

APPENDIX-01

1. PROGRAMME REQUIREMENTS

1.1 General

1.1.1 Construction Programme and project monitoring

1. The contractor shall propose and submit his detailed construction program separately and as per the procedure detailed in the scope of work. Contractor may be asked to schedule and complete the work block wise I area wise in a phased manner fixing priorities to different stretches of the work to give access to other interfacing contracts as mentioned in the Bid documents.
2. The tentative construction program shall be submitted within the period as specified in the Bid document for approval of the Employer as 'Baseline Program'. The base line program shall clearly reflect interface and access dates for other civil I system-wide contracts. The basis of the time schedule for each activity such as productivity of man and machines and time cycle of each activity and resource planning shall be submitted along with the base line program.
 - a. After the work has started, the contractor shall deliver in the first week of every month to the Employer and the Engineer an update of the Construction Program showing changes, if any, in planning or progress scheduling and reflecting the progress of all the activities of the network and the project status as at the end of previous month.
 - b. If the contractor falls behind the approved Construction Program by more than one month, he shall, within fourteen days of the date of such information, submit to the Employer for approval, a revision of the construction program showing the proposed measures, including augmentation of plant, labor and material resources to complete the works on time.
 - c. Whenever the contractor proposes to change the construction program, he shall immediately advise the Employer in writing and, if the Employer I Engineer considers the change a major one, the contractor shall submit a revised program for the approval of the Employer.
 - d. Detailed Network Plan (Works Program): Detailed Network Plan shall be prepared by the contractor for each and every activity within the same time frame and in the same sequence. Activity at this level shall not be more than 15 days' duration, except for summary items like procurement I mobilization etc.
3. The contractor shall select a PC-based broad planning and control software (licensed version of Primavera). The two networks shall be implemented on works as detailed in the Scope of work. The contractor shall supply one original licensed copy of the software selected including manuals and any subsequent versions thereof at no extra cost along with the Baseline program network and detailed network plan and load it on the PC system of the Employer and Engineer so that uniform monitoring of the project is done and any slippages are identified well in time and corrective action taken. The contractor shall also arrange suitable training of the personnel of Employer and the Engineer on the selected software, if required, at no extra cost, as per the directions of the Employer.

The following reports, in agreed formats and frequency, shall be submitted by the contractor at his own cost:

- 1) Progress Reports
- 2) Material Status Reports
- 3) Equipment and Manpower Deployment Reports
- 4) Any other Report desired by the Employer or the Engineer

4. The Employer / Engineer's monitoring team will have access to all the data / information of the contractor, required for the assessment of the progress and monitoring. If necessary, the monitoring team will visit the Vendor / Contractor's works in order to assess the status of critical activities.
5. Periodic Project Status Review Meetings will be held by the Employer. The contractor shall depute his Engineers / Managers at appropriate level, as decided by the Employer, to attend the Review Meetings with all up to date information in a presentable quickly perusable format.
6. Progress photographs of the major events shall be submitted by the contractor along with the Progress Reports. Video Recording of the progress of works shall be maintained from beginning till completion of work as directed by the Engineer.
7. The contractor shall provide additional inputs whenever the PERT-CPM / network diagram (Primavera) indicates a possible slippage in the completion schedule. Such additional inputs may require supplementing of equipment, personnel, work in excess of the normal work per day, and work in excess of the normal work per week or other resources. Provisions in the relevant Clause of General Conditions of Contract will be applicable in cases of delays due to contractor.

1.1.2 Purpose of Program

- a) The purpose for the requirement of Program (Scheduling) information described in this document is to provide the Engineer with status reports for managing, monitoring and coordinating the awarded contract during the execution within the overall multi-contract project schedule. It describes a series of reports to be submitted by the contractor to the Engineer during the execution of the contract, following the award of Contract.
- b) Contractor shall program his work at all times to meet the Key Dates and the Works Area Hand-over Dates specified in the bid documents and the specified interface periods for the design and installation of the works with those of the Designated Contractors and shall during the progress of the works constantly monitor his progress against the programs described below.
- c) Contractor shall include in all programs his work obligations towards shared access, shared site areas and other coincident or adjacent Works Areas.
- d) The Works Program, and all more detailed or revised versions, shall be submitted to the Engineer for his consent.

1.2 Methodology

- 1.2.1 The computerized Primavera network using the Precedence Diagramming Method (PDM) has been selected by the Employer as the technique for contract management system and in coordinating the multi-contract project. This technique shall also be employed by the Bidder in preparing their Bid submissions and by the contractor in their Construction Stage submissions.
- 1.2.2 Unless otherwise agreed by the Employer, all programs submitted by the contractor shall be produced using computerized Primavera Networks developed implementing the Precedence Diagramming Method (PDM) with Resource Loaded Charts and Tables.
- 1.2.3 Contractor shall implement and use throughout the duration of the Contract, a computerized system to plan, execute, maintain and manage the planning, design, pre-construction, construction, and sub-contracts in executing the Primavera scheduling by PDM. The reports, documents and data shall be provided monthly and shall be an accurate representation of the current status of the Works and of the work remaining to be accomplished; work planned to be taken up during next month, shall provide a sound basis for identifying problems, deviations from the planned works, and for making decisions; and shall enable timely preparation of the same for presentation to the Engineer.

1.3 Programme management software

Primavera programming software used shall be Primavera 6.0 v 21.12 programming software shall be used.

1.4 Submissions

- 1.4.1 The contractor shall develop bid Program into the Initial Works Program including an outline Narrative Statement and submit within 28 days of the date of receipt of Letter of acceptance and its more detailed version within 15 days of receiving the Employer's consent to the proposed Initial Works Program.
- 1.4.2 Activities in the initial works program should be arranged as per the Works Break down Structure (WBS) of the work. The WBS of the work would be developed by the contractor in consultation with the Employer I Engineer. Contractor would get the WBS approved by the Employer and the program expert.
- 1.4.3 The first Three Month Rolling Program shall also be submitted along with Initial Works Program within 28 days of the date of receipt of Letter of Acceptance and all subsequent editions shall accompany the Monthly Progress Report. The Monthly Progress Reports shall also include a Program Update as described below. These programs shall subsequently be updated as described below.
- 1.4.4 Following the Employer's consent to Contractor's Initial Works Program submission, the contractor shall make submissions of the Detailed Works Program suitably amended to take into account the programs of Designated Contracts. It is the contractor's responsibility to ensure timely co-ordination with the Designated Contractors to review, revise and finalize his Initial Work Program so as not to affect the progress of Works / and or the works of the Interfacing Contractors. The resubmitted program when approved by the Employer and the program expert shall form the Baseline Program against which actual progress of the Contract shall be reckoned. As the work progresses, it may be necessary to update I revise the Baseline program but such updating shall only be carried out with the prior consent of the Employer / Engineer or when directed by them.
- 1.4.5 For Initial & Detail Work Program submission, one (1) original and six (6) copies each (along with electronic copy) of the following Programs and Reports shall be submitted to the Employer I Engineer:
 - a) Program: Baseline Primavera Network
 - b) Program: Baseline Milestone based Cost Activity Schedule
 - c) Baseline Schedule Report
 - d) Narrative
 - e) Baseline Physical Progress 'S' curve
 - f) Baseline Resource Charts (with Resource leveling)
 - g) Detailed Method Statement
- 1.4.6 The Employer / Engineer shall review and comment on the Contractor's programs and information submitted. The Engineer will confirm his consent or otherwise of the submissions.
- 1.4.7 The Employer / Engineer shall require the contractor to re-submit within fifteen (15) calendar days if he is of the opinion that the programs and information submitted by the contractor is unlikely to meet the Contract key dates.
- 1.4.B If in the opinion of the Employer / Engineer, any of the contractor's revised programs or Baseline Schedule Report is not acceptable, it shall be construed as a failure of the contractor to meet a Milestone.
- 1.4.9 Notwithstanding the above, the Employer / Engineer may at any time during the course of the Contract require the contractor to reproduce the computer-generated Baseline Schedule Report described above to reflect actual activity dates and generate schedules based upon "what if" statements. The initial computer-generated report after receiving the Engineer's consent will serve as the base against which the contract progress will be measured. Any

changes to the Report reflected in subsequent Baseline Schedule Reports shall also require the Engineer's consent.

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

1.5 Works Programme

- 1.5.1** The Works Programme shall show the contractor's plan for organizing and carrying out whole of the Works.

- 1.5.2** The Works Programme shall be a computerized Primavera network developed using the Precedence Diagramming Method (PDM) and shall be present in bar chart and time-scaled network diagram format to a weekly time scale.

- 1.5.3** Tasks in the Works Programme shall be sufficiently detailed to describe activities and events that include, but are not limited to, the following:

- (a) Key Dates, and Works Area Hand-over Dates and Interface dates.
- (b) All physical work to be undertaken in the performance of the Contract obligations, including Temporary Works,
- (c) The requested date for issue of any drawings or information by the Engineer,
- (d) Procurement of major materials and the delivery and I or partial delivery date on-Site of principal items of Contractor's Equipment,
- (e) Commissioning date of Contractor's major equipment
- (f) Any off-site work such as production or pre-fabrication of components,
- (g) Installation of temporary construction facilities,
- (h) Interface periods with Designated Contractors or utility undertakings,
- (i) Design, supply and I or construction activities of sub-contractors,
- (j) Any outside influence which will or may affect the Works.

- 1.5.4** The Works Programme shall show achievement of all Key Dates, Interface dates and Works Area Hand-over Dates. The Works Program shall also show all Milestones, but the Milestones shall not be taken as imposing any constraints that in any way affect the logic or limit any other dates in the program.

- 1.5.5** Activity descriptions shall be unique, describing discrete elements of work. Any activity creating an imposed time or other constraint shall be fully defined by the contractor.

- 1.5.6** The Works Programme shall be organized in a logical work-breakdown-structure including work stages and phases, and shall clearly indicate the critical path(s).

- 1.5.7** Activity duration shall not exceed 15 days, unless otherwise consented to by the Engineer, except non-construction activities such as submittals, submittal reviews, procurement and delivery of materials or equipment and concrete curing. The contractor shall submit a Program / Project Calendar cross reference clearly indicating the allowance for holidays.

- 1.5.8** The Works Program, in each submission, shall be accompanied by an Activity Report and a Narrative Statement as described below in both electronic and hard copy format (time scale logic diagrams in A1 / A3 size, reports in A4 size).

- 1.5.9** Activity Report shall list all activities, and events in the Works Program, sorted by activity identification number.

The Activity Report shall include the following for each activity and event:

- i. Activity identification number and description,
- ii. Duration expressed in Days,

- iii. Early and late start & early and late finish dates. Planned start and finish dates,
- iv. Calculated total float and free float,
- v. Predecessor and successor(s), accompanying relationships and lead I lag duration,
- vi. Imposed time or date constraints,
- vii. Calendar.

1.5.10 Narrative Statement

The Narrative shall be a comprehensive statement of the contractor's plan and approach for the execution of the Works and the achievement of key dates, handover dates, submission dates and any intermediate dates. It shall incorporate outline method statements in respect of major items of work including construction sequences, launching scheme, resources required including primary item of plant, Construction Equipment required, person responsible, quality checks, inspection and test procedures, tolerances, Temporary Works and the like, risk analysis, etc. for carrying out that activity. It shall fully explain the reasons for the main logic links in the Program and include particulars of how activity duration is established. This shall include estimated quantities, production rates, hours per shift, work days per week and a listing of the major items of Construction Equipment planned for use on the project. Activities, which may be expedited by use of overtime or additional shifts, shall be identified and explained. A listing of holidays, and other special non-work days being used for the computer reports shall be included.

1.5.11 Baseline Physical Progress 'S' Curve

The contractor shall also submit a forecast Cumulative Physical Progress 'S' curve based on the time-phased distribution of cost in the Primavera Network Logic Diagram, expressed in percentage terms. This 'S' curve shall be generated from the computerized Primavera Network Logic Diagram.

1.5.12 Baseline Resource Charts

The contractor shall also submit a Resource Charts, generated from the Contractor's Primavera Network Diagram, showing the anticipated manpower and main Construction Equipment usage during the execution of the Project. The Resources shall be properly leveled using primavera VP6 software.

All submissions of proposed Works Programs subsequently, after approval of the Initial Works Program, shall include the actual physical progress of work and forecast of the remaining work. Actual progress shall be stated in percent complete, remaining duration, and actual start and finish dates for each activity in the Works Program.

1.6 Initial Works Programme

- 1.6.1 The Initial Works Programme submitted as under Clause 1.4.1 need not include the full details given under Clause 1.5 above. It should be a condensed version with combined activities of longer duration but must show clearly how the requirements of the Contract shall be achieved. Activities in the initial works program should be arranged as per the Works Break down Structure (WBS) of the work. The WBS of the work would be developed by the contractor in consultation with the Engineer. Contractor would get the WBS approved by the Engineer. The outline Narrative Statement shall be in sufficient detail to clearly show the contractor's intention.
- 1.6.2 Within 15 days of the Engineer's consent to the Initial Works Program, the contractor shall submit to the Engineer an expanded and more detailed version of the Initial Works Program containing all of the information and detail required under Clause 1.4 and 1.5 above.
- 1.6.3 Such submission shall make use of the Program submitted earlier but refined to include the best estimates of dates for the work of Designated Contracts which has impact on the contractor's program. Such programs shall be amended subsequently to incorporate the actual dates I schedule of the affecting contracts. It is the contractor's responsibility to ensure timely co-ordination with the Designated Contractors to finalize the Initial Program, without affecting progress of the work.

1.7 Works Programme Revisions

- 1.7.1 The contractor shall immediately notify the Employer and the Engineer in writing of the need for any changes in the Works Program, whether due to a change of intention or of circumstances or for any other reason. Where such proposed change affects timely completion of the Works or any other Key Date the contractor shall within fourteen (14) days of the date of notifying the Engineer submit for the Engineer's consent its proposed revised Works Program and accompanying Narrative Statement. The proposed revised Works Program shall show the sequence of operations of any and all works related to the change and the impact of changed work or changed conditions.
- 1.7.2 If at any time the Employer / Engineer considers the actual or anticipated progress of the work reflects a significant deviation from the Works Program, he may request the contractor to submit a proposed revised Program which together with an accompanying Activity Report and Narrative Statement, shall be submitted by the contractor within fourteen (14) days after the Engineer's instruction. The proposed revised Works Program shall show the sequence of operations of any and all work related to the change and the impact of changed work or changed conditions. Revisions should not affect the overall completion of the project.
- 1.7.3 All activities that have negative float must be analyzed by the contractor to identify the impact on the timely completion of the Works or on the achievement of Key Dates.

1.8 Three-Month Rolling Programme

- 1.8.1 The Three-Month Rolling Programme shall be an expansion of the Detailed Works Program, covering sequential periods of three months. The Three-Month Rolling Program shall provide more detail of the contractor's plan, organization and execution of the work within these periods. In particular, the contractor shall expand each activity planned to occur during the next three (3) month period, if necessary, to a daily level of detail.
- 1.8.2 The Three-Month Rolling Program shall be developed as an Primavera network, and shall be presented in bar chart and time-scaled network diagram format. Bar charts shall be presented on an A4 and time-scaled networks diagrams on an A3 size reproducible media. Tasks in the program shall be derivatives of and directly related to tasks in the approved Works Program.
- 1.8.3 The contractor shall describe the discrete work elements and work element inter-relationships necessary to complete all works and any separable parts thereof including work assigned to sub-contractors within the contract period.
- 1.8.4 Activity duration shall not exceed two (2) weeks unless and otherwise consent of Engineer is granted.
- 1.8.5 Each activity in the Three-Month Rolling Program shall be coded, or described so as clearly to indicate the corresponding activity in the Works Program.

1.9 Three-Month Rolling Programme Revisions and update

- 1.9.1 The Three-Month Rolling Programme shall be extended forward each month as described under Clause 1.8.1 above. Each submission of the Three-Month Rolling Program shall be accompanied by a Program Analysis Report, describing actual progress to date, and the forecast for activities occurring over the next three-month period in order to achieve progress as per the approved Works Program.
- 1.9.2 If the Three-Month Rolling Program is at variance with the Works Program, the Program Analysis Report shall be accompanied by a supporting Narrative Statement describing the contractor's plan for the execution of the activities to be undertaken over the three-month period, including program assumptions and methods to be employed in achieving timely completion.
- 1.9.3 The contractor shall revise the Three-Month Rolling Program or propose revisions of the Works Program, or both, on a monthly basis to ensure consistency between them.
- 1.9.4 Three-Month Rolling Program (revised) to be submitted on a monthly basis by 5th of

every month with respect to the progress achieved by the last day of the previous month. A penalty of ₹. 100,000 /l - (Rupees One Lakh) per instance will become applicable to the contractor for non-submission of the revised Three-monthly rolling program as per above clauses, irrespective of the causes lead to variances if any and the penalty will be **deducted in the subsequent IPC which will be non-refundable.**

1.10 Weekly review

Once a week, on a day mutually agreed to by the Engineer and the contractor, a meeting will be held to assess progress by the contractor during the previous week, progress review which will also be attended by the programs Expert and the contractor's Program Engineer. The contractor shall submit a construction schedule listing activity completed and in-progress from the previous week and the activities scheduled for the succeeding two weeks based on the detailed Works Program. Copies of the schedule shall be submitted on A3 sized papers.

1.11 Project Calendar

For the Project, the contractor shall adopt 7 days a week calendar, identical calendar for the purpose of programming and Execution of Works. Official documents shall be transacted during 6 days' week – Monday through Saturday. For Project purposes, a week begins at 00:01 hours on a Monday and ends at 23:59 hours on a Sunday. The completion of an activity or the achievement of an event when given a week number shall be taken to mean midnight on the Sunday at the end of the numbered week. An access date or activity start date when given as a week number shall be taken to mean 00:01 hours on a Monday of the Numbered week.

1.12 Programming Personnel

The contractor shall submit, as part of its Staff Organization Plan, the names and required information for the staff to be employed on Works Programming. The principal Works Programmer shall hold reputable professional qualifications acceptable to the Engineer including at least five (5) years relevant experience in programming civil engineering works. Others in the group shall have at least three (3) years' experiences in such work. The programmers shall be employed by the contractor full time on the Contract until the completion or such earlier time the Engineer may give his consent.

1.13 Programme and Report Submission Format

The contractor shall submit one (1) original and six (6) copies and one (1) reproducible (for Programs) of all submissions to the Engineer. All submissions shall be in A0, A1, A3 or A4 size, as appropriate except as may otherwise be agreed by the Engineer. In addition, the computerized program and report shall be submitted in compatible discs. The format for all Program and Report submissions shall be strictly in accordance with the format as stated herein or as requested by the Engineer.

1.14 FAILURE TO SUBMIT PROGRAMME

Failure of the Contractor to submit any programme, or any required revisions thereto within the time limits stated for acceptance by the Engineer, shall be sufficient reason for not making the relevant stage on account payment by the Engineer

The Contractor should actively participate in implementing PMIS & BIM system by BI-RIDE

2. MONTHLY PROGRESS REPORTS

2.1 General

The contractor shall submit to both the Employer and the Engineer, a Monthly Progress Report, in a format approved by the Employer. The format may be modified any number of times by the Employer and the revised formats shall be followed by the contractor from the date of advice of the same by the Employer. This Report shall be submitted by the end of each calendar month and shall account for all work actually performed from 26th day of the last month and up to and including the twenty-fifth (25th) day of the month of the submission. The above days (i.e., 26th and 25th) may be modified by the Employer. It shall be submitted in a format to which the Employer shall have given his consent and shall contain sections I sub-sections for, but not be limited to, the topics listed in clauses below.

2.2 Physical Process

- a) It shall describe the status of work performed, significant accomplishments, including critical items and problem areas, corrective actions taken or planned and other pertinent activities, and shall, in particular, address interface issues, problems and resolutions.
- b) It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Program.

2.3 Programme Update (For Entire Project)

Programme updating shall include

- (a) The monthly Program Update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the twenty-fifth (25th) of the month together

with estimates of remaining duration and expected activity completion based on current progress. The above day (i.e., 25th) may be modified by the Employer. The Program Update shall be accompanied by an Activity Report and a Narrative Statement. The Narrative Statement shall explain the basis of the contractor's submittal:

- (i) Early Work and Baseline Submittals – explains determination of activity duration and describes the contractor's approach for meeting required Key Dates as specified in the Contract.
- (ii) Updated Detail Program Submittals – state in narrative the Works actually completed and reflected along Critical Path in terms of days ahead or behind allowable dates. Specific requirements of narrative are:
 - 1. If the Updated Detailed Work Programme indicates an actual or potential delay to Contract Completion date or Key Dates, identify causes of delays and provide explanation of Work affected and proposed corrective action to meet Key Dates or mitigate potential delays. Identify deviation from previous month's critical path.
 - 2. Identify by activity number and description, activities in progress and activities scheduled to be completed.
 - 3. Discuss Variation Order Work Items, if any.
- (b) The Program Status which shall: -
 - (i) Show Works Program status up to and including the current report period, display Cumulative progress to date and a forecast of remaining work.
 - (ii) Be presented as a bar-chart of size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings.
- (c) The Activity Variance Analysis which shall analyze activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and completed in advance of the Works Program.

2.4 Three Month Rolling Program

The monthly issue of the Three-Month Rolling Program.

2.5 Financial Status

It should include following

- a) A narrative review of all significant financial matters, and actions proposed or taken in respect to any outstanding matters.
- b) A spread sheet indicating the status of all payments due and made.
- c) A status report on status of extra items, if any

2.6 Status of Claims

A report on the status on any claims outstanding. The report shall in particular provide interim updated accounts of continuing claims.

2.7 Milestones I Key Dates Status

A report on the status of all milestones I key dates due to have been achieved during the month and forecasts of achievement of any non-achieved key dates and those due in the next month, with explanatory remarks for not achieving them.

2.8 Resources Status

- 2.8.1 The contractor shall submit to the Engineer each month a detailed list by trade classification, of manpower employed during the report period, stock of all major construction materials as also a list of all serviceable major items of construction plant and equipment on site including those which are proposed to be mobilized during the next month.

- 2.8.2 A report on the status of deployment of all key personnel and other manpower by trade Vis – a - Vis their deployment schedule and explaining constraints if any.
- 2.8.3 Status of stock of all the major construction material vis -a- vis its requirements for next month.
- 2.8.4 Status of all serviceable major construction plant and equipment at site.

2.9 Procurement Report

- 2.9.1 A summary of all significant procurement activities during the month, including reasons of delay (if any) and action taken to overcome problems.
- 2.9.2 A report listing major items of plant and materials which will be incorporated into the Works. The items shall be segregated by type as listed in the Specifications and the report should show as a minimum the following activities:
 - (a) purchase Order Date – Scheduled I Actual,
 - (b) manufacturer I Supplier and Origin,
 - (c) letter of Credit Issued Date,
 - (d) manufacturer I Supplier Ship Date – Scheduled I Actual,
 - (e) method of Shipment,
 - (f) Arrival Date in India – Scheduled I Actual.
 - (g) Arrival date at site and commissioning date

The report should also explain the delays (if any) in arrivals of the major equipment at site and the actions taken by the contractor to expedite the same and the measures proposed to makeup the time loss.

2.10 Production and testing

It should include following:

- (a) A review of all production and manufacturing activities during the month.
- (b) Summaries of all production and manufacturing outputs during the month together with forecasts for the next month.
- (c) Review of all testing activities (both at site and at the manufacturer's premises) during the month.

2.11 Safety

A review of all safety aspects during the month including safety inspections / audits, reports on all accidents and actions proposed to prevent further occurrence.

2.12 Environment

A review of all environmental issues during past month shall include all monitoring reports, mitigation measures undertaken, and activities to control environmental impacts.

- 2.13 In case of failure of the contractor to make submissions as per section 1.4 herein above, the Employer I Engineer will retain 5% of the due progress payment till the submissions. For non-submission of Monthly Update and Progress Reports as per Clause 2 herein above, the Employer I Engineer will retain 5% of the due progress payment in each case, which shall be released upon submission of the same. In case the submissions are not made in the month it is due, the retained payment would be released only in the next Monthly Running Bill.

APPENDIX-02

METHOD OF MEASUREMENTS FOR PERMANENT WORKS

1. INTRODUCTION

1.1 The detailed procedure to be followed for the recording of measurements and for the preparation and passing of contractors Bills for permanent works is set out in the following paragraphs.

2. MEASUREMENT OF WORKS

2.1 General

- 2.1.1 Measurements shall be taken at such intervals as are found necessary or convenient. Generally, one bill will be preferred in a month or as specified in the contract.
- 2.1.2 Entries should be made only in ink, and no entry should be erased or defaced so as to make it illegible. Correction of mistake, if any, shall be made by neatly crossing out the incorrect entry and rewriting and correct words or figures. All such corrections should be initialed by the contractor's Engineer as well as by the Engineer's Representative at site.
- 2.1.3 Format of Record of Measurements sheets and procedure for issue of these measurement sheets will be as decided by Employer in consultation with the Engineer.
- 2.1.4 Before starting the earth work for embankment, cutting, bridge excavations etc., the initial ground levels shall be taken jointly along with engineer.

2.2 Items for which Good-for-Construction GFC Drawing is issued

- 2.2.1 As soon as the Good-For-Construction GFC drawing for a work is issued, the contractor will calculate the details of quantities of various items of PRICE SCHEDULE involved, in a format approved by Engineer, and submit the calculations and schedule of quantities to the Engineer / Engineer's Representative and get them approved for the drawing.
- 2.2.2 Once the schedule of quantities is thus approved, the contractor will submit five copies of the approved schedule to Engineer's Representative in an approved format.
- 2.2.3 The contractor will submit his payment claims based on the approved schedule of quantities along with certification of actual work done as per specifications, drawings and contract conditions and within the tolerances as specified. Measurement will be entered in Record of Measurement Sheet duly signed jointly on each page by contractor's authorized qualified engineer and Engineer's Representative.
- 2.2.4 Abstract of measurement will be prepared by the contractor in the approved form based upon these measurements.

2.3 Items for which Good-For-Construction GFC Drawing is not issued

- 2.3.1 For all such works, whose measurement cannot be calculated from any Good-For-Construction (GFC) drawing, all measurements will be taken by the contractor's authorized qualified Engineer in the presence of the Engineer's Representative at site. These measurements will be recorded on approved form of Record Measurement Sheet and signed jointly by contractor and Engineer's Representative.
- 2.3.2 Contractor will ensure that a properly qualified Engineer is deputed for taking measurements and also that all the measurements taken are witnessed and signed by the Engineer's Representative.
- 2.3.3 All measurements should be recorded at site on the Record of Measurement Sheet in the presence of the Engineer's Representative.
- 2.3.4 Each Measurement Sheet should be signed by the contractor's Engineer as well as by the witnessing Engineer's Representative.
- 2.3.5 Based on the recorded measurement, the contractor shall prepare abstract of quantities in the approved format.

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1 Purpose

This document titled 'Construction Quality Guideline' sets the minimum Quality Standards that are to be adopted and implemented across all the projects of the BSRP project Programs. This document only provides an outline and overview of the obligations, the detailed and specific quality requirements are described in Indian Legislation.

2 Scope

- This procedure applies to Bangalore Suburban Rail Projects and sub projects at BSRP, project information / records created regardless of format, which includes information generated by the General Consultant, D&B Contractor(s) and 3rd Parties.
- BI-RIDE contracts complete packages. These packages consist in detail engineering, construction / production, quality planning, assurance and control and at last quality verification.
- BI-RIDE requires the fulfilment of the BI-RIDE CMS Quality Policy, the quality objectives and the project quality plan(s) throughout the lifecycle of the contracted work

3 Definitions

Table 1: Definitions

Term	Definition
BI-RIDE	The Employer and Client
General Consultant	Bangalore Suburban Rail Projects' General Consultant (Egis, AECOM & WSP JV).
The Engineer	The Delegated Client Representative to administer the Contract
Initiator / Originator	The person who starts the process.
Participant	The person who is or may be involved in the implementation of the procedure.
D&B Contractor	The organization contracted by the Employer to carry out the Project D&B works.
3 rd Parties	3 rd party Project stakeholders.
Project Partners	The term 'Project Partners' used throughout this document includes the Client, General Consultant, other Consultants, Contractors, Subcontractor's, Suppliers and anyone else who undertake works on the Bangalore Suburban Rail projects.

4 Responsibilities

4.1 Project Directors

- Provide positive leadership on quality issues.
- Promote an enthusiastic quality culture that delivers positive commitment to and engages all employees in continuous improvement in quality performance.

- c. Keep abreast of developments of Indian quality legislation and industry standards.
- d. Ensure that a quality management system is implemented within their sphere of responsibility and monitor and review its effectiveness and take necessary improvement action.
- e. Monitor that personnel under their control comply with their individual responsibilities in quality matters.
- f. Ensure that the disciplinary process to address breaches of the quality policy or management system is applied where necessary.

4.2 Senior Managers

- a. Senior Managers are people in the organisation at any level above senior supervisor and below director.
- b. Provide positive leadership on quality issues within their area of operation.
- c. Promote an enthusiastic quality culture that delivers positive commitment to and engages all employees in continuous improvement in quality performance.
- d. Implement the business unit quality management system. In particular:
 - i. Identify quality training needs and have the necessary training arranged and when arranged, release those who require training.
 - ii. Make arrangements for quality induction training for all new starters at the workplace under their control.
 - iii. Implement operating procedures, for the planning and control of activities associated with identified risks.
 - iv. Ensure that written method statements, risk assessments and/or quality rules are brought to the attention of management.
 - v. Appoint appropriate personnel to undertake quality duties.
 - vi. Ensure that suitable arrangements are in place for the effective control of changes to planned methods of work.
 - vii. Keep abreast of developments in Indian quality legislation and industry standards.
 - viii. Monitor and review the effectiveness of the quality management system and report deficiencies.
 - ix. Monitor that personnel under their control comply with their individual responsibilities in quality matters.
 - x. Give personnel under their control, including contractors, clear instructions as to their responsibilities to ensure correct working methods.

4.3 Designers

- a. Ensure staff, are competent and adequately resourced to address the quality issues likely to be involved in the design.
- b. Consider quality when designing structures, equipment systems, temporary works.
- c. When carrying out the design, provide adequate information about any quality risks associated with the design.
- d. Coordinate activities with that of others to improve the way in which quality is managed and controlled.

4.4 Quality Managers and Officers

- a. Provide positive leadership within their area of operation and promote the adoption of best practice.
- b. Promote an enthusiastic quality culture that delivers positive commitment to and engages all employees in continuous improvement quality performance.
- c. Keep abreast of developments in quality legislation and industry standards.
- d. Monitor and report on the effectiveness of the quality management system and progress against the quality performance standards and make recommendations for improvement as appropriate.
- e. Monitor and report on operational quality performance and make recommendations for improvement and monitor to ensure that effective action is taken.
- f. Lead and provide functional management for any quality personnel under their control.

- g. Assist with the identification of quality training needs, and monitor delivery and recording.
- h. Monitor and report on the implementation of the approved quality objectives.
- i. Produce quality performance reports as required.
- j. Promptly alert line and functional management to significant quality issues and where appropriate be involved in the investigation and ensure that the findings are reported.
- k. Review quality reports, identify any trends and ensure that there is an appropriate response to prevent future recurrence.

4.5 Section, Site, Discipline Engineers and Foremen

- a. Appreciate the responsibility allocated to individuals within the operative and management structure.
- b. Set a good example and leadership on the site.
- c. Ensure that only trained and authorised workers use plant and equipment and that persons undergoing training do not operate plant and equipment unless closely supervised by a competent person.
- d. Ensure that employees under their control attend quality induction training before working on the site and that they are correctly supervised at all times
- e. Ensure that materials, plant and equipment under their control or brought to site by the subcontractor has any necessary certificates of test, inspection and examination and is safe to use
- f. Ensure that clear instruction and information is given to persons under their control.
- g. Carry out recorded quality inspections of site conditions.
- h. Attend any meeting on quality issues as required and as applicable, co-operate with all personnel on matters of quality.

4.6 Supervisors

- a. Supervisors are people at the first level in the organisation that have responsibilities over the work of others.
- b. Provide positive leadership on quality issues for the members of the work team for which they are responsible.
- c. Promote a positive attitude in the workforce and encourage behaviours that protect both people and the environment.
- d. Monitor that personnel under their control comply with their individual responsibilities in quality matters.
- e. Give personnel under their control, including contractors, clear instructions about the required methods of work.
- f. Identify any quality training requirements of personnel under their control and advise appropriate management accordingly.
- g. See that all quality issues are reported immediately to the relevant manager.

4.7 All Employees

Set a good personal example on quality issues within your area of operation.

1. Legal and Other Requirements

- a. All work is to be undertaken in compliance with the requirements of Indian Law. If no local standard exists or the applicable standard is not specified, the appropriate and compatible internationally recognised standard or code of practice shall be adopted.
- b. The hierarchy of standards is as follows:
 - i. Indian Standards (IN),
 - ii. Euro Norm (EN),
 - iii. British Standards (BS),
 - iv. International Standards and Codes of Practice
 - v. Alternative standards may be proposed if they can satisfactorily be demonstrated that they are

equivalent, in all respects, to the defined standards. Where there is a discrepancy or a conflict, the higher or stricter standards shall take precedence. Project Partners are to ensure that all prescribed registers, certificates and records are maintained and available for inspection at the relevant work locations by any authorised person.

2. Quality Objectives

- a. Quality objectives must be defined and made available for all internal and external stakeholders. The completion of the quality objectives must be checked on a regular basis and the measures must be adopted accordingly in line with the BI-RIDE's Quality Strategy and to achieve Right the First Time.
- b. These quality relevant objectives (KPI) will be defined by the BI-RIDE's Executive Management and Program Team as appropriate.
- c. Quality goals which are applicable to each program and/or project contract and particular type of work will be defined by the Project Partner with agreement of the Engineer.

3. Quality Standards, Codes and Specifications

- a. Quality standards, codes and specifications must be defined during design and engineering by the engineering disciplines (infrastructure and civil works, system/MEP, rolling stock, operation and maintenance) for the different packages.
- b. The program will comply with all pre-defined international codes and standards which satisfies the requirements of ISO 9001:2015 and deliver a state-of-the-art BSRP.

4. Tender and Procurement

- a. Quality during tendering and procurement will be ensured by the following measures:
 - i. All tendering documents must fulfil the requirements of ISO 9001:2015.
 - ii. All program partners must be certified according to ISO 9001:2015. The certification must include the scope of services being provided to BI-RIDE and include the specific project location.
 - iii. Basic quality requirements for all tendered parts must be defined (during design and engineering) with documentation by engineering discipline (e.g. infrastructure and civil works, system/MEP, rolling stock, operation and maintenance).
 - iv. Define selection criteria based on selected capabilities and experiences.
 - v. Define pre-qualification in line with BI-RIDE processes and procedures.
 - vi. Detailed quality requirements must be defined by program partners according to the complexity of their scope of supply (to be defined during procurement Process).
 - vii. Potential program partners must provide a provisional quality plan according to the complexity of their scope of supply (to be defined during procurement). This provisional quality plan must be submitted together with the bidding documents.
 - viii. Ongoing improvements of quality requirements (e.g. change of standards) by the BI-RIDE program and potential program partners must be incorporated throughout the project lifecycle.
 - ix. Tendering documents must be approved by engineering discipline, where applicable (e.g. infrastructure and civil works, system/MEP, rolling stock, operation and maintenance).

5. Design and Engineering

- a. The contractor must define:
 - i. Design and engineering stages.
 - ii. Review, verification and validation appropriate to each design and engineering stage.
 - iii. Responsibilities and authorities for design and engineering.
 - iv. Inputs, related to the contract requirements, must be defined as there are:
 - v. Functional and performance requirements:

- Applicable statutory and regulatory requirements.
 - When applicable, information derived from previous similar designs.
 - Other requirements essential for design and engineering.
- b. Design and engineering outputs must:
- i. Define relevant standards, codes and specifications.
 - ii. Meet the project requirements.
 - iii. Define testing/inspection procedures as appropriate.
 - iv. Provide appropriate information and documentation (e.g. for purchasing,
 - v. Construction/production, testing, training, operation, maintenance etc.).
 - vi. Be reviewed at suitable stages by an independent Design Verification Engineer (DVE) in order to:
 - Evaluate the ability of the results or design and engineering to meet requirements.
 - Identify any problems and propose necessary actions.
- c. Design and engineering changes must be identified and records maintained
- d. Design and engineering changes must be reviewed, verified and validated as appropriate, and approved by DVE before implementation.
- e. Changes must be explicitly mentioned in order to highlight that the initial requirements have been altered.
- f. During testing phase special attention should be paid to changes (of scope or quality requirements) to the project.
- g. All defined quality relevant measures must be integrated in the contractor's Quality Management Plan (QMP).
- h. Design and engineering results must be checked, evaluated and validated by DVE before construction/production begins. These checks, evaluations and approvals must be documented and reported (communicated). The quality of the design work must be validated by the DVE at the end of the contract.

6. Construction

- a. To ensure adequate quality planning during the construction phase the following measures are foreseen:
- i. Program Partners must have a validated QMP
 - ii. Copy of the contractor's current QMP
 - iii. Schedule showing all foreseen tests/inspections
 - iv. Schedule to perform audits in the contracted work
 - v. Procedure describing the handling of corrective action
 - vi. Procedure describing non-conforming items
 - vii. Process for continuous improvement.
- b. Program Partners must accomplish their work according to their validated QMP and have to:
- i. Fulfil quality requirements.
 - ii. Accomplish the work according to the relevant standards, codes and specifications.
 - iii. Document and report the accomplished work.
 - iv. Train their personnel and assess their competencies.
 - v. Fulfil the requirements related to the contracted work.
 - vi. Perform and document planned tests/inspections.
 - vii. Deliver as-built-drawings to BI-RIDE.
 - viii. Demonstrate the traceability of all quality relevant issues.
 - ix. Preserve products.
 - x. Control the monitoring and measuring equipment, including documentation.
 - xi. Perform and document internal audits.
 - xii. Handle non-conformities according to the related procedure. Nonconformities must be demonstrated to BI-RIDE propositions/solutions resulting from nonconformities
 - xiii. Carry out a continuous improvement (corrective and preventive action) with documentation. Solutions resulting from the continuous improvement process must be analysed

- c. The Engineer will, as regularly as deemed appropriate, monitor work samples with a frequency to ensure quality:
 - i. By inspecting the contractor's work on site.
 - ii. Verify the contractor's work according to the QMP.
 - iii. Perform and document planned tests/inspections.
 - iv. Verify the as-built-drawings of the contractor.
 - v. Analyse and approve changes within the contract.
 - vi. Pay special attention to project changes (scope or requirements) during test phase.
 - vii. Perform internal audits for each applicable contract.
 - viii. Analyse non-conformities with the contractor and approve solutions.
 - ix. Analyse solutions resulting from the continuous improvement process of the contractor within the contract and approve them.
 - x. Testing
- d. To ensure adequate quality planning during the test phase the following measures are foreseen:
 - i. Involving of end-user
 - ii. Organisation of test performance
 - iii. Definition of test results
 - iv. Test scheduling
 - v. Definition of any quality procedures during test performance
 - vi. Training of personnel, as required
 - vii. Test documentation.
- e. Performing quality assurance during the testing phase will be guaranteed by the following measures:
 - i. Definition of functions
 - ii. Observance and fitting of new designed functions with documentation
 - iii. Observance and fitting of functions which caused problems during design and
 - iv. Engineering or construction phase with documentation
 - v. Observance and fitting of functions which have been changed or optimised during design and engineering or construction phase with documentation
 - vi. Testing documentation in general.
- f. BI-RIDE contracts complete packages. These packages consist in detail engineering, construction / production, quality planning, assurance and control and at last quality verification.
- g. BI-RIDE requires the fulfilment of the BI-RIDE Quality Policy, the quality objectives and the project quality plan(s) throughout the lifecycle of the contracted work.

7. **Commissioning and Handover**

- a. To ensure adequate quality planning during the commissioning and handover phase the following measures are foreseen:
 - i. Involving of end-user
 - ii. Organisation of commissioning procedures
 - iii. Definition of commissioning results
 - iv. Commissioning scheduling
 - v. Definition of specific quality procedures for commissioning process
 - vi. Training of personnel
 - vii. Commissioning documentation
 - viii. As-built-drawings must be prepared and supplied upon completion.
- b. To ensure adequate quality assurance during the commissioning and handover process a number of measures have to be foreseen. These measures include, but are not limited to a general check of project, project packages and interfaces, including check of:

- i. Documentation
- ii. Materials
- iii. Buildings and installations
- iv. Electrical equipment
- v. HVAC equipment (all building services)
- vi. Earthworks
- vii. Concrete works
- viii. Structural works
- ix. Waterproofing
- x. Painting and coating
- xi. Operation processes and procedures
- xii. Training processes
- xiii. Regular testing and inspection processes and equipment
- xiv. Emergency and escape procedures and equipment.

8. Operations and Maintenance

- a. Quality planning during operation and maintenance will be guaranteed by adopting the following measures:
 - i. Operation ability must be demonstrated and documented.
 - ii. Operating rules must be defined.
 - iii. Roles and responsibilities must be defined.
 - iv. Operation personnel must be trained, including the certification of the trainees.
 - v. New personnel must be trained according to the job-requirements before starting. Fulfilling of the job-requirements must be demonstrated and documented.
 - vi. All training measures must be planned.
 - vii. Required, adequate documentation (operation and maintenance manual) must be available.
 - viii. Inspections must be planned.
 - ix. Precautionary maintenance must be planned.
 - x. Inspection and maintenance personnel must be trained.
 - xi. Inspection and maintenance tools must be available.
 - xii. Spare parts must be available.
 - xiii. Inspection and maintenance documentation must be available.
 - xiv. Operation and maintenance procedures must be defined.
- b. To ensure adequate quality assurance during operation and maintenance the following measures are foreseen:
 - i. Operational ability procedure
 - ii. Personnel training documentation and planning procedure
 - iii. Inspection planning and documentation procedure
 - iv. Maintenance planning and documentation procedure.

9. Training

- a. To ensure adequate quality planning for the training the following measures are foreseen:
 - i. Operation personnel must be trained according to a pre-defined training schedule with demonstration of the fulfilling (e.g. examination, depending on the job description) of the requirements.
 - ii. Inspection and maintenance personnel must be trained according to a pre-defined training schedule with demonstration of the fulfilling (e.g. examination, depending on the job description) of the requirements.
 - iii. New personnel must be trained according to the job requirements before starting. Fulfilling of the job requirements (e.g. examination, depending on the job description) must be demonstrated and documented.

- b. To ensure adequate quality assurance for the training the following measures are foreseen:
 - i. Personnel ability procedure
 - ii. Personnel training documentation and planning procedure.

10. Closing

- a. To ensure adequate quality planning for the closing process of the contract the following measures are foreseen:
 - i. Operation ability must be demonstrated over a pre-defined period
 - ii. Tests and inspections must be finished and documented
 - iii. Personnel must be trained.
- b. To ensure adequate quality assurance for the closing of the project all previous quality planning, assurance and control measures must be closed. Therefore, all project elements must be checked to ensure the required documentation is available and handed over to BI-RIDE. For example:
 - i. Tendering and Procurement
 - ii. Contracting
 - iii. Design and Engineering
 - iv. Construction
 - v. Testing
 - vi. Commissioning and Handover
 - vii. Operation and Maintenance
 - viii. Training.
- c. A completion list will be implemented and all missing documentation must be compiled within an adequate timeframe. The contract will be closed when BI-RIDE gives a written confirmation of the final acceptance of all deliverables before handover to the operator.

11. Quality Surveillance, Non-Conformities and Improvement

- a. The Quality Manager (QM) must conduct internal audits at planned intervals to determine whether the QMP:
 - i. Conforms to the planned arrangements and to the requirements of BI-RIDE
 - ii. Is effectively implemented and maintained.
- b. An audit program must be planned, taking into consideration the status and importance of the processes and areas to be audited, as well as the results of previous audits. The audit criteria, scope, frequency and methods must be defined. An audit schedule must be prepared.
- c. If non-conforming project execution is detected the following measures are required:
 - i. Take action to eliminate the detected non-conformity
 - ii. Authorise its use, release or acceptance under concession by a relevant authority
 - iii. and, where applicable, by BI-RIDE
 - iv. Take action to preclude its original use or application
 - v. Take action appropriate to the effects or potential effects of the non-conformity, if the non-conforming project execution is detected after beginning of operation.
- d. When non-conforming project execution is corrected it must be subject to re-verification to demonstrate conformity to the requirements.
- e. Records on the nature of non-conformities and any subsequent actions taken, including concessions obtained must be maintained.
- f. The QM must continually improve the effectiveness of the QMS through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and project quality reviews.
- g. The QM must take action to eliminate the causes of non-conformities in order to prevent recurrence. Corrective actions must be appropriate to the effects of the nonconformities encountered and include, but are not limited to:

- i. Reviewing non-conformities
 - ii. Establish the causes of non-conformities
 - iii. Evaluating the need for action to ensure that non-conformities do not recur
 - iv. Assessing and implementing corrective action
 - v. Recording the results of action taken
 - vi. Reviewing the effectiveness of the corrective action taken.
- h. The QM must determine action to eliminate the causes of potential nonconformities in order to prevent their occurrence. Preventive actions must be appropriate to the effects of the potential problems, at least:
- i. State potential non-conformities and their causes
 - ii. Evaluating the need for action to prevent occurrence of non-conformities
 - iii. Set and implement the needed action
 - iv. Records of results of action taken
 - v. Reviewing the effectiveness of preventive action taken.

12. Quality Monitoring and Reporting

- a. To ensure the effectiveness of the quality monitoring and reporting BI-RIDE will implement a quality committee who will meet regularly. This quality committee will analyse and report to the management team of the BI-RIDE program the following matters at least (not limited to the list below):
- i. Minutes of the previous meeting/review of pending actions and decisions
 - ii. Quality key issues
 - iii. Project status
 - iv. Project documentation and reporting
 - v. Inspection and testing
 - vi. Surveillance
 - vii. Non-conformities and improvement
 - viii. Audits
 - ix. Next meeting

APPENDIX-04**ORGANISATION CHART AND KEY POSITIONS**

The contractor shall provide the following organization chart for the Works as follows: Head office Organization Chart

One organization chart shall be provided for the contractor head office indicating the management and staff structure, with responsible personnel I departments described for all aspects of the work.

Site organization Chart

The contractor shall provide the proposed site organization indicating the proposed structure, staff partners and positions necessary to adequately manage and control the Works.

The contractor shall have a competent team of Managers, Engineers, Technical staff etc. so as to complete the work satisfactorily as per various requirements of the contract.

The Key Positions (not limited to) and corresponding qualification and experience are as under:

Key Personnel & Staff:

Category	Specialisation Position	Minimum Numbers	Qualification	Minimum Experience post qualification in metro& Railway rail project with specified Field (refer Column 2) (Years)	Minimum total experience post qualification (Years)
(1)	(2)	(3)	(4)	(5)	(6)
C1.1 *	Contractor's Representative (Project Manager), official representative of the Contractor to the Employer with experience in Metro/ Railway construction/Depot construction/Major infrastructure projects including design management, project management and construction supervision construction management and reporting.	1	B.E. (Civil)	5	≥20
C1.2 *	Project Controls Manager, with experience in major	1	B.E. (Civil)	5	≥15

Category	Specialisation Position	Minimum Numbers	Qualification	Minimum Experience post qualification in metro& Railway rail project with specified Field (refer Column 2) (Years)	Minimum total experience post qualification (Years)
(1)	(2)	(3)	(4)	(5)	(6)
	infrastructure projects, including design management, project management, and construction management and reporting.				
C1.3 *	Dy. Project manager, with construction experience in Metro/Railway/Depot construction/Major infrastructure projects including design management, project management and construction supervision construction management and reporting.	1	B.E. (Civil)	5	≥18
C1.4 **	Structural Engineer, experienced in civils, Metro & Railway stations and structures on large infrastructure rail/Metro projects.	1	B.E (Civil)	5	≥12
C1.5	MEP Systems Manager, with experience in station, Fire detection/ Alarm and suppression system, and ventilation and air-conditioning systems including Plumbing works	1	B.E (Electrical or Mechanical)	5	≥12
C1.6 **	Design Architect, experienced in the design of Metro/Railway or	1	B. Arch.	5	≥15

Category	Specialisation Position	Minimum Numbers	Qualification	Minimum Experience post qualification in metro& Railway rail project with specified Field (refer Column 2) (Years)	Minimum total experience post qualification (Years)
(1)	(2)	(3)	(4)	(5)	(6)
	Underground stations or Depot				
C1.7 **	QA Manager, experienced in management of Quality Assurance systems on large infrastructure projects.	2	B.E. (Civil)	4	≥15
C1.8**	QC Manager, experienced in management of Quality Control systems on large infrastructure projects.	3	B.E. (Civil)	4	≥10
C1.9**	Health and Safety Manager, experienced in management of Health & Safety Assurance systems on large infrastructure projects, including OHSAS 18001 compliance	2	B.E. (Civil)	5	≥15
C1.10**	Environmental Manager, experienced in management of Environmental Assurance systems on large infrastructure projects including ISO 14001 compliance	1	B.E. (Env.)	4	≥12
C1.11**	Civil Construction Manager, experienced in major infrastructure experience in Metro/Depot/ Railway stations/ Station construction	4	B.E. (Civil) or Diploma (Civil)	3	≥10 for BE ≥13 for Diploma

Category	Specialisation Position	Minimum Numbers	Qualification	Minimum Experience post qualification in metro& Railway rail project with specified Field (refer Column 2) (Years)	Minimum total experience post qualification (Years)
(1)	(2)	(3)	(4)	(5)	(6)
C1.11A**	Civil Construction Engineer, experienced in major infrastructure experience in Metro/Depot/ Railway stations/ Station construction	8	B.E. (Civil) or Diploma (Civil)	2	≥5 ≥8 for Diploma
C1.12**	Senior Geotechnical Engineer, with experience in geotechnical site investigation and reporting in Infrastructure projects	1	M. Tech (Geotech) or M.Sc. (Geology)	5	≥10
C1.13	MEP Construction Engineer, experienced in major infrastructure design and build and experience of fit-out of Metro Stations including Plumbing works	2	B.E (one Electrical and one Mechanical)	BE with 5 years Diploma with 8 years	≥10
C1.14	MEP Testing and Commissioning Manager/Engineer, will co-ordinate all activities of the commissioning schedule, so that there is completion of testing, and commissioning of the system including Plumbing works	1	B.E (Electrical or Mechanical)	5	≥10
C1.15	Architectural Construction Manager/Expert, experienced in major	2	B. Arch.	5	≥12

Category	Specialisation Position	Minimum Numbers	Qualification	Minimum Experience post qualification in metro& Railway rail project with specified Field (refer Column 2) (Years)	Minimum total experience post qualification (Years)
(1)	(2)	(3)	(4)	(5)	(6)
	infrastructure design and build and experience of fit-out of Metro & Railway Stations				
C1.16*	Stakeholder Manager/utility Manager, will be the primary contact with all external parties and will meet, discuss and understand their needs and issues and manage their expectations	1	B.E. (Civil)	3	≥10
C1.17*	Commercial Manager, will provide oversight on all commercial matters relating to the design, construction and supply contracts, managing the procurement and budget control functions.	1	Graduate in Civil Engineering and Cost Accountant	5	≥15
C1.18	Risk Manager, will be experienced in identifying risks to the project and to the program as a whole through a systematic approach and developing risk mitigation strategies.	1	Graduate in Engineering	5	≥15
C1.19	Sustainability Manager, will provide implementation oversight and assurance and performance reporting on all sustainability matters	1	Graduate in Engineering	3	≥10

Category	Specialisation Position	Minimum Numbers	Qualification	Minimum Experience post qualification in metro& Railway rail project with specified Field (refer Column 2) (Years)	Minimum total experience post qualification (Years)
(1)	(2)	(3)	(4)	(5)	(6)
	including sustainability certification.				
C1.20	BIM Manager, will provide oversight on all building information management and Clash detection	1	Diploma/Graduate in Engineering/Architecture	3	≥10
C1.21**	Interface Manager will manage and document design interface between all disciplines and stakeholders	2	B.E. (Electrical or Mechanical or Civil or Electronics)	5	≥15
C1.22	Systems Assurance Manager, will be responsible for the implementation of all systems assurance requirements including hazard, configuration and requirement management	1	B.E (Electrical or Mechanical)	3	≥10
C1.23	Public Relation Officer, responsible to manage/handle press, PR activities, brand visibility	1	PG in Mass Communication/ Journalism	-	≥7

NOTES:

* - To be available from the Commencement date.

** - To be available within 45 Days from the Commencement Date (wherever 2 positions are required at least 1 should be deployed)

1. The above categories of key positions shall be minimum required for successful completion of the work which shall be deployed at different points of time as per the progress and requirement of work and may not

be required to deploy simultaneously and continuously. However, these personnel shall be deployed at site in advance as per requirement and as directed by the Engineer and the decision of Employer in this regard shall be final and binding. The above Manpower deployment plan shall be submitted by the contractor within 14 days of award of work and shall be approved by the Employer.

2. The contractor shall submit the CVs of the above key positions to Employer for approval within 28 days of issue of letter of Acceptance (LOA).
3. The contractor shall deploy resources as per the above-mentioned minimum requirement and also confirm to deploy manpower over and above the minimum numbers indicated above, if the work requires so.
4. The performance of project personnel deployed will be evaluated periodically by the Employer during the contract period. In case the performance of any of the project personnel is not satisfactory, the contractor shall replace them with better or equivalent personnel immediately as per the directions of the Employer.
5. The tenderer may propose any number of names of Personnel for each Key Position. Any of the proposed personnel as approved by the Employer for each key position shall be mandatorily deployed in case of award of work.
6. Non-deployment of the Key personnel as per approved personnel for Sl.no 1,2,6 &10 as per approved man power plan leads to imposition of Penalty of Rs 2,00,000 / - Per Key personnel per month. For other personnel, a penalty of Rs. 50,000 / - per person per month shall be levied.
7. The proposed Key personnel shall not be changed till the completion of the work. Under emergent circumstances, in case they are required to be changed, the new incumbent should have similar or better experience and qualification than as required above. These changes are permitted only with the approval of the Employer. Change in key personnel for one time without penalty is permitted. However, for subsequent changes there will be Penalty at Rs 2,00,000 / - Per Key personnel for Sl.no 1,2,6 &10, unless the change is desired by the Employer.
8. All Key Personnel must be permanently stationed at Bengaluru till the completion of the work.
9. The penalties imposed are non-refundable.

APPENDIX-05

The Tenderer or JV/ Consortium as a whole must deploy the minimum required Contractor's Equipment for the Works as given below.

Sl.	Description	Total
1	Hydraulic Piling rigs	2 Nos.
2	Pillion roles (tripods) with conventional winch	6 Nos.
3	Fully automatic and computerized Batching and Mixing plant of capacity 30 cum/hour or higher	1 No.
4	Concrete pump or concrete boom placer	2 nos.
5	120 MT or higher capacity suitable cranes for erection of PEB and other structural elements.	2 No.
6	Transit mixer	8 nos.
7	Vibratory roller 80 to 100 KN static weight	8 nos.
8	Motor Grader	2 Nos.
9	Excavator 0.9 cum bucket capacity or higher	4nos.
10	Dumper	12 nos.
11	Water tanker	2 nos.
12	Paver	1 no
13	Tandem roller	2 nos.
14	JCB / Front loader	2 nos.

Notes:

- i. The Tenderer shall undertake to deploy sufficient resources to carry out the Works. These resources are for peak period of each activity and shall be mobilised by the Contractor to suit his works programme.
- ii. If the Contractor opts for short line method for casting, the number of pre-cast bed shall be increased accordingly.
- iii. The Contractor's Equipment shall not be more than five years old reckoned from the date of original manufacture.
- iv. Hiring of Cranes shall be as per approved vendors for supply of cranes. The contractors are free to propose and utilize plant and machinery after getting approval from the Engineer. Third party certification of cranes, competency certification of the operators etc. would be required before grant of approval.
- v. Deleted
- vi. The proposed Contractor's Equipment shall not in any event be construed as a submission of final requirement for the Works.
- vii. Plant and equipment indicated above is minimum to be deployed at appropriate stage of the work. However, depending on the requirement to complete the work within the stipulated completion period the Tenderer shall deploy additional

machinery as circumstances warrant at no extra cost. Plant and machinery above shall not be older than 5years. In case of failure of any plant and machinery deployed at site the same shall be repaired/replaced within 7days from the time of failure.

- viii. Tenderer shall submit the copies of ownership of the equipment, In case of hire / purchase, Copies of MOU with the supplier/ owner of the equipment.
- ix. *Contractor shall be penalized as deemed fit.
- x. The above type of plant and equipment (but not limited to) may be required for execution of the work. The contractor shall submit the details of plant & equipment to be deployed in the above table within 28 days of issue of LOA to the Engineer & Employer for approval.
- xi. Deleted.
- xii. Deleted.

APPENDIX-06

DOCUMENT SUBMISSION AND RESPONSE PROCEDURE

1. PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

The contractor shall utilize a PMIS integrating with BIM software such that all documents generated by the contractor can be transmitted to the Employer and the Engineer by electronic means(and vice versa) and that all documents generated by either party or electronically captured at the point of the origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the Engineer office at sit and the Employers office by the contractor.

All requisite training and periodical refresher courses of the above PMIS, to all the staff nominated by the Employer shall be organized by the contractor. The same is within the scope of this work.

IFC format (Industry foundation Classes):

IFC list format is a platform neutral format. Hence all I any BIM program used by tenderer should provide files in IFC format for interoperability between different BIM programs.

2. SUBMISSIONS TO THE ENGINEER

The general requirements are as follows:

2.1 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

- 1) The Employer will provide a web-based information management system of transmittal for formal project correspondence, documents, and information to ensure efficient information management on the Project. Where it is necessary to transmit original signed documents, these shall be acceptable forms of correspondence only when they have been issued via the system first.
- 2) The Employer will provide the Project-wide use of the system during the Design and Construction

Phases and also the Defects Notification Periods.

- 3) The system shall be capable of issuing a list of outstanding responses from the Engineer 7 days before the due date of the response.

2.2 DRAWING AND SPECIFICATION REGISTER

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

3. RECORDS AND REPORTS

3.1 FORMAT

Reports and records shall be submitted via the system to the Engineer and shall be in a format agreed by the Engineer. Reports and records shall be signed prior to submission by the contractor's agent or by a representative authorized by the contractor.

3.2 PROJECT DOCUMENT CONTROL PROCEDURE

Within twenty-eight (28) days after Commencement Date, the contractor shall submit via the system a Project document control procedure to the Employer and Engineer for review, which shall include but not be limited to the following:

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

- 2) A system of issuing documents to ensure that pertinent documents are issued to all appropriate locations;
- 3) A document change or re-issue system to ensure that only the latest revision of a document can be used; and
- 4) A submission identification system that identifies each submission uniquely by the following:
 - a) contract number;
 - b) discipline;
 - c) submission number; and d) revision indicator.

3.3 PROJECT RECORD

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

3.4 ADEQUACY OF THE PROJECT RECORD

The contractor shall submit the documents as required by the Engineer as Project records in full and on time. The Engineer shall determine the adequacy of the Project record. Any delay, beyond a reasonable limit, is liable for penalty, as deemed fit, by the Employer.

4. SUBMISSION AND RESPONSE PROCEDURE

4.6 GENERAL

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

4.7 PROPOSAL

Each submission shall be accompanied by a brief introduction to explain which sub-system, part or section of the Works to which the submission refers, listing the documents enclosed with the

submission, and describing in outline how all relevant requirements of the Employer's Requirements are achieved by the proposals.

4.8 SUBMISSION RESPONSE REQUEST

For each stage of submittal, the contractor shall prepare a Submission Response Request (SRR) carrying the date of submission, the submission reference number as defined in Clause 2.2 (4) above, the submission title, the stage of submission (e.g., Technical Design, etc.), and the authorized signature of the contractor's responsible engineer to confirm that, in the opinion of the contractor, the submission:

- 1) complies with all relevant requirements of the Employer's Requirements;
- 2) conforms to all interface requirements;
- 3) contains, or is based on auditable and proven or verified calculations or design criteria;
- 4) has been properly reviewed by the contractor, according to the contractor's Quality Assurance System, to confirm its completeness, accuracy, adequacy and validity; and
- 5) has taken account of all requirements for approval by statutory bodies or similar organizations, and that where required, such approvals have been granted.
- 6) contains 2 (two) properly signed copies of Independent Design Checker Certificate (Form IDCC) and 2 (two) properly signed copies of the Construction Design Pack Certificate (Form CDPC).

4.9 THE ENGINEER'S RESPONSE

The Engineer's response to the submission from the contractor will be made within 21 calendar days of receipt of the submission. If the submission is made later on the Design Submissions Programme, the Engineer may extend the review period depending on the amount of documentation

accompanying the submission.

4.10 MONTHLY DESIGN REVIEW MEETINGS

Throughout each Design Stage, the contractor shall attend monthly design review meetings with the Engineer and the Employer. At these review meetings, the contractor shall present information, drawings, and other documents to the Engineer in respect of all submissions programmed to occur during the following five-week period. The contractor's presentations shall be in sufficient depth to enable the Employer / Engineer obtain a clear understanding of the contractor's proposals and to discuss the methodology and process used in reaching the proposed design solutions.

4.11 THE ENGINEER'S OBSERVATIONS

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

4.12 NOTIFICATION

If, in the Engineer's opinion, following receipt of a submission, there is benefit to be gained from a meeting with the contractor to clarify or discuss any of the contents of the submission, he will notify the contractor accordingly with not less than 3 days advance notice, and the contractor shall attend at the time and place notified by the Engineer.

4.13 NOTICE OF NO OBJECTION

The contractor in respect of the Works or any sub-system, part or section may make no submission thereof unless a Notice of No Objection of No Objection with Comments has been received for the previous stage of the same Works or any sub-system, part or section thereof.

5 RESPONDED PROCEDURE

5.1 RESPONDED PROCEDURES

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

- 1) "Notice of Rejection" (with "A" Comments)
- 2) "Notice of No Objection"
- 3) "Notice of No Objection with Comments" (with "B" or "C" Comments)

5.2 RESPONSE DEFINITION

Definition of the Engineer's response:

- 1) "Notice of Rejection" (with "A" Comments):

If, following his review of the submission, the Engineer discovers major non-compliance, discrepancies, or omissions etc. that in his opinion are of a critical nature, the Engineer will issue a "Notice of Rejection" (NOR) with type "A" comments. The contractor shall revise and reissue the submission at the earliest, but not later than 15 calendar days of receipt of "Notice of Rejection" from the Engineer addressing the Engineer's comments. Subsequently the Engineer will respond at the earliest, but not later than 15 calendar days of receipt of the resubmission. Following the issue of a NOR by the Engineer, the contractor is not entitled to proceed to the next programmed stage for that section of the work until all of the Engineer's comments have been fully addressed and a NONO issued. As this is critical in nature, any delay in revising and reissuing by the contractor beyond the limit specified above, is liable for penalty, as deemed fit, by the Employer. The decision of the Employer is final in this regard.

- 2) "Notice of No Objection":

If, following his review of the submission the Engineer has not discovered any non-compliance with the contract the Engineer will issue to the contractor a formal "Notice of No Objection (NONO)". A NONO from the Engineer irrespective of with or without comments does not in any way imply the

Engineer's consent of the submission nor does it remove any responsibility from the contractor for complying with the Contract. Issue of a NONO from the Engineer only entitles the contractor to proceed to the next stage of the programmed work.

3) "Notice of No Objection" (With Comments):

if following his review of the submission, the Engineer discovers discrepancies or omissions etc. that in his opinion are not of a critical nature the Engineer may issue a "Notice of No Objection" with Comments, (NONOC) the comments will be of either type B or type C as defined below. The contractor shall respond to the comments in accordance with the requirements of Clause 4.3. Following the issue of a NONOC by the Engineer the contractor is entitled to proceed to the next stage of the programmed work subject to the inclusion of amendments necessary to address the comments.

6 The contractor shall respond to Type B and C comments and get the Engineer's agreement and closure prior to full inclusion in the Final Design.

6.1 THE ENGINEER'S COMMENTS

Definition of the Engineer's comments:

- 1) Type "A" Comments are of a critical nature that renders the submission non-compliant with the Contract, the submission shall be corrected and resubmitted.
- 2) Type "B" Comments are of an intermediate nature that shall be responded, agreed and incorporated.
- 3) Type "C" Comments are of a minor nature or may affect future submissions.

7 RECORDS

The contractor shall establish and maintain a place for the storage and archiving of all the documents relating to the Works that are not required to be submitted to the Engineer under Clause 2.

8 IMPLEMENTATION OF BIM SYSTEM

- (i) The contractor shall implement BIM system for executing and delivering the services set out in this Agreement. Building Information Modelling (BIM) uses computing power and systems to create 3D models of all kind of buildings and infrastructure, with information about its design, operation and current condition. At the planning and design stage, it enables designers, owners, and users to work together to produce the best possible designs and to test them virtually before they are constructed. During construction, it enables the Employer, contractors, and suppliers to integrate all components, cutting out waste and reducing the risk of errors. In operation, it provides users with real-time information about available services and facility managers with accurate assessments of the condition of assets.
- (ii) Proof checking of all structural designs shall be done using BIM modelling. The contractor shall implement the necessary hardware, software, and provide human resources towards this till the end of DLP. 3D Coordination between all disciplines shall be achieved by incorporating them in a single model.
- (iii) The contractor shall be required to produce, update and present to Employer on a fortnightly basis an integrated 3D BIM model incorporating rail track (Viaduct), topography, architecture, structure, plumbing and all other building services and system wide requirements in design review meetings. These models shall be 3D rendered and shall help in design visualization and clash detection of elements as well as finalization of design.

In addition, contractor shall also provide following individual models:

1. Rail alignment Modelling
2. Structure design modelling
3. Terrain modelling
4. Quantity take-off from BIM model wherever required
5. Visualization and Animated Walkthrough

6. Clash detection

- (iv) Final coordinated GFC drawings of all disciplines shall be generated only from the BIM model.
- (v) The contractor shall develop as built BIM Model up to LOD 500 level and submit the same to Employer at the time of completion of the project. Schedule of BIM implementation Plan and standards to be adhered to, shall be provided after award of contract.
- (vi) IFC format (Industry Foundation Classes)
IFC format is a platform neutral format. Hence all I any BIM program used by tenderer should provide files in IFC format for interoperability between different BIM programs.

APPENDIX-7
WORK AREAS

WORK AREAS

No land shall be made available by the Employer for site offices, and site laboratories. Contractor shall make his own arrangements at his own cost. In case the any land available within the depot area can be utilized by the Contractor for site Offices and Site laboratories only. -

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APPENDIX-8
PROJECT CALENDAR

- (1) The Project Weeks shall be commenced on a Monday. A day shall be deemed to commence at 00:01 hour on the morning of the day in question. Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week.
- (2) Requirements for the computation of Key Dates are given in **Contract Data of Section IX, Key Dates**.
- (3) A 7-day week calendar shall be adopted for various (Work) programme schedules for scheduling purposes.
- (4) For Project purposes, the presentation shall be in "Week" units.

APPENDIX-9**DRAFTING AND CAD STANDARDS****1. INTRODUCTION**

- (1) The purpose of this document is to define the minimum Drafting and CAD standard to be achieved by the Contractor for all drawings produced by the Contractor for the purpose of the Works.
- (2) By defining a common format for the presentations of drawings and CAD files, the exchange of drawn information is improved and will maximize the use of CAD in the co-ordination process.
- (3) All submissions shall be made to the Employer's Requirement in a format reviewed without objection by the Employer's Requirement and in accordance with the requirements in and as approved by the Employer:
 - (a) the Contract;
 - (b) the Document Submittal Instructions to Consultants and Contractors.
- (4) Paper and drawing sizes shall be "A" series sheets as specified in BS3429.
- (5) The following software latest and update version compatible for use with Mac / Intel-Windows based computers shall be used, unless otherwise stated, for the various electronic submissions required:

Document	Type	Electronic Document Format
Text	Documents	MS Word,
Spread	Sheets	MS Excel,
Data Base	Files	MS Access,
Presentation	Files	MS PowerPoint or Keynote (Mac) or any other approved by the Employer,
Programmes	Ver2.0a	Primavera for Windows or any other approved PIMS, Sure track AutoCAD Graphics CorelDraw / AutoCAD
Photographic		Adobe Photoshop,
Desktop	Publishing	Page Maker
CADD	Drawings	AutoCAD

- (6) Media for Electronic File Submission

One copy shall be submitted unless otherwise stated in Memory Device.

- (7) Internet File Formats/Standards

- (a) The following guidelines shall be followed when the Contractor uses the Internet browser as the communication media to share information with the Employer.
- (b) All the data formats or standards must be supported by Microsoft Internet Explorer version 3 or above running on Windows NT and Windows 10 or the latest.
- (c) The following lists the file types and the corresponding data formats to be used on Internet.

The Contractor shall comply with them unless prior consent is obtained from the Employer's Requirement for a different Data format:

File Type	Data Format
Photo Image	Joint Photographic Experts Group (JPEG)
Image other than Photo	GIF or JPEG
Computer Aid Design files(CAD)	Computer Graphics Metafile (CGM)
Video	Window video (.avi)

Sound	Wave file (.wav)
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- (B) The following states the standards to be used on Internet when connecting to database(s). The Contractor shall comply with them unless prior consent is obtained from the Employer's Requirement for a different standard:

Function to be Implemented	Standard to be Complied With
Database connectivity	Open Database Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hypertext Markup Language (HTML)

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

2. GENERAL REQUIREMENTS

1. GENERAL

- (1) The Contractor shall adopt a title block similar to that used in the Drawings for all drawings prepared under the Contract. It shall be approved by the Employer.
- (2) Each drawing shall be uniquely referenced by a drawing number and shall define both the current status and revision of the drawing.
- (3) The current status of each drawing shall be clearly defined by the use of a single letter code as follows:
 - P - Preliminary Design Drawing
 - D - Definitive Design Drawing
 - C - Construction Reference Drawing
 - W - Working Drawing
 - B - As-Built Drawing
 - M - As Manufactured Drawing
 - E - Employer's Drawing

2. TYPES OF DRAWING

- 1) 'Design drawings' mean all drawings except shop drawings and as-built drawings.
- 2) Working drawings are design drawing of sufficient detail to fully describe the works and adequate to use for construction or installation.
- 3) Site drawings and sketches are drawings, often in sketch form, prepared on site to describe modifications of the Working drawings where site conditions warrant changes that do not invalidate the design.
- 4) 'Shop drawings' are special drawings prepared by the manufacturer or fabricator of various items within the Works to facilitate manufacture or fabrication.
- 5) 'As-built drawings' show the Works exactly as constructed or installed. They are usually prepared by amending the working drawings to take into account changes necessitated by site conditions and described in Site drawings. These drawings shall be completed on a regular basis as the works progress, and shall not be left until completion of the entire works.

3. COMPUTER AIDED DESIGN & DRAFTING (CAD) STANDARDS

3.1 INTRODUCTION

SCOPE OF USE

Data input procedures between the Employer / Engineer and contractors must be coordinated, and the key parameters used to form CAD data files must be standardised. The production of all CAD data files shall comply with the following requirements.

3.2 OBJECTIVES

The main objectives of the CAD standards are as follows:

- (a) To ensure that the CAD data files produced for Project are co-ordinated and referenced in a consistent manner.
- (b) To provide the information and procedures necessary for a CAD user from one discipline or external organisation to access (and use as background reference), information from a CAD data file prepared by another discipline or external organisation.
- (c) To standardise the information contained within CAD data files which may be common to more than one discipline such as drawing borders, title boxes, grid lines etc.
- (d) To establish procedures necessary for the management of CAD datafiles.
- (e) To ensure all contractors use 'Model space' and 'Paper space' in the production of their CAD files.

3.3 GENERAL

- (1) To facilitate co-ordination between contractors, it is a requirement that all drawings issued by contractors for co-ordination or record purposes shall be produced using CAD methods. Drawings shall be issued in digital format in addition to the paper copies.
- (2) The intent of the issue of digital information is to aid the related design by others. The definitive version of all drawings shall always be the paper or polyester film copies which have been issued by the contractor or organisation originating the drawing.
- (3) Drawings and drawing packages issued for co-ordination, record purposes or for acceptance shall be accompanied by a complete set of the corresponding CAD datafiles.
- (4) Any contractor or organization making use of the CAD data from others shall be responsible for satisfying him that such data is producing an accurate representation of the information on the corresponding paper drawing which is satisfactory for the purpose for which he is using it. Provided the general principles of this section have been achieved by the originator of the CAD data, contractors making use of the CAD data from others shall not be entitled to require alterations in the manner in which such CAD data is being presented to them.
- (5) In particular, automatic determination of physical dimensions from the data file shall always be verified against the figured dimensions on the paper or polyester drawings. Figured dimensions shall always be taken as correct where discrepancies occur.

3.4 TERMINOLOGY & ASSOCIATED STANDARDS/GUIDELINES

Any terminology used within this section that is ambiguous to the user shall be clarified with the Employer's Requirement. British Standard BS1192 is used in principle as a guide for drawing practice, convention, CAD data structure and translation.

3.5 PAPER DRAWINGS

- (1) For the Project "Paper" drawings are considered to be the main vehicle for the receipt and transmittal of design and production information, typically plans, elevations and sections.
- (2) The Project wide accepted media for the receipt and transmittal of "Paper" drawings will be paper and polyester film of various standard ISO 'A' sizes. The composition of this information shall be derived from a CAD "Model".
- (3) The CAD derived "Paper" drawing composition will reflect a window of information contained within a CAD "Model Space" file together with a selection of information contained within the associated CAD "Paper Space" file.

3.6 CAD DATA CREATION, CONTENT & PRESENTATION

A consistent method of CAD data creation, together with content and presentation is essential. The method of CAD "Model Space and Paper Space" creation is as follows:

(1) Model Space Files

- (a) Typically, CAD "Model Space" files are required for general arrangement and location plans and will consist of a series of other "Model Space" referenced CAD files covering the total design extents at a defined building level (the number of referenced files should be kept to an absolute minimum). Data contained within a CAD "Model Space" file is drawn at full size (1:1) and located at the correct global position and orientation on the Project Grid / or defined reference points.
- (b) Each CAD "Model Space" file will relate to an individual discipline. Drawing border / text, match / section lines or detailed notation shall NOT be included within a CAD "Model Space" file. Dimensions shall be included within a CAD "Model Space" but located on a dedicated layer. Elevations, Long Sections and Cross Sections shall also be presented in CAD "Model Space" as defined above, but do not need to be positioned and orientated on the Project Grid.

(2) Paper Space CAD Files

- (a) "Paper Space" CAD files are utilized to aid the process of plotting "Paper" drawings and are primarily a window of the CAD "Model Space" file. A "Paper Space" CAD file will typically contain drawing borders, text, match or section lines & detailed notation. Once these files are initially set up and positioned the majority of "Paper Drawing" plots at various approved scales are efficiently and consistently generated by displaying different combinations of element verse and symbology contained within the "Paper Space" file and the referenced "Model Space" files.
- (b) The purpose is to ensure that total co-ordination is achieved between the CAD "Model Space" file and the "Paper Drawing" output during the revision cycle of the design and production process. Duplicated data in "Model and paper Space" files will not be acceptable unless an automatic update link exists between the two data sets. "Paper Space" files are not typically required as part of the CAD Media Receipt from contractors, unless specifically requested.

3.7 CAD QUALITY CONTROL CHECKS

- (1) Random CAD Quality Control Audits will be carried out by Engineer on all CAD media received and transmitted.
- (2) These checks DO NOT verify the technical content of the CAD data received or transmitted (as this is the responsibility of the originating organization), however compliance with Project CAD and Droughting Standards shall be checked.
- (3) In addition, all contractors who transmit and receive CAD data from the Project shall have CAD quality control procedures in place. A typical quality control procedure shall contain CAD data quality checking routines coupled with standards for CAD data transmittal and archiving.

3.8 CAD DATA TRANSFER MEDIA AND FORMAT

When CAD data is received & transmittal between Engineer and the Contractor, the media shall be as follows:

- (a) Data Exchange Format - AutoCAD Release 14 (.DWG) or latest version
- (b) Operating System -windows Latest version
- (c) Data Transfer Media: Memory Stick/ RW of adequate capacity
- (d) All CDs must be labeled on the data shield with:
 - (i) Name of Company
 - (ii) Project Title
 - (iii) Drawing Filenames (for diskettes only)

- (iv) CD no.
- (e) All media shall be submitted with a completed Form
- (f) The Contractor must ensure the supplied media is free from virus. SUB-directories on tapes or disks are not permitted. If CAD Data is created using UNIX, archive commands must be unrooted.

3.9 CAD MEDIA RECEIPT & TRANSMITTAL

- (1) CAD Media Transmittal (from the Contractor to Engineer) - this will consist of the following:
 - (a) CAD Digital Media
 - (b) CAD data sheet
 - (c) CAD issue / revision sheet
 - (d) CAD Quality Checklist confirming compliance.
 - (e) Plot of each "Model Space" file issued on an A1 drawing sheet (to best fit).
- (2) The above CAD media will be collectively known as "CAD Media Transmittal Set". The CAD data file transmittal format required by Employer 's Representative from all contractors shall be in AutoCAD (Latest version)
- (3) All CAD media received from contractors will be retained by Engineer except for SCSIdisk (if used) as an audit trail / archive of a specific contractor's design evolution.
- (4) CAD Media Receipt (from Engineer to the Contractor)
 - (a) CAD media should normally be obtained from the respective interfacing contractor(s), but should Engineer issue CAD media it will consist of the following:
 - (i) CAD Digital Media typically contain only CAD "Model Space" files.
 - (ii) CAD data sheet.
 - (iii) CAD issue / revision sheet
 - (b) The above CAD media will be collectively known as the "CAD Media Receipt Set". The CAD data file transmittal format used by Engineer to all contractors will be in AutoCAD (version 14)
 - (c) Each CAD transmittal CD will be labeled with proper disk label as approved by the Engineer/ Any CAD data transmitted without this label is assumed to be provisional information not to have been quality checked and therefore not formally issued.

3.10 REVISIONS

- (1) All 'Revisions', 'In Abeyance' and 'Deletions' shall be located on a common layer. This layer can be turned on or off for plotting purposes.
- (2) The following example text indicates the current CAD file revision, i.e., 'Revision [A]'. This shall be allocated to a defined layer on all CAD "Model Space" files, in text of a size that will be readable when the CAD "Model Space" file is fitted to the screen, with all levels on.

3.11 BLOCK LIBRARIES, BLOCKS, & BLOCK NAMES

- (1) All Construction Industry symbols produced as CAD Cells shall typically conform to British Standard BS1192 - part 3.
- (2) All Blocks created shall be Primitive (i.e., NOT Complex) and shall be placed Absolute (i.e. NOT Relative).
- (3) The Contractor's specific block libraries shall be transmitted to Engineer together with an associated block library list containing the filename (max. 6 characters) and block description. The Contractor shall ensure that the library is regularly updated and circulated to all other users, together with the associated library listing.
- (4) All Blocks of a common type, symbols or details should initially be created within a CAD "Model

Space File" specifically utilized for that purpose. These files will be made available on request by Employer's Representative.

- (5) Blocks created will typically be 2D unless 3D is specifically requested. In both instances they shall have an origin at a logical point located within the extents of each Block's masked area or volume.

3.12 CAD DIMENSIONING

Automatic CAD Dimensioning will be used at all times. Any dimensional change must involve the necessary revision to the model space file. If the CAD Quality Control Checks find that the revisions have not been correctly carried out, the rejection of the entire CAD submission will result.

3.13 CAD LAYERING

All CAD elements shall be placed on the layers allocated for each different discipline. The layer naming convention to be adopted by the Contractor shall be submitted for acceptance and inclusion within these standards.

3.14 GLOBAL ORIGIN, LOCATION & ORIENTATION ON THE ALIGNMENT DRAWING.

- (1) Location or Plan information in "Model Space" files shall coincide with the correct location and orientation on the Project grid for each specific contract.
- (2) Location plans shall have at least three setting out points shown on each CAD "Model Space" file. Each setting out point shall be indicated by a simple cross-hair together with related Eastings and Northings co-ordinates. The Contractor(s) shall establish the 3D co-ordinates for their respective works, which will then be used by all other contractors including the Contractor.

3.15 LINE THICKNESS AND COLOUR

To assist plotting by other users, the following colour codes will be assigned to the following line thickness / pen sizes.

Colour	Code No	Line Thickness
Red	10	0.18
White	7	0.25
Yellow	2	0.35
Brown	34	0.5
Blue	130	0.7
Orange	30	1.0
Green	3	1.4
Grey	253	2.0

3.16 CAD UTILIZATION OF 2D & 3D FILES

Although the project standard is 2D CAD files, certain disciplines and contractors may use 3D CAD files for specific applications or where the isolated use of 3D aids the design and visualization process (i.e., Architecture, Survey and Utilities). In these specific instances 3D CAD data will only be transmitted if all other users can use this data. If this is not the case, 3D to 2D translation shall be processed by the creator prior to issue.

3.17 CAD FILE NUMBERING

- (1) Contractors CAD File Numbering shall be described in 2.2above.
- (2) Employer CAD File numbering unlike most of the contractors, Employer will not be required to produce numerous CAD files. This will follow the numbering system Except that the status of the drawing in 2.1(3) shall be "E".

3.18 CAD FILE NAMING CONVENTION - GENERAL

CAD "Model Space" files shall be named in accordance with general drawing conventions. Note: The CAD standards shall be compatible with BIM platform of BI-RIDE.

3.19 ERP, OSO AND 3D BIM PLATFORM

The Contractor shall utilise a PMIS integrating with BIM software such that all documents generated by the Contractor can be transmitted to the Employer and 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 office at site and the Employer's Office by the Contractor.

APPENDIX-10

WORKS AREAS & TEMPORARY POWERSUPPLY

1. INTRODUCTION

- (1) The Contractor shall provide within the designated principal Works Areas, at locations agreed with the Employer / Engineer, the compounds and facilities for the Employer and the Engineer and other contractors of the Employer defined under Clause 2 of this Appendix.
- (2) The standard conditions applying to the use of any Works Area by the Contractor for its site facilities are given under Clause 2 of this Appendix.
- (3) The Conditions for supply of electricity by the Contractor to Designated Contractors are given under Clause 3 of this Appendix.

2. STANDARD ENGINEERING CONDITIONS

The following standard engineering conditions apply to all Works Areas:

- (1) Formation
 - (a) The Works Areas shall be formed to the levels that the Employer / Engineer has given his consent. No levels shall be amended without prior consent of the Employer / Engineer.
 - (b) The Works Areas shall be surfaced in a manner agreed with the Employer / Engineer, compatible with their intended use, and, in particular, footpaths and roadways connecting facilities shall be clearly defined. Measures shall be taken to the satisfaction of the Employer / Engineer to ensure all areas are properly drained and kept free of static water.
 - (c) The removal, diversion or reinstatement elsewhere as may be required of any existing works or installation whatsoever within the Works Areas shall be carried out to the satisfaction of the Employer.
- (2) Roads & Parking
 - (a) Space shall be provided within the Works Areas for parking, loading / unloading and maneuvering of motor vehicles.
 - (b) Any damage done to the adjoining public roads and fixtures and properties (public or private) shall be made good to the satisfaction of the Employer.
- (3) Drainage & Sewerage
 - (a) All storm or rainwater from the Work Areas including any access roads thereto shall be conveyed to the nearest stream course, catch-pit, channel or storm water drain as required by the Engineer. All temporary and permanent works shall be carried out in such a manner that no damage or nuisance are caused by storm water or rain water to the adjacent property.
 - (b) No drain or watercourse shall be used without consent of the Employer.
 - (c) Damages or obstructions caused to any watercourse, drain, water-main or other installation within or adjoining the Works areas shall be made good to the satisfaction of the Employer.
 - (d) Treatment and disposal of sewage and waste water from the works areas shall be provided to the satisfaction of the Employer.
- (4) Buildings
 - (a) No permanent structures other than those required for the Permanent Works shall be Temporary permitted on the Works Areas.
 - (b) Electricity, water, telephone and sewerage shall be provided by the Contractor, as required, for all temporary buildings.
 - (c) No potable water obtained from the Govt. sources shall be used for heating, cooling and humidification purposes, or vehicle washing without the written consent of the Engineer.

(5) Pedestrian Access

Every existing pedestrian access throughout the Works Areas shall be maintained in a usable condition at all times to the satisfaction of the Engineer including lighting, signing and guarding.

(6) Fencing

The Works Areas shall be secured against unauthorized access at all times. In particular fencing or the like shall be maintained, removed and re-erected in the new location wherever and whenever a Works Area is relinquished in stages.

3. APPLICABILITY

- (1) Where the Contractor is required to provide temporary electrical supplies, or to use, extend or expand on temporary supplies installed by others, all such activity shall be executed in accordance with Paragraphs of this Appendix.
- (2) When the Contractor makes use of temporary electrical supplies provided by others he will observe and comply with the requirements of this Appendix.

4. WORK ON SITE

- (1) The contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Employer for review not later than 4 weeks before the appointment and who shall be solely responsible for ensuring all the necessary equipment on site. The contractor shall not install or operate any temporary site electrical systems until his representative is appointed and has commenced duties.
- (2) The name and contact telephone number of the representative having been reviewed without objection by the Employer shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.
- (3) Schematic diagrams and the details of the equipment for all temporary electrical installations shall be submitted by the Contractor, and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for his consent.
- (4) All electrical installation work on Site shall be carried out in accordance with the requirements laid down in BS 7375 and the Specification. All work shall be supervised or executed by qualified and suitably categorized electricians, who are registered as such under the Electricity Ordinance 1990/Electricity (Registration) Regulations 1990.

5. ELECTRICAL GENERAL

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

- (1) Indian Electricity Rules
 - (2) The Power Companies' Supply Rules;
 - (3) Electricity and its subsidiary Regulations;
 - (4) IEE Wiring Regulations (16th Edition);
 - (5) BS 7375 Distribution of Electricity on Construction and Building Sites;
 - (6) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites; and
 - (7) BS 6164 Safety in Tunneling in the Construction Industry.
- (B) Any other applicable national standards

6. MATERIALS, APPLIANCES AND COMPONENTS

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

7. DESIGN CONSIDERATIONS

- (1) Distribution equipment utilized within the temporary electrical distribution system shall incorporate the following features:-
 - (a) Flexibility in application for repeated use;
 - (b) Suitability for transport and storage;

- (c) Robust construction to resist moisture and damage; and
- (d) Safety in use.
- (2) All cabling shall be run at high level whenever possible and firmly secured to ensure they do not present a hazard or obstruction to people and equipment.
- (3) The installation on Site shall allow convenient access to authorized and competent operators to work on the apparatus contained within.

8. MAINS VOLTAGE

- (1) The site mains voltage shall be as per the electricity authority, 415V/3 phase 4 wire system.
 - (a) single phase voltage shall be as per the electricity authority, 230V supply.
 - (b) Reduced voltages shall conform to BS 7375.

(2) Types of Distribution Supply

The following voltages shall be adhered to for typical applications throughout the distribution systems:

- (a) fixed plant - 415V/ 3 phase;
- (b) movable plant fed by trailing cable - 415V /3phase;
- (c) installations in Site buildings - 230V /1phase;
- (d) fixed flood lighting - 230V/1phase;
- (e) portable and hand held tools -115V /1phase;
- (f) Site lighting (other than flood lighting) -115V /1 phase; and
- (g) Portable hand-lamps (general use) -115V /1phase.
- (3) When the low voltage supply is energized via the Employer's transformer, any power utilized from that source shall be- either 415 V. 3 phase or 230 V. 1 phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.
- (4) Protection of Circuits
 - (a) Protection shall be provided for all main and sub-circuits against excess current, under and over voltage, residual current and earth faults. The protective devices shall be capable of interrupting (without damage to any equipment or the mains or sub-circuits) any short circuit current that may occur.
 - (b) Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with: -
 - (i) BS 88;
 - (ii) BS EN 60898; and
 - (iii) BS 7375;
 - (iv) Any other appropriate Indian Standards.

9. EARTHING

- (1) Earthing and bonding shall be provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises and to ensure that faults are rapidly cleared by installed circuit protection.
- (2) Earthing systems shall conform to the following standards: -
 - (a) IEE Wiring Regulations (16th Edition);
 - (b) BS 7430;
 - (c) BS 7375; and
 - (d) IEEE Standard 80 Guide for Safety in AC Substation Grounding.

10. PLUGS, SOCKET OUTLETS AND COUPLERS

Low voltage plugs, sockets and couplers shall be color coded in accordance with BS 7375, and constructed to conform BS EN 63809 high voltage couplers and 'T' connections shall be in accordance with BS 3905.

11. CABLES

- (1) Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required. Supply cables up to 3.3KV shall be in accordance with BS 6346.
- (2) For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to one of the following specifications appropriate to the duties imposed on it:
 - (a) BS 6708 flexible cables for use at mines and quarries;
 - (b) BS 6007 rubber insulated cables for electric power and lighting; and
 - (c) BS 6500 insulated flexible cords and cables.
- (3) Where low voltage cables are to be used, reference shall be made to BS 7375. The following specifications shall also be referred to particularly for under ground cables:-
 - (a) BS 6346 for armored PVC insulated cables; and
 - (b) BS 6708 Flexible cables for use at mines and quarries.
- (4) All cables which have a voltage to earth exceeding 65 V (except for supplies from welding transformers to welding electrodes shall be of a type having a metal sheath and/or armour which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.
- (5) Armoured cables having an over sheath of polyvinyl chloride (PVC) or an oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring.
- (6) For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.
- (7) Cables which have applied to them a voltage to earth exceeding 12 V but not normally exceeding 65 V shall be of a type insulated and sheathed with a general purpose or heat resisting elastomer.
- (8) All cables which are likely to be frequently moved in normal use shall be flexible cables. Flexible cables shall be in accordance with BS 6500 and BS 7375.

12. LIGHTING INSTALLATION

- (1) Where Site inspection of the Works is required during the nights, the Lighting circuits shall be run separate from other sub-circuits and shall be in accordance with BS 7375 and BS 4363.
- (2) Voltage shall not exceed 55 V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.
- (3) Luminaires shall have a degree of protection not less than IP 54. In particularly bad environments where the luminaires are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.
- (4) The Contractor shall upgrade the lighting level to a minimum of 200 lux by localized lighting in all areas where required by the Engineer.
- (5) Mechanical protection of luminaires against damage by impact shall be provided by use of wire guards or other such devices whenever risk of damage occurs.

13. ELECTRICAL MOTORS

- (1) Totally enclosed fan cooled motors to BS 4999: Part 105 shall be used.
- (2) Motor control and protection circuits shall be as stipulated in BS 6164. The emergency stops for machinery shall be provided

14. INSPECTION AND TESTING.

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

15. IDENTIFICATION

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

16. MAINTENANCE:

- (1) Strict maintenance and regular checks of control apparatus and wiring distribution systems shall be carried out by an electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems. The Contractor shall submit for review by the Engineer details of his maintenance schedule and maintenance works record.
- (2) All portable electrical appliances shall be permanently numbered (scarf tag labels or similar) and a record kept of the date of issue, date of the last inspection carried out and the recommended inspection period.

17. METERING

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

- (a) Site fabrication facilities;
- (b) Site workshops and work yards; and
- (c) Site offices and stores.

APPENDIX-11
CURVE AND GRADIENT DETAILS
BSRP CORRIDOR

HORIZONTAL AND VERTICAL ALIGNMENT

All tentative details with regard to the Horizontal and Vertical Alignment are shown on the plan & profile sheets of the drawings provided in tender document. It is indicative for guidance purpose only for the contractor to develop further design process of optimization to achieve improved operational efficiency duly complying with various technical requirements and codes, Railway/ BSRP practices, Railway/BSRP guidelines and standards.

APPENDIX-12**UTILITIES****UTILITIES**

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DEFINITIONS**1. UTILITIES:**

Utilities are defined as public utilities above or below ground and include all live water mains, sewer mains, water wells, power cables, streetlights, transformers, pillar boxes, telephone posts, telecommunication cables, gravity sewers, storm water drains, gas lines which are either shown on the Employer's Drawings (chartered) or identified on site by the Contractor (uncharted).

1.1 Chartered Utilities:

Chartered Utilities are the utilities (as defined above) which are shown on the Employer's Tender Drawings.

1.2 Uncharted Utilities:

Uncharted Utilities are the utilities (as defined above) which are not shown on the Employer's Tender Drawings.

1.3 Responsibility of the Contractor.

- 1.3.1 The Contractor shall make his own enquiries and investigations, including excavating trial holes/pits, to ascertain the existence, nature, location, and size of utilities. A schedule of utility diversions and utilities to remain but to be supported / protected (the utility diversion plan) shall be prepared by the Contractor and submitted.

The schedule will list out utilities that:

- i. will be diverted by the Contractor during the course of the Works, and
- ii. will remain in place and require the use of specific construction protection methods to complete the underground structures around and below the utilities including support of the utilities during construction by the Contractor.

- 1.3.2 The Contractor shall take into consideration the time required for utility diversions into the overall Works Programme for the Contract. However, efforts shall be made to avoid diverting/disturbance of any utility and continue the Works by supporting the same but the required services being provided by these utilities shall be maintained at all the times by the Contractor. Any delay to construction works due to delay in Utility diversion work will be responsibility of contractor, no claims shall be entertained in this regard.

- 1.3.3 The diversion work shall be undertaken by the Contractor as per the approval of the Utility owning Agencies and a notice from the Engineer. Temporary supports and protection by methods proposed by the Contractor and agreed by the Utility Agency shall be provided to the utilities. Permanent supports and protection shall be provided wherever required for the safety and security of the utility service.

- 1.3.4 The Contractor shall immediately inform the Engineer and the Utility Agencies of any

- (a) damage to utilities.
- (b) leakage of utilities.

- (c) discovery of utilities not previously identified.
- 1.3.5 When diverting and/or protecting sewerage and storm water lines the Contractor shall ensure that drainage to the site and adjacent areas is maintained at all times and that at no times flooding/overflow or other nuisance occurs.
- 1.3.6 The Contractor shall inform the Employer/Engineer of the programme of all works of utility diversion/ protection works and shall take all steps to enable the utility diversions to proceed in accordance with the programme. The Contractor shall maintain close liaison with the Utility Agencies. The Contractor shall set up and manage a Utility Liaison Group of experienced personnel for the duration of the Contract.
- 1.3.7 Records of the existing utilities encountered shall be kept by the Contractor on the Site and a copy provided for the Employer/Engineer. The records shall contain the following details:
 - (a) location of utility.
 - (b) date on which the utilities were encountered.
 - (c) nature and sizes of the utilities.
 - (d) condition of utility.
 - (e) temporary or permanent supports provided, and
 - (f) Diversions made –Temporary or permanent
- 1.3.B The Contractor shall include the details (plan, location, ownership, size, and material) of all such utilities on the As Built Drawings.
- 1.3.9 The diversion/protection of utilities (Charted/Uncharted) shall be covered under the provisional sum given in the Pricing Summary under **schedule-'V'**. The Contractor shall be paid as per the current Schedule of Rates of the respective departments (KPWD, IR-USSOR, BWSSB, BESCO, BSNL, or any other Govt agency etc.) plus 10% for overhead and profit. The priority of reference for deriving rate shall be in the same order as stated above. Until such time as such rate(s) are agreed or fixed, the Engineer, after consultation with the Employer, shall determine the provisional rate(s) to enable IPC to be issued by the Engineer.
- 1.3.10 Temporary diversion of each utility is allowed for one time. If the utility is to be restored, permanent restoration shall be considered in addition to the temporary diversion.
- 1.3.11 NOC & Approval of schemes for Diversion of Utilities from the concerned regulatory /statutory/Local Authority is the responsibility of the Contractor in coordination with Employer, Employer will only assist in getting permission and nothing extra is payable on this account. Similarly, necessary precautions which are specified from time to time by the utility owning agencies shall be followed. Contractor should make his own survey for identification of underground/above ground utilities.

2. DIVERSION AND PROTECTION OF UNDERGROUND/OVERHEAD UTILITY LINES

- 2.1 The work comprises of replacement, relocation, diversion and protection of existing subsurface, surface and overhead public utilities viz. sewer mains, water lines, water wells, storm water drains, gully pits including connection pipes, house drains, gas pipe lines, electric and telephone cables, optical fibre cables including their appurtenance structure, O.H. electrical transmission line, electric poles, traffic signals, etc. which will be disturbed due to construction of the metro stations, where applicable.
- 2.2 The Contractor shall effectively protect all public utilities falling within the stations, station entry & exit locations and their immediate adjoining areas or which are likely to be exposed, disturbed or damaged during the execution of the work or in consequence thereof, in such a manner and using such materials as required or specified by the concerned public Utility Agencies and as per instruction of the Engineer, and hold them in proper position without any damage being caused to them during execution of work. Where adequate spaces are not available adjacent and outside the stations, the utilities may have to be hanged within the station-box itself to facilitate the construction work.
- 2.3 The contractor shall provide and lay pipes, water wells, gas mains/gully pit connections/house drains and other electric, telephones, copper telecom cable, optical fibre cables and other cables or any other underground structures or services falling within the station and their immediate adjoining areas which may be found to have been disturbed or damaged due to the Contractor's fault and/or defective and careless workmanship. The decision of the Engineer in this respect shall be binding and final and all costs of rebuilding

or repairing of such damaged services or structures as foresaid shall be deducted from the Contractor, if the same is not taken care of within a reasonable time frame, mutually agreed between the Engineer and the Contractor. The claim or penalty imposed by the concerned utility department for the damage of utilities done by the contractor shall be recovered from the Contractor.

- 2.4 The Contractor shall enquire of and collect information from all concerned public Utility agencies, owners, Government Departments and local bodies in connection with the sewer lines, water mains, water wells, cables, wires and any other obstruction either overhead or on ground or underground which may be encountered in the course of execution of the work and which are likely to affect the progress of the work, at his own cost and risk. No idle labour charge will be admissible on account of delay in collecting the above-mentioned information.
- 2.5 The Contractor shall have to excavate trial trenches of suitable sizes for satisfactorily exploring all the underground utilities as required and as instructed by the Engineer before commencement of any permanent work below ground level. All works related to utility identification and preparation of drawings obtaining stake holders approval shall be included in the Contractors quoted price. The time of completion for the project is inclusive of diverting and/or protection (temporary as well permanent) of utilities.

3. ADDITIONAL CONDITIONS FOR DIVERSION/PROTECTION OF BWSSB UTILITIES

- 3.1 It is the responsibility of the Contractor to get the approval of the proposed water/sewer/storm water/ pipeline etc., diversion/shifting from the concerned Agency/Authority. However, Engineer / Employer may facilitate the co-ordination work with concerned agency for getting the necessary approval.
- 3.2 In case the concerned utility agency/authority maintains a list of registered/approved contractors for undertaking such works and desires such shifting/diversion of pipeline/utility etc. work to be undertaken by such registered/approved contractors, then such shifting/diversion of pipeline/utility etc., shall be carried out by engaging the registered/approved contractors.
- 3.3 In case the Engineers of concerned utility agency intend to supervise the work, the Contractor (or sub-contractors engaged by the Contractor) have to carry out the work as per the instruction of the utility agency during diversion work by the Contractor.
- 3.4 In case of permanent diversion of water/sewer/storm water/pipelines etc., it is the responsibility of the Contractor to carry out such work without affecting water supply/without affecting sewage disposal etc. If required alternative temporary arrangement shall be made by the Contractor without any additional cost.
- 3.5 In case of temporary water pipe/sewer pumping mains (without manholes) diversion (which means divert the pipeline temporary away from station box and brought back to the original position after completion of station work), it is the responsibility of the Contractor either to use the retrieved diverted pipes or new pipes to restore back the original place without affecting the water supply/utility service.
- 3.6 In case of temporary diversion of gravity sewer pipelines with manholes are required, the Contractor, initially before taking up the station work has to ensure that the flow is diverted by laying sewer pipeline and constructing manholes away from the station box and then only divert the flow. After completion of station work, the Contractor shall have to lay again another sewer pipelines and again construct new manholes for restoring back to the original place.
- 3.7 In case of temporary supporting of water/sewer pipelines, if any damages occur during construction period it is the responsibility of the Contractor to rectify the damages to the satisfaction of concerned agency. The cost of the rectification works shall be borne by the Contractor.
- 3.B It is the responsibility of the Contractor to obtain completion certificate from concerned utility agency for each diversion work. The payment for such diversion work will be made to the Contractor after obtaining completion certificate from concerned utility agency.
- 3.9 The Contractor shall handover all the retrieved material to the stores of the concerned utility agency/concerned department at the Contractor's cost and submit the proof of handing over.

4. ELECTRICAL UTILITIES (BESCOM / KPTCL)

- 4.1 The Contractor shall submit the utility diversion programme to Engineer / Employer with diversion justification based on trial pit information.

- 4.2 The Contractor shall submit the diversion plan to Engineer at least 60 (sixty) days in advance of work commencing to obtain approval from Electrical utility agencies. For utility diversion proposals of BESCOM / KPTCL, the Contractor shall submit diversion justification with trail pit information and drawing(s) with the proposed diversion route(s).
- 4.3 The Contractor would submit application of diversion works to electrical utility agencies with diversion plans. The Contractor shall render necessary assistance.
- 4.4 The Contractor shall coordinate with the local officials to assess quantities and specifications of materials required for diversion works. Necessary assistance would be provided by the Employer and the Engineer.
- 4.5 The Contractor shall obtain necessary permission from the concerned departments/agencies to carry out the diversion/shifting works and get necessary permission from Traffic Police Department.
- 4.6 Wherever possible, horizontal directional drilling method shall be adopted at location where utility diversion works crosses roadways and require lane closures for excavation to avoid inconvenience to the traffic.
- 4.7 The electrical utilities diversion/ shifting should be carried out by the Contractors/agencies registered with the electrical utility agencies / KPWD and have the required grade license from the Chief Electrical Inspector to Government. The Contractor should be well acquainted with electrical works so as to maintain the standard. The Contractor shall inform the same to Employer/Engineer for getting consent from the concerned electrical utility agency.
- 4.B The Contractor shall identify the quantity of materials required for the contract such that the material can be procured by the Contractor in bulk and in advance to the implementation of the utility diversion works. The quality of materials to be procured shall be approved by the concerned utility agency. Materials used for diversion/ shifting shall be of quality conforming to the applicable standard of the electrical utility agency and as per relevant BIS.
- 4.9 The source of materials and the guarantee for the materials to be used shall be submitted to Engineer for obtaining approval from the concerned utility agency. Any failure of the material within the guarantee period shall be replaced and installed free of cost by the Contractor.
- 4.10 Contractor shall inform the local officers/officials of the concerned utility agency about the diversion works at least 15 (fifteen) days before the execution of diversion.
- 4.11 The diversion / shifting utility work shall be carried out under the direct supervision of officials and the utility agency decision shall be final in this regard. The Contractor shall provide free access to officers/ officials / workman for the purpose of inspection/supervision.
- 4.12 After restoration of regular service completion certificate shall be obtained from the concerned departments/agencies. The regulations for working with utility agencies shall be as follows.
 - a. The diversion/shifting utility work should be carried out without causing any inconvenience to the operation and maintenance of Sub-Station and other departmental works of the concerned utility agency.
 - b. The Contractor shall execute and complete the work strictly in adherence to the time schedule and to the satisfaction of the engineers and adhere strictly the direction of the utility agency in any matter.
 - c. The Contractor shall be responsible to protect the public and the employees of the utility agency against any accident that may arise during the execution of diversion/shifting utility works. The Contractor shall indemnify the Employer for any claims for damages/injuries to the person/property resulting from any such accident. The Contractor shall Compensation Act by the way of obtaining an accident risk type insurance to meet all purpose of relief, failing which or otherwise the Contractor shall be solely responsible for meeting the compensation awarded under the said Act.
 - d. The Contractor shall undertake to ensure free flow of traffic during execution of the diversion/shifting works and shall be responsible for any accident/loss of lives/property. Damage to the other existing utilities during diversion shall be rectified by the Contractor at his own cost.
 - e. The Contractor shall employ qualified technical personnel to carry out the diversion/shifting of utility works.

- f. The Contractor shall apply well in advance for Line Clearance (LC) for carrying out the joint works/shifting works. Employer would authorise the Contractor to take LC from the concerned utility agency. If needed, Employer would provide assistance to the Contractor to get the LC. LC will be given by the concerned utility agency depending upon exigencies, which have to be strictly adhered to.
- g. The Contractor shall handover all the retrieved / unused material to the stores of the concerned utility agency /concerned department at the Contractor's cost.
- h. Contractor to pay the penalty/charges imposed by the utility agency for damage to the utilities on their own.
- i. The Contractor shall undertake not to revoke the above conditions until the completion of diversion/shifting works.

5. BBMP UTILITIES DIVERSION

- 5.1 Diversion of Storm water drain shall be carried out as per the design, standard and general specifications of BBMP /PWD/concerned Highways Department.
- 5.2 The diversion route for storm water drain shall be approved by BBMP /concerned PWD/ Highways Department.
- 5.3 The invert level of diverting drain shall be maintained on par with upstream/downstream of connecting drains.
- 5.4 The Contractor shall make alternate arrangements to divert and ensure smooth flow of water from upstream side during construction.
- 5.5 The Contractor shall provide the adequate sizes of drain or follow the existing sizes as agreed by the concerned agency.
- 5.6 Diversion of storm water drain shall be carried out through the registered Contractors of BBMP/PWD/Highways Department (if such a list of approved/registered contractors is maintained by the utility agency).
- 5.7 Streetlights shifting shall be carried out as per the specification of BBMP.

6. BSNL UTILITIES DIVERSION:

BSNL utilities such as copper cable and OFC cables which are likely to be affected to be identified based on trial pit information. Contractor to prepare the diversion plan in coordination with the BSNL utilities agencies and get approval for the diversion plan. Employer/Engineer may provide assistance in this regard. Contractor to assess the required quantities based on the diversion plan. Cables procured to be Quality control checked by the concern wing of BSNL. Contractor to coordinate and arrange for the Quality control check by BSNL Diversion of BSNL utilities to be done by the BSNL approved subcontractors and the completion certificate to be obtained from BSNL for the utility's diversion done.

- 7. Private Telecom/OFC/Other cable Contractor to manage the existing private telecom and OFC cables.

8. ADD NEW ADDITIONS – GAIL etc.

General:

The Contractor shall provide 6 months rolling programme every 3 month.

APPENDIX 13

OFFICE ACCOMMODATION, EQUIPMENT AND PERSONNEL

- 1 Accommodations for the Employer & Engineer (earmarked separately) with sufficient natural light & ventilation with the layouts, designs, materials, appliances, personnel etc. approved by Engineer / Employer.
- 1.1 The contractor shall provide the following offices within the time limits specified (Refer Key Dates / Contract Data for details of Liquidated Damages, in case of delay beyond the limits):
- 1.1.1 **Project office accommodation** of at least 300 Sqm (with at least 30% of specific area decided by the Employer, air-conditioned) : 1 Project Office (the minimum number mentioned in the scope) for the Employer & Engineer with air-conditioned cabins for senior officials of Employer and Engineer (as decided by the Employer) and conference halls, as per the approved drawings. Project Office shall have separate areas/buildings ear marked for Employer & Engineer, as approved by the Employer. Distribution and periodical redistribution of the above area in different offices will be done by the Employer as per the need. The cost for providing the Project office is included in the contract price.
- 1.1.2 Deleted.
- 1.2 In addition to the above area, covered parking facility shall be provided exclusively for the cars of Employer & Engineer for at least 2 Cars at Project Office. There shall be a portico or a basement (basically, a covered area from the location of getting off the car to the entrance of the office), so that officials do not get drenched during heavy rain, while entering the offices.
- 1.3 The above total area of 300 Sqm for project office, mentioned above, is considering 1 Project office. If there is an increase in this number as per the need, additional area @ at least 100 Sqm additional Project office and @ at least 40 Sqm additional satellite Site office shall be provided with no additional cost.
- 1.4 Small or teensy-weensy, cramped, grungy, shabby, dribbling, shoddy sheds / cabins with temporary / inferior materials / furnishings will not be allowed as project/site offices, even temporarily.
- 1.5 The following specifications shall be followed for various items of the Project office earmarked for Employer/Engineer. All the requirements mentioned above and below are minimum requirements and shall be complied with. These are not exhaustive and any associated specification for any other relevant item can be specified by the Employer later by Engineer / Employer. Superior specifications / materials than those specified can be used with the approval of Engineer / Employer.
 - i. False Ceiling:
 - a. GI-powder coated (T & L) grid system and high-density fiber reinforced Cement board of approved brand, texture, colour & quality of size (1200 x 1200) mm, 6mm thick are having density of 1250 Kg / m3 conforming to ASTM-E84, ISI 14862-2004, respectively
 - ii. Doors:
 - a. 2.1 m X 1.2 m Teak wood door – (Main Door); Brass Fittings; PVC Doors or any other approved doors for toilets
 - b. Doors of approved material shall be provided for the cabins of various senior officials of Employer & Engineer and for the conference hall.
 - iii. Windows:
 - a. UPVC / Aluminium windows 3 track Sliding windows with M.S grill; frames with metal mosquito nets (gap-less) in one track
 - iv. Tiles:

- a. Vitrified tiles (Scratch Proof) I Wooden flooring of approved brand & quality for office cabins & common rooms; Antiskid tiles of approved brand & quality for the floors of bathrooms

v. Toilets, Plumbing & Sanitary ware:

CPVC pipes for internal work and PVC pipes for outer walls (2.5" PVC pipes)

All Fittings shall be of ISI standard. Ceramic Fittings of approved brand & quality shall be provided for all sanitary ware of washrooms & washbasins. All plumbing fittings, doors, handles etc., shall be of approved brand & quality.

Attached washrooms with one wash basin with pedestal (or wall mounted) and a platform and one wall mounted EWC shall be provided for at least four cabins and for conference hall in each Project Office and for at least two cabins in each Site Office. The Employer may redistribute the above as per the requirement. In addition, at least one common toilet each with at least four urinals for men and at least two EWCs shall be provided near the common area in each Project Office. In addition, one exclusive toilet with one washbasin and one EWC shall be provided for Female staff in each Project Office I Site office. At least one attached washroom with one wash basin and one EWC shall be provided in one cabin in each Site office. At least one common toilet with at least two urinals and at least two EWCs shall be provided in each Site Office. In addition, one separate toilet (outside the building) with one washbasin and at least one IWC shall be provided in each Project Office and each Site Office for assistants, office boys site attendants, drivers, mechanics, cleaning staff etc. By all means, uninterrupted clean water supply shall be ensured in all these toilets for all the 24 hours till the end of DLP. Hand wash of approved quality shall be available on all wash basins and it shall be recouped as and when required. Hand towels of approved quality and colour shall be available on a towel rod I hanger near all wash basins and the same shall be got washed once in every 2-3 days, depending on the need. They shall be replaced as and when necessary.

All project offices I site offices and their premises and all the toilets (attached, common and outside) shall be maintained in a clean and hygienic condition by deploying dedicated staff for this purpose. The cleaning of all the toilets shall be done frequently (common toilets - once in about 2-3 hours). The exact frequency of cleaning of each toilet will be specified by the Employer based on the need in each Project office I Site office and the same shall be meticulously followed.

All the toilets shall be provided with mosquito nets and efficient & noise-less exhaust fans. The nets shall be periodically checked for any gaps, holes etc., through which mosquitoes can enter and the nets shall be always maintained hole-free and gap-free. The exhaust fans shall be always maintained in proper working condition.

The dimensions of toilets and disposition of openings and fittings shall be at least in accordance with the anthropometric data as per the relevant IS code(s).

vi. Electrical Wiring:

- a. Concealed wiring with fire proof cables of IS standard, as directed, with approved materials

vii. Electrical Fittings & Appliances:

- a. Switches, fans, split type air conditioners of required tonnage (to suit the cabin concerned or the conference hall) and fluorescent ceiling lamps (LED I CFL) of sufficient lumen of approved brand, lumen & quality.
- b. The outer units of split type air conditioners shall be sufficiently away from the cabins or conference halls, as approved by the Employer, so that the noise is not audible to the officials

viii. Painting:

Inside: primer one coat +2 coats of emulsion paint of approved brand and colour.

Outside: 1 coat primer + 2 coats of weather proof paint of approved brand and colour.

ix. Others:

- a. Overhead water tanks with sufficient Head of water to ensure the required velocity for water supply; Septic tanks authorised connection to public sewerage system

x. Networking:

- a. Wiring with CAT6E cable or superior, with switches and router connector point as per the approved Plan.

xi. Intercom: A system of intercom telephones, as specified and approved

1.6 The contractor shall provide at least the following furniture & facilities in each project office and site office for the use of Employer and Engineer:

- a. Manager's Premium tables of approved brand, colour, texture, height & quality: size at least 5'x3' L-table with side cadenza complete with laminate finish - at least 4 nos.
- b. Executive Tables of approved brand, colour, texture, height & quality: size at least 4'x3' table with side cadenza complete with laminate finish - in least 6 nos.
- c. Conference Tables (20' x 6' approx.) of approved brand, colour, texture, height & quality with conference chairs: for 20 - person seating - 01 no.
- d. Workstations of approved brand, colour, texture & quality with partitions up to the approved height: size 4'x 5'. Modular workstations green ply makes with merino Laminate and storage cabinets - in least 6 nos.
- e. Workstations of approved brand, colour, texture & quality with partitions up to the approved height: Modular size 4'x3' straight workstation with partition and storage. Cabinets under the working counter as per the approved plan-10 nos. (10 nos. in each project office)
- f. High back High quality revolving Executive chairs of approved brand, colour, texture & quality with tilt able neck rest and adjustable hand rests (adjustable in 3 dimensions) and with fabric finish - at least 5 nos.
- g. Medium back revolving chairs with hand rests of approved brand, colour & texture and quality with FRP finish- at least 30 nos.
- h. Low back revolving chairs of approved brand and quality with FRP finish - 24 nos.
- i. White magnetic boards and pin boards in each room /work stations, white board with stand & 4 white board markers of approved colours (to be recouped as and when needed) and one LED TV of 55 inch of approved size, brand and quality for projecting the presentations for conference room (for Project Office).
- j. Racks & shelves as per the requirement in all chambers and common area, as approved.
- k. Supplying, erection, testing and commissioning of Off-Line UPS system suitable for operation with all accessories on sufficient power back up (with minimum backup time of 2 hours) including 12V DC, AH Batteries in polypropylene container for UPS low maintenance tubular batteries, to meet the power load in case of power disruption (for project office). The system should be able to feed the power to all the desktop computers, printers etc. for at least 4 hours continuously.
- l. Split type air-conditioners of approved make and quality - 1.0 Tonne capacity - at least 03 nos. (at least 03 nos in project office); 1.5 Tonne capacity - at least 04 nos in project office for cabins; 2 air conditioners of 1.5 Tonne or required capacity for each Conference hall in project office.

In addition, the contractor shall provide the following for each Project/Site Office:

- a. Telephones, intercom & High-speed Broad Band Connection - 2 Land line connections + 10- line intercom with instruments & Broad Band Connection.
- b. Digital colors Photocopy Machine (Up to A3 size)- 01 no. of approved brand & quality
- c. Refrigerator (290 Litre capacity) - 01 no. of approved brand & quality
- d. Microwave oven – 02 nos. of approved brand & quality
- e. Drinking Water Dispenser (Hot, Cold & Normal) - 01 no. of approved brand & quality
- f. Tea / Coffee Dispenser - 01 no. of approved brand & quality
- g. Standby DG Power - As required, to run and maintain the office for at least 6 hours.
- h. Safety Helmets, Boots, and any other safety device - as per Requirement to be specified by the Employer / Engineer.

NOTES:

Though the above requirement of furniture and others is mentioned for each office, Engineer / Employer may redistribute the total requirement as per the need of each quarter or earlier. Transporting the same from / to each project / site office each quarter or earlier, based on need, forms a part of the scope of the work. The sizes of a few tables, side racks etc. may be more or a little different from the sizes mentioned above, to suit the layout. The decision of the Employer is final in this regard.

In addition to the above, the following furniture, appliances, equipment, and tools are required combined for all the project/site offices (This is additional requirement for all the offices. Distribution and periodical redistribution of these to various Project & Site offices will be done by the Employer, as per the need). Engineer / Employer may alter the specifications depending on market availability, requirement and other site considerations etc.

- i. Side units with table - 10 sets
- ii. Filing cabinet (36 lockers unit) – 5 nos.
- iii. Lockers cabinet (36 lockers unit) – 5 nos.
- iv. Steel Cupboard - 10 nos.
- v. Digital Camera – 01 No.
- vi. Crockery including cups and saucers – 50 sets.

1.7 The contractor is required to maintain the offices till the end of DLP and to provide the following (but not limited to):

- i. Timely pay all electricity/phone/water/high-speed Broad band charges (A nominated staff member of the contractor shall take care of timely payment without being reminded.)
- ii. Timely provide all stationery items and consumables for office use and keep a reserve, as approved (A nominated staff member of the contractor shall take care of them and ensure reserve supplies.)
- iii. Carry out all necessary repairs to office, equipment, appliances, toilet fittings immediately, as and when required, without any delay (A nominated staff member of the contractor shall daily inspect all of them and identify any problem and undertake repairs, even without being told.)
- iv. Provide mineral water bottles as per the daily consumption of the staff (A nominated staff member of the contractor shall take care of them and ensure reserve supplies.)
- v. Provide tea, coffee, snacks, sanitizers, tissue papers etc., as per the requirement and advice, during meetings/discussions and during late evening/early morning/night working etc. (A nominated staff member of the contractor shall take care of them, without any delay.)
- vi. Arrange proper and safe conveyance (through four wheelers engaged for this purpose) to female staff working for Employer/Engineer, whenever the work gets delayed and whenever the situation warrants (as decided by the Employer) - (A nominated staff member of the contractor shall take care of them.)

1.8 Fire extinguishers shall be provided as per the recommendations of the Bengaluru City Fire Brigade.

- 1.8.1 To facilitate coordination for site activities, testing, inspections, liaison with other concerned agencies etc., the contractor shall provide two vehicles of approved make, model and quality along with drivers till the end of the contract period for project office and one till the end of DLP for each project office, to the Employer. The cost for providing the is included in the contract price.
- 1.9 The contractor shall provide, erect, and maintain appropriate name boards, as specified, with approved materials, for each of the offices and cabins. The material of each name board, font size, font type, spellings etc. on each name board and their locations shall be as approved by the Employer before they are erected.
- 1.10 The contractor shall supply the following personnel within 30 days from the date of issue of LOA for the use of the Employer, till the end of DLP.
- a) Watchmen: Round the clock at each Project / Site office
 - b) Office Assistant / Secretary: 02 nos.
 - c) CAD Operator / Technical Assistant: 02 nos.
 - d) Computer Programming Assistant: 02 nos.
 - e) Office boy cum Site attendant: 2 nos.

The candidature of all the above personnel shall be as personally approved by the Engineer / Employer. Any inefficient / problematic personnel shall be replaced forthwith. The qualifications, expertise, allotment of work, working time, shifts, overlap time, grouping, seating arrangement and any other related matter will be as decided by the Employer. The decision of the Engineer / Employer is final in all these regards. Proper approved safety equipment shall be provided for the site attendants.

2 **Equipment for the use of Engineer and Employer:**

The contractor shall provide the following new equipment and software at each Project/ Site office as listed and maintain them for the exclusive use of the Employer and the Engineer till the end of DLP **(The distribution will be done by the Employer):**

- (a) Desktop Computers (with computer tables) – 05 nos. of approved brand & quality with cordless keyboards and cordless mice, as approved by the Employer. The computers shall be Intel core i5 or its latest generic descendent or higher, running at the specified and approved clock rate (Hyper technology) with no wait state, If the Central Processing Unit has no floating-point arithmetic capabilities, a math-coprocessor shall be installed.

A minimum of 1TB (SSD) 5400RPM 16GB RAM with software configurable into extended memory and expanded memory. The expanded memory shall be one combo drive (DVD, R / CD RW), (7200 RPM); 27" colors monitor - 04 nos. and 22" colors monitor - 02 nos.

- (b) Lap Top Computers with carry cases – 2 nos. of approved brand & quality – with at least 15.6" display, as approved by the Employer.

Both the desktop & laptop computers shall at least have the following specifications:

1. Processor: Intel core i7 or higher, 5.0 GHz (hyper technology) with in-built LAN, Modem, AGP card, Audio Card, and Wi-Fi Internet Card.
 - i. Cache Memory: 512 KB L2 cache
 - ii. Memory: 16GB DDR RAM Expandable up to 32GB
 - iii. Hard Disk: 1 TB or at least 500 GB - preferably SSD
2. At least 1920 X 1080 resolution, S3 VIRGE MX 3D Graphics Controller Chip, 64 Bit Graphics Accelerator, Bit BLT hardware
3. Pointing Device: 102 multimedia Keyboard Acupoint Point Device
4. Ports: 1 Parallel, 1 Serial, at least 2 USB Ports, PS I 2 Mouse I Keyboard, SVGA Video Port, Line in Jack, Headphone & External Microphone Jack, 1 Serial Infrared Port, USB port with Wi-Fi LAN.
5. Card Bus: 2 x PCMC1A Slots (Type II) or 1 x PCMC1A Slot (Type III) Card Bus ready.
6. Battery I Power: AC Adaptor I Li-Lon rechargeable battery with built in battery charger & Software Power Management.
7. OS I Software: Pre-installed Windows 11 professional or Mac OS as approved, latest version of MS office, Windows Utilities, Mediamatics Arcade Pak, Diagnostic Utilities, Ring Central, MS Internet Explorer, Norton Anti-Virus, Speech activated typing software, latest version of MS Project I Primavera (as approved).
8. Communication: 56 Kbps Integrated Fix I data Modem with V.90 support; Speakers
9. Carrying Case: Laptop carrying cases (for all the Lap top computers) of approved brand and quality.

NOTE: Recoupment of batteries of cordless keyboards and mice, as per the requirement, are included in the scope.

- (c) Printers – 06 nos. (A4 size – 05 nos. A3 size – 02 nos and Plotter of A0 size – 01 nos.)

At least one printer of A0, A3 & three printers of A4 size shall be Colour; Two printers of A4 size shall be Laser Colour; Timely replacement of Toners / Cartridges with original ones, as per the consumption pattern

- (d) Languages:

Python (latest version), Java and any other language as directed by the Engineer. (e)

Application Software:

- (i) Microsoft office, latest release
- (ii) A database management package as approved by the Employer
- (iii) Latest licensed version of AUTOCAD Civil 3-D, for 05 users.

- (e) Project Management Package (Microsoft Project) I Primavera V. P6-2 licenses (1 Core Module and 1 Web based Module), as approved Multimedia, as approved

- (f) UPS system with sufficient power backup (with minimum backup time of 2 hrs.) to meet the power load in case of power disruption.
- (g) Surge Protection Devices (one for each computer and printer as given above) Power supply for the systems is to be AC 240 volts, 50 Hz from normal building wiring circuit mains, Power regulator, stabilizer or transformer should be supplied by the contractor for the computer systems such that the systems can function efficiently.
- (i) Four mice with cord (not cordless) for standby purpose.

NOTE: Though the above requirement of computers and others is mentioned for each office, Engineer / Employer may redistribute the total requirement as per the need in each quarter or earlier and transporting and reinstalling the equipment from I to each project I site office each quarter or earlier, based on need, forms a part of the scope of the work.

NOTES:

- a. The items under Clause 2.0 above can be retained by contractor (except 2.0 (e)-Application Software) after the completion of the project / DLP, as specified.
- b. The tenderer is supposed to take all the above requirements and the above retention clause into account while quoting the price. The above requirements are for effective execution and close monitoring of the progress and quality of work and the all the conditions and provisions will be enforced in letter and spirit.

3 Documentation

- 3.1 A complete set of documentation will be supplied with each System. The documentation should be self-tutorial in nature and be readily understood by non-computer personnel.

The following manuals shall be supplied with the system:

- a. Manual on how to operate the equipment; and
- b. Manual on how to use the facilities and software provided by the supplier. (Including languages and utilities)

4 Auto CAD Operator:

The contractor shall provide one sufficiently experienced Auto CAD operator with a separate desk top computer, 22" monitor, computer table, computer chair, keyboard, mouse and all other relevant items and software including licensed version of latest Auto CAD software exclusively for the Engineer till six months beyond the date of completion of contract. This is in addition to the requirement of CAD operators specified earlier. The candidature of the above personnel shall be as approved by the Employer.

APPENDIX – 14

CONTRACTOR'S SITE LABORATORY

1. SITE LABORATORY

1.1 The Site Laboratory shall be approximately 250 sq.m in area. It shall consist of the following accommodation:

- | | | |
|----------------------------------|---|--------------------------------------|
| • Concrete Laboratory | - | 01 No. – 60 Sq.m Floor Area |
| • Soil Laboratory | - | 01 No. – 30 Sq.m Floor Area |
| • Office | - | 02 Nos. – 15 Sq.m Floor Area each. |
| • Store Room | - | 01 No. – 10 Sq.m Floor Area |
| • Kitchen | - | 01 No. – 10 Sq.m Floor Area |
| • Toilet, Changing Room & Shower | - | For Male (Sufficient for 06 persons) |

1.2 The remainder of the 250 sq.m shall consist of Storage Area for Concrete Cube Curing Tanks. The Laboratory, Office etc. shall be in one Building, the Curing Tank Storage Building may be in a separate building. If the separate building, it shall be adjacent to the Laboratory building and connected to it by a level, weather proof passageway. In addition, an area of covered hard standing of 50 sq.m for motor vehicles shall be provided adjacent to the Laboratory.

2. STANDARD OF CONSTRUCTION

2.1 The laboratory shall be constructed to the best Engineering practice and as approved by the Employer / Engineer. Two independent telephone lines with two extensions each shall be provided for the laboratory. Telephones shall be located in areas approved by the Employer / Engineer.

2.2 A Water tank with minimum capacity of 2000 liters shall be installed. Constant water pressure of 15 KPa minimum shall be ensured in each laboratory.

2.3 In the case of sinks used for washing samples, adequate trapping and / or separating devices shall be provided to ensure the proper functioning of the facility.

3. FURNISHINGS AND FIXTURES

The Contractor's site laboratory shall be provided with required furnishing and fixtures.

4. LABORATORY EQUIPMENT

4.1 The laboratory equipment, as listed below, shall be approved by the Engineer. The Contractor shall submit for the Engineer's approval within 2 weeks of the order to commence work the name of the supplier it intends to use for each piece of apparatus together with the relevant catalogue number.

4.2 The layout of the equipment in the testing laboratory shall be as instructed by the Employer / Engineer. The equipment shall be maintained to accuracy appropriate to the required testing methods with routine calibration by an accredited organization as recommended by the appropriate Authority. Equipment shall also be calibrated after maintenance or relocation.

4.3 The Contractor's site laboratory shall be equipped with the following material testing equipment as a minimum. The nature and quality of equipment required for pre-stressing may be varied by the Engineer depending on the detail of the Contractor's Design and Construction methods or for any other reason which he deems to be valid and necessary for the proper control of quality:

Description	Qty / Unit
Liquid limit device (Casagrande type) (01 complete set)	1 set
Grooving Tools	1 No
Evaporating dish	1 No
Spatula 100mm Blade	1 No
Laboratory balance, Capacity 500 g (Sensitivity 0.01 gms.)	1 No
Wash bottle – capacity 500 ml.	1 No
Moisture cans – capacity 50 ml	24 No
Determining Plastic Limit (01 complete set)	
Evaporating dish	1 No
Spatula 100mm Blade	1 No
Glass plate (250 x 250 x 12mm)	2 No
Moisture cans – capacity 50 ml	12 No
Stainless Steel Rods (3mm dia)	2 No
Determining Moisture Content (01 complete set)	1 Set
Micro Over (capacity 35 ltr – control temperature upto 200 °C	1 No
Weighing Machine (capacity 200 gm – sensitivity 0.01 gm)	1 No
Lab. Tongs	1 No
Moisture cans – capacity 75 ml with lid.	36 No
Compaction Characteristics (01 complete set)	1 Set
Standard Compaction Mould – 100mm dia	1 No
Modified Compaction Mould – 150mm dia	1 No
Standard Compaction Rammer – 2.5 Kg.	1 No
Modified Compaction Rammer – 4.5 Kg.	1 No
Straight Edge – 300mm long	1 No
Sample ejector for 100mm and 150mm	1 No
Mould Sample tray 60 x 60 x 8 cm	3 No
Wash bottle, 500 ml	2 No
Moisture cans 250 ml	24 No
Density of soil in-place by sand core method (02 complete sets)	2 Set
Sand density cone apparatus 150ml	2 No

Description	Qty / Unit
Plate, 300mm X 300mm	2 No
Chisel 25mmX 150mm	2 No
Hammer	2 No
One gallons field cans	24 No
Sampling spoons	2 No
Soft hair brush	2 No
Moisture cans	48 No
Sieve Analysis	
Sieve shaker (portable)	1 Unit
Coarse sieves in sizes from 100mm to 10mm (1set Fine sieves #4, #8, #16, #30, #40, #50, #100, #200 each) - (Pans & covers)	
Specific gravity and absorption of coarse aggregate	
Wire basket, 200mm dia Heavy duty suspension balance, 20kg X 1gm with accessory for weight in water	1 Set
Suitable water container	1 No
Unit wt. of aggregate	
Balance, 100Kg cap. with 10gm precision	1 No
Tamping rod 16mm diaX600mm long	1 No
Measuring containers (3, 10, 15, 30 ltrs)	1 Each
Flakiness & Elongation	
Flakiness gauge, Elongation Index	1 Set
Soundness Test	
Sodium Sulphate	25 Kg
Soaking Tank	1 No
Balance, Cap. 3Kg, sensitivity 0.1gm	1 Set
Sieves: coarse, Fine	1 Set
Concrete	
Bickets for concrete sampling	12 No
Slump Cone	12 No
Tamping rod	12 No
Base plate	12 No
Mixing pan for concrete	2 No

Description	Qty / Unit
Scoop for general purpose	2 No
Concrete thermometer	2 No
Concrete cylinder mould, 150 mm * 300mm; 100 mm* 300 mm	10 each
Concrete cube mould, 100 mm cube & 150 mm cube	10 each
Adjustable spanners for Dismantling cube moulds	6 No
Capping set	2 No
Capping compound	
Concrete curing tank with capacity for 270 cubes, temperature controlled, with circulation system drain and lockable cover	5 Nos
Schmidt test hammer	1 No
Compression testing machine (simple hand operated)	1 No
Mould oil Temperature chart recorder	1 No
Miscellaneous	
Vernier callipers to measure up to 200mm, with elongated jaws	5 No
Steel rule, 300 mm long graduated	2 No
Rubber gloves	10 Pair
Cotton working gloves	20 Pair
First aid kit	1 set
Wire brush	6 No
Steel tape, 3m, 5m, 30m	3 each
Ball peen hammer, 1 kg	2 No
Paint scraper. Approx. 100mm wide	8 No
Float, steel Approx.280 x 120 mm	8 No
Sack barrow	1 No
Shovel: Square Mouthed	2 No
Round Mouthed	2 No
24-wheel trolley, heavy duty, approx. 0.7m X 1.0m long Pneumatic tyred type	1 No
Wheel barrow, rubber tyred - Comprehensive tool kit	1 No
claw hammer, multi-grips, spanners (adjustable)	1 No
Type NR Schmidt Hammer and tester with recording device	1 No
Testing Anvil for Schmidt Hammer test (SHT)	1 No
Chart recording paper for SHT	10 Pkts
Cover meter for detecting metal objects to depth of 100 mm - below the surface of non-magnetic objects	3 Nos.
Noise meter	1 No
RCPT Testing Machine	1 No
Permeability Testing Machine	1 No

APPENDIX-15**APPROVED MANUFACTURERS / SUPPLIERS FOR CIVIL WORKS**

All materials and products shall conform to the relevant standards/specifications of IS code, BS Code etc. and shall be of approved make and design. A list of manufacturers / vendors is given herein below for guidance. The contractor shall submit the proposal to the Employer. The approval of a manufacturer/vendor shall be given only after review of the sample / specimen by the Employer. The complete system and installation shall also be in conformity with the – **“Applicable Codes, Standards and Publications”**.

List of approved makes for products and materials is given below. The Employer reserves the right to adhere any of the vendor against each of the item.

No.	Details of Materials/Products	Manufacturer's Name
1.	Epoxy / Polyester resin For fixing anchor fasteners in soffits	<ul style="list-style-type: none"> • Fosroc Chemicals • STP MBT • Apple chemie • BASF • Sika • Hilti
2.	Fire rated Sealant	<ul style="list-style-type: none"> • Dow Corning's "Firestop Sealant 700: by Universal Silicones Lubricants Pvt Ltd. • GE Silicone's Pensil 300 Fire stop Sealant" • Hilti
3.	Ply wood	<ul style="list-style-type: none"> • Uniply • Europly • Archidply • Century ply • Hunsurply • Corbett • Duroply (Green marked, BWR Grade) of Sarda Plywood Industries Ltd., • Green Plywood Kitply
4.	Block board	<ul style="list-style-type: none"> • Uniply • Euro Board • Greenply blockboard • Century board • Archid blockboard • Duroboard of Sarada Plywood • Bhutan Board
5.	Veneers	<ul style="list-style-type: none"> • Greenply • Euro make • Jackson • Timex • Legend • Sarda Plywood Industries Ltd.

No.	Details of Materials/Products	Manufacturer's Name
6.	Burl Veneer	<ul style="list-style-type: none"> • Greenply • Euro make • Jackson • Venture Enterprise • Kitply Industries Ltd.
7.	Adhesive	<ul style="list-style-type: none"> • "Pidilite • Araldite • Jivanjor • Apple chemie • SUPREME BITUCHEM INDIA PVT. LTD. • Fairmate
	Cement based Adhesive	<ul style="list-style-type: none"> • Ultratech • APPLE CHEMIE INDIA PVT. LTD • MYK Laticrete • BASF • FOSROC • Fairmate
8.	Flush Doors	<ul style="list-style-type: none"> • Kutty, • Karnataka State forest department, • Greenply, Decorative Duroply (Green marked), • Kitply
9.	Plastic Laminates	<ul style="list-style-type: none"> • Formica • Greenlam • Vir • Sundeck • Neoluxe • Bakelite Hylam • Century • Marino
10.	Aluminium Sections	<ul style="list-style-type: none"> • Indian Aluminium Co. • Hindustan Aluminium • Jindal, • Boruka • Hindalco
11.	Aluminium Composite Panel	<ul style="list-style-type: none"> • Flexibond • Alucobond • AluKbond • Eurobond • AlucoPanel • Alstrong Enterprises India Pvt Ltd. • Alutech Industries. • Eurobond Industries Pvt Ltd. • City Bond • Hunter Douglas • Durobuild.
12.	Float Glass/Toughened Glass Insulating Glass	<ul style="list-style-type: none"> • Float Glass India Ltd • Modiguard • Saint Gobain • Belgium glass Ltd

No.	Details of Materials/Products	Manufacturer's Name
13.	Bevelled and Embossed Glass/Mirrors	<ul style="list-style-type: none"> • Gujarat Guardian Ltd. • Modi • Saint Gobain
14.	Powder Coatings	<ul style="list-style-type: none"> • Berger • Nerocoat • Jenson & Nicholson
15.	Asphalt Emulsion	<ul style="list-style-type: none"> • Karnak Chemical Corporation • STP
16.	Tile Joint Filler	<ul style="list-style-type: none"> • Bal Adhesives & Grouts • Roff construction Chemicals Pvt Ltd. • GE Bayer Silicon • MC-Bauchemie (IndiaPvt Ltd) • Apple Chemie • BASF • Fosroc • Pidilite
17.	PVC Tile Spacers	<ul style="list-style-type: none"> • Kajaria Ceramics Limited • Arpitha Exports
18.	Heavy Duty Chequered Tiles	<ul style="list-style-type: none"> • NITCO • Modern Tiles • Johnson • Kajaria
19.	Ceramic Tiles	<ul style="list-style-type: none"> • Kajaria • Bell • Spartek • Goldcoin • Johnson • Somany • RAK Ceramics • Murudeshwar Ceramics • Asian Granito India Limited. • NITCO
20.	Vitrified Tiles	<ul style="list-style-type: none"> • "Naveen Diamontile" of Murudeshwar Ceramics Ltd. • "Granamite" of Restile Ceramics Limited • "Marbo Granit" of Bell Granito Ceramica Ltd • Johnson Tiles • Somany Tiles • Asian Granito India Limited. • RAK Ceramics • Bell • Kajaria
21.	Marble blended Vinyl Tiles/Sheet	<ul style="list-style-type: none"> • Armstrong of Inarco Ltd • Terkett Floorings • Krishna Vinyl

No.	Details of Materials/Products	Manufacturer's Name
22.	Glass Mosaic Tiles	<ul style="list-style-type: none"> • Mridul Enterprises • Italia • Palladio
23.	Marble Mosaic Tiles	<ul style="list-style-type: none"> • Nitco • Basant Tiles
24.	Aluminum Linear Ceiling	<ul style="list-style-type: none"> • Luxalan • Interarch • J C Industries • Hunter Douglas • Fundermax • Armstrong
25.	Steel Panel Ceilings	<ul style="list-style-type: none"> • Interarch • Armstrong • Metckaft
26.	Resin Bonded Glass Wool	<ul style="list-style-type: none"> • Rockloyd • Kingsway • LLYOD Insulations (INDIA) Ltd.
27.	MS Tubes	<ul style="list-style-type: none"> • Tata • Lloyd Metal & Engineering Co. • NSL Limited • Jindal • SAIL • ESSAR • JSW • Jindal Steel & Power Ltd. • Apollo • Surya
28.	Modified Bituminous	<ul style="list-style-type: none"> • "Multiplas Standard" of Integrated • Waterproofing Membrane Limited • "SUPER THERMOLAY"/"POLYFLEX" • of STP Limited . • "LOTUS-3" of the Structural Waterproofing Co. Limited • "HEAVY DUTY POLYPLY" of Ana • Roofings Private Ltd • Apple chemie • Shell • Hincola
29	Polysulphide Sealants	<ul style="list-style-type: none"> • Pidilite Industries Ltd . • STP • Fosroc • Choksey • Apple chemie • Fair Mate Chemical Pvt Ltd. • Hindcon Chemicals Limited • APPLE CHEMIE INDIA PVT. LTD • BASF

No.	Details of Materials/Products	Manufacturer's Name
30.	Silicone Sealants	<ul style="list-style-type: none"> • G.E. Bayer Silicone • Dow Corning • Waclear • APPLE CHEMIE INDIA PVT. LTD
31.	Sealant Joints	<ul style="list-style-type: none"> • Watson Bowman Acme Corporation • "Silpray" of G.E. Bayer Silicare
32.	Paints	<ul style="list-style-type: none"> • I.C.I. • Berger • Jonson & Nicholson • Asian Paints • Dulux • Nerolac • Surfa
33.	Emulsion Paint	<ul style="list-style-type: none"> • ICI • Dulux Velvet • Luxol Silk • Jonson & Nicholson • Asian Paints • Dulux • Surfa • Kansai Nerolac Paints Ltd.
34.	Acrylic Emulsion paint	<ul style="list-style-type: none"> • Berger • Asian Paints • Dulux • Kansai Nerolac Paints Ltd
35.	Synthetic Enamel	<ul style="list-style-type: none"> • I.C.I. • Berger • Jonson & Nicholson • Asian Paints • Dulux • Surfa • Kansai Nerolac Paints Ltd.
36.	Cement Based Primer	<ul style="list-style-type: none"> • Berger • Asian Paints • Kansai Nerolac Paints Ltd. • Dulux.
37.	IPN	<ul style="list-style-type: none"> • Berger • Kansai Nerolac Paints Ltd. • Krishna Conchem Products Pvt Ltd.
38.	Epoxy Paint	<ul style="list-style-type: none"> • Berger • Asian Paints • Kansai Nerolac Paints Ltd • Choksey Chemicals Pvt Ltd. • Apple chemie • BASF

No.	Details of Materials/Products	Manufacturer's Name
39.	Texture Paints	<ul style="list-style-type: none"> • Spectrum • Unitile • Surfa • Birla
40.	Wall Putty	<ul style="list-style-type: none"> • Birlawhite • Berger • JK
41	Epoxy Putty	<ul style="list-style-type: none"> • Berger • Asian Paints • Kansai Nerolac Paints Ltd
42	Polyurethane Paint	<ul style="list-style-type: none"> • MRF • Berger • Kansai Nerolac Paints Ltd.
43	Wax Polish	<ul style="list-style-type: none"> • Reckitt & Colman • Asian • Berger
44.	Melamine	<ul style="list-style-type: none"> • ICI Delux Timberstone Melamine Coating • Asian / • Berger
45.	Membrane Water Proofing	<ul style="list-style-type: none"> • TREMCO • Bitumat • Apple Chemie • BASF • Pidilite • SUPREME • Tikidan
	Cement based water proofing	<ul style="list-style-type: none"> • Ultratech • Supreme • Silka • Weber • Pidilite • Perma
46.	Cement Bonded Particle Board	<ul style="list-style-type: none"> • Bison Panel Board • Everest Industries
47.	Stainless Steel Railings	<ul style="list-style-type: none"> • Salem Steel • GM 2 metal works • Entarchcon Infratech Pvt. Ltd. • Renuka Equipments Pvt Ltd
48.	Raised (Access) Floor / Cavity floor	<ul style="list-style-type: none"> • Hewetson • United Insulation • Proactive Systems • Universal Infrastructure Systems
49.	Fire Check Doors	<ul style="list-style-type: none"> • Shakthi Hormann Pvt.Ltd. • Signum

No.	Details of Materials/Products	Manufacturer's Name
50.	Pressed Steel Door Frames	<ul style="list-style-type: none"> • Deccan Structural Systems Pvt. Ltd, • Agew • San-Harvic • Signum
51.	Ceramic Claustra	<ul style="list-style-type: none"> • Scindia Potteris
52.	Interlocking Paving Tiles	<ul style="list-style-type: none"> • Pavestone Marketing Pvt Ltd • Nitco Marble & Granite Pvt. Ltd • NITCO
53.	Ashford Formula	<ul style="list-style-type: none"> • JB Associates
54.	Eleganstone	<ul style="list-style-type: none"> • Bubna Commodities (P) Ltd
55.	Rock Wool	<ul style="list-style-type: none"> • Lloyd Insulation (India) Ltd • ROCKWOOL
56.	Cavity Block	<ul style="list-style-type: none"> • Apco Concrete Block • Besser Concrete Systems Ltd • Sobha Concrete Products
57.	AAC Blocks	<ul style="list-style-type: none"> • Hyderabad Industries Ltd • Ballarpur Industries Ltd • Ultratech • Duralite • Airolite • Apex
58.	Cement concrete designer tile	<ul style="list-style-type: none"> • Eurocon tiles, • Duracrete • Ultra tiles. • NITCO • Johnson • Somani
59.	Polycarbonate sheets	<ul style="list-style-type: none"> • GE Plastics (Lexan) • M/s Gallina Acroplus. • Coxwell • Poly U • Fabic • SABIC I.DANPALON • Tuflite
60.	Iron Mongery	<ul style="list-style-type: none"> • Dorma • Ozone • Kich • Yale • Dorset • Henderson • Ebco • Godrej
61.	AAC Block joint adhesive	<ul style="list-style-type: none"> • Ultratech • Apple Chemie
62.	Readymade Plastering	<ul style="list-style-type: none"> • Ultratech • Apple Chemie • FOSROC

No.	Details of Materials/Products	Manufacturer's Name
63.	Cement base grouting	<ul style="list-style-type: none"> • Ultratech • Apple Chemie • BASF • Fosroc • Perma • Supreme
64.	Baffle Ceiling	<ul style="list-style-type: none"> • Armstrong • Hunter Douglas
65.	Exterior cladding	<ul style="list-style-type: none"> • Hunter Douglas • Fundermax
66.	Perforated metal ceiling	<ul style="list-style-type: none"> • Hunter Douglas • Fundermax • Armstrong
67.	Glass Dome	<ul style="list-style-type: none"> • Entrachcon Infratech Pvt. Ltd.
68.	Tensile Roofing	<ul style="list-style-type: none"> • Saint Gobain • Serge Ferrari
69.	Roof Latches	<ul style="list-style-type: none"> • LATCHWAYS
70.	AL Roof Vents	<ul style="list-style-type: none"> • Agaris Airvent Systems
71.	Roofing 1. Galvalume 2. Zinalume	<ul style="list-style-type: none"> • Tata Blue Scope • JSW Steel • SAIL • LLYOD Insulations (INDIA) Ltd. • VM Zinc • VIJAYANATH • LLYOD Insulations (INDIA) Ltd. • Tata Blue Scope
72.	Toilet Cubicles	<ul style="list-style-type: none"> • Macro Enterprises • Merino • Greemlam
73.	Tactile Flooring	<ul style="list-style-type: none"> • Johnson Tiles • NITCO
74.	CEM Board	<ul style="list-style-type: none"> • USG Boral • NCL
75.	Calcium Silicate Board	<ul style="list-style-type: none"> • Promat • Armstrong • Hilux
76.	AL windows & Glazing	<ul style="list-style-type: none"> • AJIT INDIA (Madras) Pvt. Ltd.
77.	Cement	<ul style="list-style-type: none"> ➤ <u>Viaduct Work & Station</u> • ACC, Ultratech, ➤ <u>Other works:</u> • Gujarat-Ambuja, Grasim, JK Lakshmi, Birla. Dalmia, JSW, Bharati Cement, RAMCO
78.	Reinforcement Bars (TMT Bars)	<ul style="list-style-type: none"> • SAIL, Rastriya Ispat Nigam Ltd, Tata Tiscon, JSW Steel
79.	Epoxy	<ul style="list-style-type: none"> • FOSROC, SIKA QUALCRETE, Araldite, BASF, Fairmate.
80.	Expansion Joints	<ul style="list-style-type: none"> • Prequalified Manufacturers as per RDSO's latest approved list or as approved by the Employer. • Fair Mate Chemical Pvt. Ltd

No.	Details of Materials/Products	Manufacturer's Name
		<ul style="list-style-type: none"> • Chembond Chemical Ltd. • Kantaflex (India) Pvt Ltd.
81.	Admixtures	<ul style="list-style-type: none"> • FOSROC, MBT, MC Baucheme, Sika, • Pidilite, BASF • Fairmate • ADO Additives Technologies Ltd. • Concrete Additives & Chemicals Pvt Ltd. (CAC Admixture).
82.	Pile Integrity Testing Agency	<ul style="list-style-type: none"> • CBRI, Pile Dynamic, AIMIL, Geo dynamic or NABL Accredited Agency
83.	Anchor Fastener	<ul style="list-style-type: none"> • HILTI, FISHER, BAUCH • Canon Fasteners
84.	Structural Steel	<ul style="list-style-type: none"> • TATA, SAIL, ESSAR, Jindal Steel & Power Ltd, JSW
85.	Stainless Steel	<ul style="list-style-type: none"> • Jindal. • JSW.
86.	Pre-stressing Strand (LRPC)	<ul style="list-style-type: none"> • TATA SSL Ltd, USHA Martin
87.	Welding Electrodes	<ul style="list-style-type: none"> • ESAB, Advani - Orlikon Weld Alloy, Modi L&T Eutectic. (RDSO approved manufactures.)
88.	Pot/Elastomeric Bearings	<ul style="list-style-type: none"> • Prequalified Manufacturers as per RDSO's latest approved list
89.	Horizontal Tie Bars/Shear Bars	<ul style="list-style-type: none"> • BB Bars System, BBV Systems, Dextra
90.	HDPE Sheathing	<ul style="list-style-type: none"> • Rex Polyextrusion, Gwalior Polypipes Ltd, M/s Dynamic Prestress
91.	Formwork Release Agent	<ul style="list-style-type: none"> • FOSROC, MBT, MC Baucheme, Ado Conmat, • CICO, SWC, Choksey, BASF, Adoadditives, STP • Fair Mate Chemical Pvt Ltd. • Chembond Chemical Ltd.
92.	Prestressing System	<ul style="list-style-type: none"> • Freyssinet, BBR, VSL, Dynamic, Killick Nixon, Tensacciai (India Ltd.), Usha Martin, Posten, VSIL
93.	Reinforcement Couplers	<ul style="list-style-type: none"> • Dextra, Moment • SANFIELD India Pvt Ltd.
94.	Drainage Pipes	<ul style="list-style-type: none"> • Tirupati Plastomatics, Duraline, REX, STIPL • Ashirvad pipes Pvt Ltd. • Prakash Surya • Prince
95.	Acrylic Textured Coatings	<ul style="list-style-type: none"> • Spectrum, Renova, Wallz, Surfa Nova, Jotun, Asian Paints
96.	Non shrink Grout	<ul style="list-style-type: none"> • Fosroc Chemical (India), Sika BASF, ELCHEM, • MBT, Sika. • Chryso India Pvt Ltd. • Hindcon Chemicals Limited • APPLE CHEMIE INDIA PVT. LTD • Flaminco Refractories Pvt Ltd. • Ultratech. • BASF • Fairmate

No.	Details of Materials/Products	Manufacturer's Name
97.	Bonding Coat	<ul style="list-style-type: none"> • CICO, FOSROC, Sunanda specialty coating Pvt. Ltd., BASF, SWC. TAM, Fairmate
98.	Polysuphide Sealant	<ul style="list-style-type: none"> • CICO. Pidilite. BASF. FOSROC. SWC, STP, • SIKA, Fairmate
99.	Steel Structural Fasteners	<ul style="list-style-type: none"> • Pooja Forge, Sundram Fasteners, Unbrako, Nelson, Panchsheel, karamtara.
100.	Micro Silica	<ul style="list-style-type: none"> • Sika, Elkem, FOSROC. MAPEI. Comiche, Star Silica, TAM, CICO, CAC, BASF, Buildetech, Ashtech, Alcofine.
101	Fire Resistant Paints	<ul style="list-style-type: none"> • Akzo Noble, PPG or equivalent, Jotun
102.	Integral Crystalline Waterproofing Method	<ul style="list-style-type: none"> • APPLE CHEMIE INDIA PVT. LTD • Fosroc • Perma • Cryton • Sika • Fairmate • TREMCO (Vandex)
103.	Water stopper/Bar	<ul style="list-style-type: none"> • Kanta Rubber. Greenstreak, Maruti, Duron • Fair Mate Chemical Pvt Ltd. • Supreme • Fairmate
104.	Liquid polymer membrane waterproofing	<ul style="list-style-type: none"> • INTEGRITANK, BASF. MAPEI, PIDILITE. DAVCO, CICO • APPLE CHEMIE India Pvt. Ltd, FOSROC, Asian Paints, MC-Bauchemie, Fairmate
105.	Curing Compound	<ul style="list-style-type: none"> • Clean tech concure, SINAK, FOSROC, ATPL • TAM, STP SWC.CICO • SUPREME BITUCHEM INDIA PVT. LTD. • Fair Mate Chemical Pvt Ltd. • Chembond Chemical Ltd. • Chryso India Pvt Ltd. • Rheoplast Technology Pvt Ltd. • Polygon Chemicals Pvt Ltd. • BASF • Pidilite • FOSROC • Sika • BASF • ATPL • Asian Paints • Fairmate • MC-Bauchemie
106.	Fly ash	<ul style="list-style-type: none"> • Thermal plant. Ashcrete, Ultra pozz, star pozz, (the fly ash shall be as per our specifications)
107.	False Ceiling	<ul style="list-style-type: none"> • Hunter Douglas • Fundermax • Armstrong
108	Aluminum Louvers	<ul style="list-style-type: none"> • Hunter Douglas-LUXALON H-3, CS-RS-1605 • Jindal

No.	Details of Materials/Products	Manufacturer's Name
		<ul style="list-style-type: none"> • Hindalco
109.	Barbed Wire / Chain-link fencing	<ul style="list-style-type: none"> • Krishna Industries Bhilwara, / Concertina Coils New Delhi,
110.	PEB/Steel Structures/Pipe Structure	<ul style="list-style-type: none"> • Fabtech • Fabrimax • Framacad, • Voltagreen, • Everest, • ZAMIL • Renuka Equipments Pvt Ltd • Bajaj steels industries Ltd. • MetalFAB
111.	Cement (For Brick Works, & General Work, Wall/Boundary Wall only)	<ul style="list-style-type: none"> • Birla Gold (Manikgarh Cements) • Chettinad Cement Corporation Pvt Ltd. • JSW Cement Limited. • Dalmia Cement (Bharat) Limited. • Ultratech • Ambuja
112.	MS Angles & Flats	<ul style="list-style-type: none"> • Ramson Steel (For general purpose only, not for dynamic & heavy loading structures)
113.	Corrosion inhibiting admixture	<ul style="list-style-type: none"> • EPCO-KP 200 from Krishna Conchem Product Pvt. Ltd. • SUPREME BITUCHEM INDIA PVT. LTD. • ADO Additives Technologies Ltd. • BASF India Limited. (Construction Chemical Division). • Silka • Pidilite
114.	Coal tar epoxy for sub-structure protection.	<ul style="list-style-type: none"> • Krishna Conchem Product Pvt. Ltd.
115.	Coating of PSC Girders and RCC Substructures	<ul style="list-style-type: none"> • IPNet from Krishna Conchem Product Pvt. Ltd. • Nerolac • Berger
116	Solid Concrete Blocks	<ul style="list-style-type: none"> • Punjab Bricks • Apex • Grams

The above list is not exhaustive. Contractor may propose similar product of other reputed vendor too for the works only upon non availability of the above material from the above vendors. However, the approval /acceptance / rejection of proposed vendor rest with the Employer.

APPENDIX - 16

APPROVED MECHANICAL, ELECTRICAL & PLUMBING MATERIAL / MANUFACTURER / PRODUCT LIST.

VENDOR'S LIST

- 1) Contractor shall generally use the material of makes as indicated below unless specified in BOQ or as approved by the Engineer. However, the contractor may use material of alternative reputed make with prior approval of Engineer provided the material meets the specification, application, duties etc. stipulated in the contract.
- 2) The contractor shall ensure the correct selection of the makes meeting the specifications and application duties. Before placing order for procurement, the sample of make shall be got verified for its suitability to the specification and application duty. However, Engineer decision will be final and binding. If the make/model proposed by the contractor does not meet the requirement of specification, the contractor will be required to propose an alternative make meeting the clause by clause requirement of specification and acceptable to the Engineer.

S. No	Items	Likely Vendors
1	GI conduit pipes	BEC, AKG and other ISI marked
2	GI Conduit accessories	Conforming to BIS & IS as per approved samples
3	Copper Conductor FRLSZH PVC insulated wires ISI marked	Finolex, Havell, Lapp, SBEE, RPG
4	Wiring Accessories (Switches, Sockets, Modular Boxes & Modular Accessories)	ABB, Legrand, Schneider, Havells, Anchor, MK Electric
5	Miniature circuit breakers, Isolators, ELCB, MCB-DBs	L&T Hager, MDS Legrand, Siemens, Merlin-Gerin, ABB, Schneider, Indo Asian
6	Moulded Case Circuit Breakers	L&T, Siemens, ABB, MDS Legrand Schneider, GE.
7	Air Circuit Breakers	L&T, Siemens, ABB, Schnieder, GE
8	Protective relays	Alstom (AREVA), ABB, L&T, Siemens, Schneider
9	LT Switchgear, Electrical Panels, Motor Control Centre	Schneider Electric, ABB, Siemens, L&T
10	Armoured XLPE Cables (FRLSZH)	RPG, Havells, CCI, SBEE, Universal
11	Double Compression glands for 1100-volt grade cables	Peeco, Comet, SMI, Dowells
12	Cable lugs Copper Crimping type, for 1100-volt grade cables	Dowells, Jinson, Universal.

S. No	Items	Likely Vendors
13	Terminal blocks	ELMEXX, PHOENIX, WAGO, Connectwel
14	LT jointing kit / Termination	Raychem, 3M
15	Cable Trays, Cable Trunking and Raceways	OBO, Pushpak, Galvofab, BEC, VSP, Innospacer, Classic.
16	Cast resin current transformers	AE, Kappa, Control & switchgear, Precise, Gilbert & Maxwell, Voltamp
17	Meters (digital)	MECO, DUCATI, Allen-Bradely, Motwane, AE, Enercon, HPL, Schneider, L&T
18	Selector switches	Kaycee, L&T (Salzer), BCH, Teknic, Schneider, ABB
19	Indicating lamps and push buttons	L&T, BCH, Vaishno, Siemens, TEKNIK, Schneider
20	Power capacitors	Meher (L&T), Alstom, GE Power controls, Epcos(Siemens)
21	LED based Light fittings	Philips, Wipro, Bajaj, Keselac-Schreder, Crompton Greaves
22	Ceiling Fans	Crompton Greaves, Usha, Havells.
23	Circulator fan & Industrial type Exhaust fans	Crompton Greaves, Almonard, Havells
24	Fire Detection & Alarm system (UL Listed)	Edwards, Notifier (Honeywell), Schrack, Simplex (Tyco)
25	Fire Survival Type Fire Alarm & Detection Cables, Fire Survival Type Wires and Control Cables. (LPCB certified)	Datwyler, LAPP, SBEE
26	Heat Ventilation and Air Conditioning System (VRV/VRF)	Daikin, Toshiba Carrier, Blue Star, Voltas, Hitachi, Mitsubishi
27	Axial Flow Fan	Kruger, Systemaire, Nicotra
28	Inline/Propeller Fan/Roof extractor Fan	Systemaire, Kruger, Alstom, Caryaire
29	Factory Made Ducts	Rollastar, Techno Fab, Zeco
30	Grille/diffuser and fire damper	Caryaire, Ravistar, Air Master, Dynacraft
31	Anchor Fasteners	Hilti, Fischer
32	Nitrile Rubber	Armaflex, Eurobatex (Italy), Vidoflex, Rubflex

S. No	Items	Likely Vendors
33	Protective Coating over Nitrile Rubber/ Closed Cell Polyethylene	Polybond
34	Fire Retardant Flexible connection	AirFlow, Navair
35	Fire Sealants	Birla 3M, Hilti
36	Vibration Isolator	Resistoflex, Flexonics (USA)
37	UPS	APC, Emerson, Numeric (Legrand), Hiral (Hitachi), FUJI.
38	Sealed Maintenance free batteries	Exide, Hitachi, Rocket, Amaraja
39	Building Management System	Honeywell, ABB, Siemens, Rockwell, Schneider
40	Diesel Engine	Cummins, Caterpillar, MTU, Kirloskar, Jackson
41	Alternator	Stanford, Leroy, Kirloskar, Marathon
42	Exhaust Pipping	TATA, Jindal (Hissar)
43	Fiber Glass Insulation	UP Twiga, Owens Corning
44	Aluminium Cladding	Jindal, Essar, Tata
45	Pipes for fire hydrant system, GI Pipe.	Jindal (Hissar), Tata steel
46	Firefighting pumps	Kirloskar Brothers Ltd., Armstrong, Mather &platt, Grundfoss
47	Domestic and Drain Pumps	Kirloskar Brothers Ltd., Mather &platt, Grundfoss, KSB
48	Gas suppression system	Ansul (Tyco), Honeywell, UTC
49	Sprinkler head (UL Listed)	Viking, Tyco, Numeric
50	Check Valves, Ball Valve, Gate Valve	Advance, AUDCO, Zenith, Inter valve, Zolato, Sant, RB, Leader
51	Butterfly valves (Fire and Hydraulics)	AUDCO, Inter Valve, Venus, Advance
52	Sprinkler Alarm Valve (fire Services)	HD Fire Protect Co or Equivalent
53	Pressure gauges	Waree, H. Guru, Fiebeg
54	Hydrant Valves, Hose Coupling, Branch Pipe	Minimax, Newage, Fire Shield, Sant

S. No	Items	Likely Vendors
55	Hose reel Drum	Steelage, Minimax, Safe guard, Ex-flame, Fire Shield
56	Hose reel	Maruti, Fire Shield, GEI
57	Rubber Bellow	Kanwal, Resistoflex
58	GI Fittings	Jainsons, Unix, "R" Brand
59	Pressure Switch	Indfos, Switzer, Danfoss
60	Pressure Flow Switch for fire services	System Sensor, Tyco Valves, Johnson, Danfoss, Indfos, Switzer
61	Fire Extinguishers	Safex, Alert, Minimax,
63	Sanitary Fittings	<ul style="list-style-type: none"> • Parryware • Jaquar • Hindware
64	Water Cooler	<ul style="list-style-type: none"> • Blue star Daikin Voltas • Oasis
65	Water heater	<ul style="list-style-type: none"> • Bajaj • AO Smith
66	Pipes and related Fittings (GI,CI,DI,CPVC,UPVC)	<ul style="list-style-type: none"> • TATA • Jindal • Apollo • Kapilansh Dhatu Udyog (P) Ltd. • Astral • Plasto • Supreme
67	Horizontal centrifugal pumps	<ul style="list-style-type: none"> • Kirlosker WILLO KSB • Groundfas Becon CRI • SHAKTI PUMPS INDIA) PVT LTD.
68	Valves	<ul style="list-style-type: none"> • Inter Valves • Lehary • Kartar • Zotoisi • Sant

3) Vendor Approval Procedure

The approval of any equipment or product to be used for permanent E & M Works shall be done in two stages

(a) The first stage is Vendor Approval, which is

- Assessment of capability of proposed Vendor to supply a particular equipment or product, with quality and performance requirements, as required by the Technical Specifications as well as other contract conditions.
- Assessment of the financial and functional strength of the Vendor to supply the requisite quantity of equipment and product as per delivery schedule acceptable to contractor.

- (b) In the second stage, called as Technical Submission Approval Stage, selection of Equipment or product from the equipment / products manufactured / supplied by the approved vendor will be done. This stage includes thorough technical assessments about the conformance of the offered equipment / product to the Technical Specifications and other requirements,
 - (c) To obtain Vendor Approval the Contractor must apply with the following documents to the Engineer
 - (i) Company Profile and Experience of the Vendor
 - (ii) Details of the facilities available at the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured.
 - (iii) ISO 9000 Certification for the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured (The Works / Manufacturing Unit where the proposed equipment / product shall be manufactured **must have** ISO 9000 Certification)
 - (iv) Proof regarding compliance to Manufacturer's Qualifications given in **Employer's Requirements - Manufacturing, Installation and Testing**. The offered products must be proven in service before.
 - (v) Audited Financial Statements of the Vendor for the last three years.
 - (vi) Type test certificates (not more than 3 years old report) from accredited laboratories for the proposed type of equipment / products to establish that the Technical Specification stipulated in Employer requirement are fully met. (In case, specific requirements are mentioned in the relevant sections of Technical Specifications with regard to type testing, same shall also be complied additionally). Proposal received without the type tests certificates as mentioned above, shall not be considered as a Vendor Proposal and summarily rejected.
 - (vii) Clause wise compliance of the relevant Clauses of Technical Specifications.
 - (viii) Details of supplies / orders executed in last ten years for the type of equipment / product offered. Supplies / orders executed for Metro Systems shall be specifically mentioned. Service experience of the item/equipment from other Metro system is required to be submitted.
 - (ix) Any other item as required by Engineer.
 - (d) Contractor must check and certify that vendor Proposal is complete and all the above documents are available in the Vendor Proposal. In addition, the Contractor must check / certify compliance to the Technical Specifications before forwarding the same.
 - (e) Incomplete Vendor Proposal will not be treated as a submission and will be returned.
 - (f) Engineer will give Approval to the Vendor Proposal (received complete with all the documents mentioned above) within ten working days from the date of receipt.
 - (g) Technical submission shall be accompanied with the calculations / other technical documents to justify the selection of any particular model of equipment / product, detailed technical features / parameters of the selected product, type test certificates from the accredited laboratories for the offered products, any other document required by the Engineer.
 - (h) Engineer will give Approval to the Technical Proposal (received complete with all the documents mentioned above) within ten working days from the date of receipt.
- 4) It may be noted that successful Tenderer shall submit proposal for approval of vender with the details mentioned in Para (1) and (2) above. After receipt of vender approval from Employer Representative/

Employer, the contractor will place order for the equipment. Mere vendor approval submission in the Technical Package shall not vest any authority with the successful Tenderer for placement of order for various Equipment Approval of Vendors shall only be done by Employer / Engineer. Conditional Tender offers received from Tenderers with particular Vendors for supply of equipment / products shall not be considered.

- 5) It may further be noted that Engineer shall be under no obligation to accept equipment / products manufactured by the successful Tenderer, unless it meets the entire criterion mentioned above.