shall be paid to correct scaling of the transducers to ensure that the full output range corresponds to the maximum expected operating range of the

measured variable. For example:

- a transducer output of 4-20mA, representing a measured voltage input shall correspond to a voltage range of typically 25% above and below the nominal voltage, not 0 to 100%;
- a transducer output of 4-20mA" representing a current transformer (CT) input shall correspond to the full calibrated range of the CT, typically 0 - 1 20% (0-6 amps): '

The Contractor shall compile, for each item of Plant, and submit to the Engineer, a tabulated list of the proposed monitoring and control signals that shall include:

- equipment description;
- signal description;
- signal type (input, output, digital, analogue, pulse, alarm, status, etc.);
- operating sense (e.g., open contact represents the alarm condition);
- scaling (range of input parameter for full scale output range of transducer).

Monitoring facilities shall be provided for all power supply systems incorporating float-charged batteries. Facilities shall include:

- direct indication of the battery voltage as an analogue signal;
- status of the battery charger (fault, mains power present, charging battery, etc.).

All local/remote selector switches capable of disabling control by the SCADA system shall have status contacts provided and connected to the SCADA system.

Labelled terminals and connection diagrams shall be provided for all monitoring and control signals. Terminals shall accept cable cores up to 1.5 sq. mm.

All analogue and transducer output signals shall be wired using cable with individually screened twisted pairs.

The Contractor shall liaise with all Interfacing Contractors to list all parameters required to be transmitted by the SCADA system.

The required parameters shall be derived from the information required at the Control Centre and at SCR's to permit operation of the system from a central control point in a safe and efficient manner in compliance with the performance specification.

The list of parameters that shall include inputs and control outputs shall define name, type, range etc. The inputs/outputs required shall include, but not be limited to, sufficient input and outputs to monitor and control any components or equipment that may affect the operation and safety of the transport system.

#### **E15 KEYS AND LOCKS**

The Contractor shall provide for all cubicles, cabinets and panels, a means of locking appropriate to the location. All locks shall conform to a system suited to meet the requirements of the Engineer and Interfacing Contractors.

#### **E16 MANAGEMENT OF CONFIDENTIAL INFORMATION**

Systems suppliers, providing software, shall ensure that the programs have built-in security procedures and systems to permit management to restrict access to specific portions of the programs or operation thereof, and/or to appropriate staff levels or departments. Any attempted unauthorized access shall be alarmed and identified.