Specifications

1. Introduction

1.1. Purpose

The purpose of these specifications is to provide the requirements associated with implementation of the scope of works under this Contract. It also defines the basis to prepare the Tender design and requirements related to the working design to be provided by the Contractor. This should be read in conjunction with the general requirements, standard specifications, special specifications, drawings, bill of quantities, all other documents referenced and included in the Contract.

The Tender design is the design provided by the Employer and presented in the specifications, drawings, bill of quantities, all other documents referenced and included in the Contract.

The Contractor shall complete all necessary working designs to execute the project following the Employer provided design. The Employer will not provide further design information to the Contractor.

If any issues are seen as per actual ground conditions at site during execution, the Contractor must adjust/update the design as per site conditions in its working design, shop drawings and coordinated drawings. These revisions shall be carried out in consultation with the Engineer and as per the directions of the Employer. These revisions shall be approved by the Employer/Engineer. The Works shall be carried out in accordance with approved drawings resolving site issues.

Compliance with the specifications does not relieve the Contractor from responsibility to ensure safe and reliable execution in accordance with applicable statutory regulations, codes and standards.

1.2. Conflicts and Deviations

Any inconsistency, conflict or disagreement between the requirements specified in these specifications or defined elsewhere in the Contract, shall be brought to the attention of the Engineer in writing by the Contractor.

The Contractor shall be responsible to assist the Engineer in resolving the conflict such that work shall be completed in timely manner as per schedule, minimising interfaces and impact on cost.

2. General Information

2.1. Background

The Government of Assam with the assistance of funding from the International Bank for Reconstruction and Development (IBRD) is implementing the Assam Inland Water Transport Project (AIWTP). The funding pattern is such that 80% of the funding is being received from the World Bank and the remaining 20% from the Government of Assam. The main objectives of the AIWT Project are as follows.

1. Improve Passenger Ferry Infrastructure and Services in Assam.
2. Improve the Institutional Capacity and Framework for Inland Water Transport in Assam.

The key project components are as follows.

1. Institutional, regulatory and safety strengthening.
2. Ferry Infrastructure and Modernisation.
3. Improvement in terminal infrastructure.
4. Project Management Support.

Assam Inland Water Transport Development Society (AIWTDS) has been formed for management of overall infrastructural & institutional development of IWT within Assam.

Inland Waterways Authority of India (IWAI) maintains the navigational infrastructure and is currently aiming to maintain a navigable depth of 2.5m from Bangladesh Border to Neamati (629 Km), 2.0m from Neamati to Dibrugarh (139 Km) and 1.5m from Dibrugarh to Sadiya.

Under the AIWT Project, several IWT terminals are planned at various locations identified and shortlisted for priority development by AWITDS. These terminals are spread all along National Waterway 2 on River Brahmaputra.

These terminals shall be developed to cater to the transportation needs of a population cluster and shall to the extent feasible, have modular design based on local architecture style, indigenous construction practices and local construction material.

2.2. Overall Scope

The objective of the contract is procurement, construction, completion and commissioning of the permanent works by the contractor and removal of the temporary works if any and the rectification of defects appearing in permanent works in the manner and to the standards and within the time stipulated by the contract.

In full recognition of this objective, and with full acceptance of the obligations, liabilities and risks which may be involved, the contractor shall undertake the execution of the works. The overall scope of work is given below.

A) Neamati:

Construction of a modular terminal for ferry services comprising of the following, but not limited to:

1) Site Development by filling with selected materials and compacting to the required degree of consolidation including ground improvement
2) Terminal Building with Rest-Rooms, Ticketing Facility, Cloak Room, Restaurant, Shops, including internal building services, etc

3) Substation Building with Transformers, Panel Room, DG Set, etc
4) Firefighting Building with storage tank, pumps, etc
5) Vehicle Parking
6) Internal Roads, Crossings, Service Routings, Markings and Furniture
7) Boundary Walls
8) External Utilities such as water supply, sewage treatment, electricity, fire-fighting, etc
9) Storm-water Drainage
10) Horticulture
11) Fixed Approach Bund with concrete beams, pavement and rails
12) Main Floating Pontoons, floatation tanks
13) Articulated Linkspans

B) Aphalamukh:

Construction of a modular terminal for ferry services comprising of the following, but not limited to:

1) Site Development by filling with selected materials and compacting to the required degree of consolidation including ground improvement
2) Terminal Building with Rest-Rooms, Ticketing Facility, Cloak Room, Restaurant, Shops, including internal building services, etc
3) Substation Building with Transformers, Panel Room, DG Set, etc
4) Firefighting Building with storage tank, pumps, etc
5) Vehicle Parking
6) Internal Roads, Crossings, Service Routings, Markings and Furniture
7) Boundary Walls
8) External Utilities such as water supply, sewage treatment, electricity, fire-fighting, etc
9) Storm-water Drainage
10) Horticulture
11) Fixed Approach Bund with concrete beams, pavement and rails
12) Main Floating Pontoon, Flotation tank
13) Articulated Linkspans

2.3. Site Information

Site information is appended separately. The Contractor is required to refer to the same

3. General Requirements

3.1. Site Acceptance and Mobilization/Demobilization

3.1.1. Acceptance of Site

In accordance with these specifications, the Contractor shall have examined the site and familiarized himself with all existing conditions. He shall accept the site in its existing condition at the time of award of contract.

3.1.2. Mobilization

Upon award of the Contract and within a reasonable time not exceeding 30 days, the Contractor shall mobilize all such labour, equipment and materials that are necessary to complete the Project in due time.

3.1.3. Demobilization

Upon due performance of the Contract and before the Taking Over Certificate is issued to the Contractor, he (the Contractor) shall demobilize all such labour, equipment and materials that are necessary to clear the site within one (1) month to the Employer's satisfaction subject to fulfillment of Defects Liability Period/Defects Notification Period.

3.1.4. Access

The Contractor shall provide and maintain adequate access to the Project site and all areas related to the works at his expense. If existing roads are to be used for access to the site, the Contractor shall maintain such roads for the duration of their use.

3.1.5. Permits and Licenses

Except as expressly stated in the Tender, the Contractor shall obtain all permits and licenses necessary for the execution and completion of the Works. The Contractor shall pay all associated fees including royalty. The Contractor shall also give the Employer a copy of all relevant correspondence and other documents relating to the Contractor's permits and licenses.

3.2. Temporary Works

The Contractor shall design, install and maintain all temporary facilities required for the construction of facilities under this Contract, which he requires on or at the Site throughout the execution of the Work, and remove the same on completion of the Works. He shall provide all such buoying, fencing, watching, lighting, connections to public utilities etc. as he needs or as required by authorities and shall install and use his temporary facilities in accordance with all statutory regulations and the requirement of the relevant authorities.

The Contractor shall submit his plan for temporary works to the Employer/Employer's Engineer, for approval, within 30 days of award of the Contract.

Temporary construction shall be adequate for intended uses and for all loads imposed without excessive settlement, deflection or deformation. All parts and members shall be properly strengthened to prevent displacement or failure.

Before or upon completion of work, unless otherwise required or directed, preparatory structures, installations and utility services shall be disconnected and removed from the Site.

3.2.1. Utilities

Temporary utilities used for construction shall have to be adequate for the intended uses and not to be overloaded or otherwise used or arranged in any manner endangering persons, premises or works. Connections shall be properly made, lines and wiring securely anchored in place and protected against accidents.

3.2.2. Water

The Contractor shall provide his own arrangements for sourcing and for distribution adequate supply water for the Project including:

Drinking water: Providing and maintaining canisters, coolers or connected drinking fountains of sufficient number to reasonably serve the Project.

Construction water: Providing and maintaining temporary water service and distribution of adequate capacity for construction.

3.2.3. Electricity

The Contractor shall make his own arrangement for power supply. If found necessary, the Contractor shall provide and maintain generators including a stand- by generator of adequate capacity to meet his additional Project requirements.

The Contractor shall make his own arrangements as outlined hereunder: Distribution of adequate capacity for power, lighting and other construction needs.

As necessary to properly and safely perform work at enclosed spaces or under hazardous conditions. Likewise, providing lights for night work/ protection as necessary.

Temporary electrical systems shall comply with the local codes and regulations.

3.2.4. Waste and Rubbish

The Contractor shall provide regular daily clean-up and removal of trash, waste, scraps, construction debris, etc. from site and temporary work yard and shall arrange for disposal of waste and rubbish to disposal areas approved by the Employer/Employer's Engineer.

3.2.5. First Aid and Fire Protection

Emergencies

The Contractor shall maintain the lists of nearest available police, hospital or medical services at the Contractor's Site Office and the same are to be displayed at a number of locations & workplaces.

Fire Protection

The Contractor shall establish and submit the following measures to the Employer/ Employer's Engineer.

- Establish appropriate emergency escape routes and procedures;
- Maintain fire extinguishers, connected hoses and other facilities necessary for reasonable fire-fighting action at the site and temporary work yard;
- Provide and maintain a first aid kit containing bandages, medicines and sterilized materials for first aid treatment of minor injuries at the Contractor's Site Office.

3.2.6. Construction Safeguards

Excavations

Trenches intersecting roads shall have to be provided with crossings suitable to carry the type of traffic involved. Vehicular curbs and pedestrian railings shall be provided as necessary. Open pits and in openings in floors and other accessible surfaces shall be protected by barricades or railings. Specific care has to be taken by contractor to protect the existing embankment works. Any damage to existing embankment works due to excavation will have to be made good and reinstated as per original condition by the Contractor at no extra cost to the Employer. The Contractor is obliged to take adequate and appropriate measures to prevent flooding at site, any damages arising due to flooding shall be rectified by Contractor at no additional cost to Employer. protected by barricades or railings.

Access

Access to structures such as scaffolds, ladders, ramps, hoists etc. shall be provided, maintained and operated as necessary.

Storage Areas

Storage and shop areas shall be provided, arranged and maintained at approved locations as necessary to properly store, handle and fabricate the various materials and equipment required.

3.2.7. Protection of the Public

The Contractor shall provide barricades and enclosures as necessary for public protection.

3.2.8. Contractor's Laboratory & Equipment

The Contractor shall provide site laboratory in order to carry out the specified tests. This laboratory shall be completely staffed and properly equipped to the satisfaction of the Employer to carry out the tests as specified.

The Contractor's site laboratory shall be available for the use of or inspection by the Employer as required by him. The Employer may require his representative to be present at any test and at any time during the working hours of the laboratory.

The Contractor shall furnish and maintain the laboratory, apparatus and supplies necessary to permit execution of the tests required by the Specifications. The Contractor shall submit to the Employer for his approval, within 28 days after award of work, a complete list of the equipment, apparatus and supplies he proposes to furnish the laboratory. The list shall include the manufacturer's name and descriptive literature.

List of instruments, tools & tackles required for Material testing laboratory /QA facility at project site to be submitted by the Contractor for Employer approval.

3.3. Submission of Documents During Project Execution

3.3.1. Programme of Works

The Contractor shall prepare and submit (both hard copy and soft copy) to the Employer within 28 days of receipt of Letter of Award the following:

- Detailed CPM Schedule showing the various activities of the Work using MS Project along with a detailed Work Breakdown Structure (WBS) and resource schedule matching the CPM.
- List of designs/drawings/documents along with their schedule of submission.
- List of Vendors/Suppliers of Bought-out items

The above shall be updated every month and submitted to the Employer.

3.3.2. Work Schedules, Survey Data & Drawings

The Contractor shall prepare and submit construction schedules, survey data, and field drawings to illustrate the appropriate portion of work. The work items shall be described and related to responsibility, fabrication, layout, and setting or erection details as specified in appropriate Sections.

The Contractor shall keep allowance in program of works for any stoppages during monsoon period, and he has to take all necessary measures to protect his equipment and the partly completed structures. The Contractor is expected to build such stoppages of work during monsoon in his overall schedule for completion. The Employer will not entertain any claims from the Contractor on this account.

Drawings shall be submitted in three sets of paper prints, A0 size and on CDs (in AutoCAD format).

3.3.3. Maintenance Plan

General

The Contractor shall prepare maintenance plan covering all aspects of the Works for the review of the Employer. This plan shall be prepared to ensure that the design life periods stated are met in full and where no design life periods are stated, the maintenance plan shall be prepared to maximize the serviceable life.

Maintenance Document

The Contractor shall provide three copies of the maintenance plan and manuals to the Employer to retain by the Employer upon the request of the Employer or following receipt of attention to the Employer’s comments.

Weekly and Monthly Progress Reports

The Contractor shall maintain a daily log describing the important events pertaining to the Works, (the working hours, the number of labourers employed, effective operation time of equipment, overtime hours), progress made in the Works. This daily log shall be submitted to

the Employer / Engineer by 1:00 PM of the following day. Compilation of these logs and their summary shall be submitted to the Employer as Weekly Progress Report in three (3) copies by middle of the next week.

The monthly progress reports shall include progress colour photographs taken from a fixed point and angle. The photographs shall be sufficient in numbers and locations to record the exact progress of works. The colour photographs shall be in size 200 mm x 250 mm and the CD containing the digital version of the same shall be provided.

The Contractor shall furnish the Employer with three (3) copies of the monthly progress reports within seven (7) days after the end of every month.

3.3.4. Design & Drawings Submissions

Design Submissions General

The relevant design drawings and specifications are provided in the Tender Documents. The Contractor shall make all arrangements and construction drawings to facilitate the construction. Any additional detailing requirement is indicated in the Specifications and elsewhere in the Tender Documents and/or addenda shall be done by the Contractor. The Contractor shall not be entitled to any extension of time for completing construction/commissioning or any other relief on account of delay caused due to providing any clarifications or in resubmitting any designs and drawings.

The Contractor shall not change any design and drawings included in the Tender without express approval/instructions by Employer/Engineer.

The Contractor shall submit for the approval of the Employer, progressively from the date of receipt of the Letter of Award, three (3) copies of the following:

- Layout of Terminal
- General arrangement of all structures
- Cross sections and other details showing important particulars such as overall dimensions, clearances, etc.
- Specification/catalogues of all standard bought-out items.
- All drawings other than shop fabrication/manufacturing drawings. These will include, but not be limited to assembly, sub-assembly, key components, etc. However, one week prior to fabrication, fabrication and part drawings shall be made available to the Employer.
- Power Requirement (installed and peak demand loads)
- Wiring drawings and equipment inter-connection diagrams of local control panels & Single
- Line Diagram of facility power distribution.
- Calculations pertaining to all structures and works as provided in the Specifications.
- A further digital copy (in AutoCAD format) of the submission shall be given on compact disc. This digital copy shall include the full submission with scanned copies of any documents prepared by hand.

The list of submission will however be discussed with the Contractor after the award.

Submission of Calculations

All calculations submitted for the Employer’s approval shall comply with the following:

a) Each calculation page shall be uniquely numbered.
b) Each section of calculations shall have a cover sheet, listing the subject of the calculations, document number and date of submission, name and qualifications of the Designer(s), the name and qualifications of the Design Verification engineer(s), and the relevant Standards, books and drawings which are the basis of the calculations.
c) Each section of calculations shall have a Table of Contents, including page numbers.
d) Calculations shall be accompanied by all necessary sketches or extracts from drawings.
e) Calculations shall include introductions explaining the purpose of the calculations and the methods and design philosophies adopted. This shall clearly state the Standards on which the calculations are based.
f) Equations and values from International Standards and Codes of Practice are to be clearly referenced which are used in the design shall be attached to the submission.
g) Where values used in the calculations are brought forward from previous calculation pages, the page reference shall be included.
h) At the end of each section there shall be a summary, listing the conclusions of the calculations, and referring to construction drawings.
i) If calculations are revised due to design changes or corrections or comments of the Employer, the calculations sheets shall be clearly marked with a revision letter.
j) All calculations shall be signed / initialled by the designer and design verification engineer.
k) The design calculations shall be written in English. In case any software is utilized to perform the calculations, a sample set of manual calculations with references of various formulae used shall also be submitted for proper verification.

Submission of Drawings

All drawings submitted for the Employer's approval shall comply with the following:

a) All drawings shall be in metric millimetre dimensions and be finally prepared in ink with legible lettering on either A0 1189mm x 841mm using AutoCAD format compatible with AutoCAD 2014 or lower version. The submitted prints shall be clearly legible throughout and there shall be no ambiguity.
b) All drawings shall be submitted in digital format on compact disc, as well as three paper prints.
c) Drafting Standards employed in the preparation of all drawings shall be sufficient to produce legible 297mm x 420mm (A3) reduced drawings.
d) Drawings from various sub-contracting services, specialist suppliers etc. shall also be presented in a similar manner (identical title blocks/format etc.) to provide a matched set of drawings.
e) All drawings shall clearly show the status and revision of the drawings. Revised drawings shall clearly indicate the nature and details of the revision work and also revision cloud & revision mark shall be marked wherever revised.
f) All drawings shall clearly identify the drafts-person responsible together with the identity of the drawings checker.

Each drawing shall show the scale(s) of the components illustrated by the drawing related to the original drawing size, A0, A1, A3 etc.

Inspection of Drawings at Site

The Employer shall have the right at all reasonable times to inspect all drawings at the premises of the Contractor or call for any drawing to be given to Employer's office.

Manuals and Technical Data

a) Manuals

The Contractor shall supply Three (3) hard copies along with One (1) soft copy (in editable format) of Erection & Installation Manuals, Operation Manuals, Spare Parts Manuals and Inspection and Maintenance Manuals prior to the starting of erection. Recommendations of the manufacturer in respect of preventive maintenance, trouble shooting, and breakdown maintenance and overhaul shall be brought out in the inspection and maintenance manuals. Soft copies of all drawings shall be supplied.

Operating instruction manuals shall be provided at the time of shipment with adequate information pertaining to the following:

i) Programming procedures; System specifications;
ii) Electrical power requirements; Expansion of internal fault diagnostics; Troubleshooting procedures;
iii) Powering up procedures;
iv) Shut down procedures

b) Technical Data

i) On completion of the works and before handing over possession to Employer, the Contractor shall supply Five (5) hard copies together with One (1) soft copy of the following:
ii) Shop drawings of all wearing parts and also major assemblies and minor assemblies which require unit replacement;
iii) All "As Built" Drawings of equipment, civil / structural, electrical items etc.
iv) Complete technical data and dimensional drawings of all bought out product/ items in the system, shall be furnished - Five (5) hard copies together with One (1) soft copy of the following:
v) List of recommended spare parts.
vi) Parts catalogues in the case of all equipment /assemblies illustrated with part numbers in drawings both for electrical and mechanical items.

Tools and Maintenance Equipment

A list of complete set of tools/tackles and instruments required to be provided for satisfactory maintenance of the Works shall be furnished.

Maintenance Plan

The Contractor shall prepare maintenance plan covering all aspects of the works for the review of the Employer as per the requirement of this tender document. This plan shall be prepared to ensure that the design life periods stated in Tender are met in full and where no design life

periods are stated, the maintenance plan shall be prepared to maximize the serviceable life. Contractor shall also furnish list of estimated manpower required to perform monthly plan.

As-Built Drawings, Design and Final Construction Report

Before submitting a request for Taking over Certificate, the Contractor shall ensure that it has furnished to the Employer all required documents including but not limited to three (3) sets of as-built drawings, final design in the supporting of as-built drawings and a final construction report as draft. And within thirty (30) calendar days after receipt of comments from the Employer, the Contractor shall submit five (5) sets of the Final Construction Report and five (5) sets of Final As-built drawings & Design documents. As-built drawings of the works consists of three (3) sets of original size copies (white print) and two (2) sets of bound copies reduced to A3 size. All documents and drawings shall be also delivered on CDs (drawings in Auto-CAD format, documents in other required formats and soft copy of the file used in software on which design was carried out).

Before submitting a request for Taking over Certificate, the Contractor shall ensure that it has furnished to the Employer all required documents including but not limited to five copies of manuals for installation, commissioning, operation and maintenance and the drawings/ documents etc., covering all aspects of the Works for the review of the Employer. This plan shall be prepared to ensure that the design life periods stated are met in full and where no design life periods are stated, the maintenance plan shall be prepared to maximize the serviceable life. In the event the Contractor makes any changes effecting such submission the Contractor shall submit afresh such document duly revising to that extent.

3.4. Quality Control and Assurance

3.4.1. General

The Contractor will be required to adopt a system of self-certification in accordance with his general quality plan and the appropriate detailed quality procedures. The quality system shall comply with Standards of ISO 9001.

The Contractor shall monitor his performance of executing his Works against two levels of certification:

The completion of individual work items.

The completion of activities listed in the Programme.

In addition to the certification of the completion of work items and activities, the Contractor shall be required to issue the Quality Assurance (QA) certificates concerning the Quality Plan, Quality Procedures and Construction Documents.

The Employer may monitor the Contractor’s work against the Contractor’s Quality Plan and Quality procedures. The Employer may do this by spot checks, and/or by continuous monitoring of the work. The Employer may also do this by carrying out compliance audits periodically against the Contractors Quality Procedures. The frequency and intensity of such checks will depend on the proven reliability of the Contractor as work progresses. Each non-compliance with the Quality Plan shall be notified promptly to the Employer by the Contractor, together with proposals for remedy of the non-compliance. The absence of monitoring of or

commenting on quality aspects as above by the Employer shall not absolve the Contractor from any of its contractual obligations and/or shall not entitle the Contractor for any claim.

3.4.2. Improper Certification of Unsatisfactory Work

If the Contractor or its personnel repeatedly confirms/declares a work as being satisfactory when such work is not satisfactory, the Employer may reject such work any time during the currency of the Contract and instruct the Contractor to re-execute such work in full or a part thereof without any implication to the Employer. In case of improper certification and/or Contractor's failure to rectify, the Employer may proceed as per the Contract including terminating the Contract. In addition to termination of contract there shall be recovery amount from contractor.

3.4.3. Quality Plan and Quality Procedures

The Contractor will be required to submit his complete General Quality Plan to the Employer within four weeks of the Commencement Date. A designer's quality plan will be accepted as an interim measure to permit design work to be started in advance of the preparation of the General Quality Plan.

Detailed Quality Procedures for each element or item of work must be submitted to the Employer for review at least four weeks before that work is due to commence. Detailed Quality Procedures are required for all items manufactured prior to delivery to site.

3.4.4. Submission and Certification of Construction Documents

The Contractor shall submit a Design Certificate (in duplicate) and Design Check Certificate from proof check consultant of the Contractor whenever the Contractor is submitting Design and Construction Documents to the Employer for review. Construction Documents submitted without the relevant Design Certificates will not be reviewed.

The Contractor is to ensure that all Construction Documents submissions are in a form that enables the Employer to review the Construction Documents as required by the Contract without delaying completion of the Works.

3.4.5. Certificates for Work Item Completion

Readily identifiable Work Items must be certified as checked and found satisfactory by

a) Contractor's surveyor responsible for checking and
b) Contractor's supervisor responsible for checking temporary works, material cleanliness, dimensions (not checked in (a) above), workmanship and all other matters to enable him to certify that the item of work complies in every respect to the contract.

The Work Item Completion Certificate shall be checked and approved by the Contractor's Quality Manager.

Each Work Item Completion Certificate must be identified by a unique and appropriate reference number.

If the Employer is not satisfied that the Works have been carried out satisfactorily as certified, the Employer shall raise a non-conformance report to which the Contractor shall respond stating his proposals for rectifying the non-conforming item and what action will be taken to prevent

recurrence. The Employer may reject such work any time during the currency of the Contract and instruct the Contractor to re-execute such work in full or a part thereof without any implication to the Employer. In case of recurrence/failure of the Contractor to rectify, the Employer may adjust the Contract price by deducting the value of such work.

Any consequences in respect of any revisions arising out of Work Item Completion Certificates being returned with comments shall not be treated as a compensation event.

3.4.6. Certificates for Activity Completion

When a section of Work has been completed satisfactorily, the Contractor shall certify that the activity has been completed in accordance with the Contract.

The Activity Completion Certificate shall be checked by the Contractor's Quality Manager and confirmed by the Contractor. The Designer's Representative shall also certify that the activity has been completed in conformance with the relevant Construction Documents and the Employer's Requirements.

The Activity Completion Certificate shall list the reference numbers and dates of Work Item Completion certificates that have been relied upon by the signatories to the Activity Completion Certificate.

Each Activity Completion Certificate shall have attached to it, copies of any materials test certificates which were received after signing the relevant Work Item Completion Certificates and which have not been submitted to the Employer under separate cover during the period between the signing of the Work Item Completion Certificate and the preparation of the Activity Completion Certificate.

3.5. Field Surveys, Studies and Investigations

3.5.1. General

The engineering design and drawings for the various Permanent Works under this specification are based on the data of field surveys and investigations.

The Contractor may carry out all necessary investigations to supplement and complete his design data, in case he feels necessary for the design of his Temporary Works.

Topographic and hydrographic survey to supplement the survey carried out by the Employer.

Soil investigation work to supplement the investigations carried out by the Employer to verify that his design assumptions are in accordance with the ground conditions.

The Contractor shall, at his own expense, carry out all the necessary surveys, measurements and setting out of the works and shall for this purpose engage well qualified, experienced and competent land surveyors.

3.5.2. Setting Out

After taking the possession of site, the Contractor should establish permanent benchmark near the entrance of terminal as per the norms of survey of India after taking A schedule of reference

dimensions shall be prepared and supplied by the Contractor to the Employer. These marks shall be maintained until the works reach finished formation level and are accepted by the Employer.

The Contractor shall be solely responsible for safe-guarding all survey monuments, bench marks etc. All dimensions and levels shown on the drawings or mentioned in documents forming part of or issue under the Contract shall be verified by the Contractor on the site and he shall immediately inform the Employer of any apparent errors or discrepancies in such dimensions and levels.

3.5.3. Topographic Surveys

The Contractor shall conduct a precision triangulation survey to establish primary and secondary survey stations and tie these with respect to Spheroid WGS 84 UTM grid for setting out the Works.

Survey stations and other control devices required by the Contractor for his execution of the work shall be established by the Contractor at his own expense and shall be removed upon completion of the works.

Topographic survey of the entire Site and its immediate surroundings including the terminal building area along the existing road shall be carried out to establish the required levels for the design of approach road and terminal building and utility area.

3.5.4. Post Construction Survey

The completion of the Works will be examined by the Contractor in the presence of the Employer. During these examinations, the Contractor shall perform the survey, which shall be used to prepare a final drawing showing all dimensions, elevations and cross sections of the "As-Built" conditions of the structures. The Contractor shall be required to remove excess materials or place additional materials, as directed by the Employer, in order to comply with the Contract Documents. The Contractor shall submit the final location of all structures with reference to the Master Grid, which shall show the actual position of each structure and deviation from the theoretical position.

3.6. Employer's Responsibilities

3.6.1. Datum Points and Levels

The Employer will give the details of a reference Benchmark in the vicinity of the Project Site and the Contractor shall establish working benchmarks linked to this and reduce to Mean Sea Level (MSL). The Contractor, prior to the start of the Works, shall confirm the location and details of datum points and levels. The Contractor shall convert all the levels accordingly with respect to MSL.

3.6.2. Contractor's Working Area

The Employer shall not provide any land area within the Project Site for the Contractor's working area like site establishment, installation of batching plant, casting yard, etc. No space for the labour camp shall be provided.

4. Reading Guidance on Specifications

4.1. General

This section is to explain the structure of Standard Specifications and Special Specifications that are part of the Contract documents.

The Contractor shall note that this document shall be used as a guide to understand the use of Standard Specifications and Special Specifications. The Contractor shall explore all the documents included in the Contract to fully understand the complete Specifications.

Compliance with the Specifications does not relieve the Contractor from responsibility to ensure safe and reliable execution in accordance with applicable statutory regulations, codes, and standards.

The Specifications for this project comprise of a suite of specification documents defined as ‘Standard Specifications’ and ‘Special Specifications’.

In general, the Standard Specifications for this project are the CPWD Specifications published by the Central Public Works Department (CPWD). The cut-off date for these specifications and any amendments made by the Central Public Works Department to the same is 31 October 2022.

Only where required and applicable, a corresponding ‘Special Specifications’ is provided identifying modifications (additions, deletions, changes) thereto the ‘Standard Specifications’.

4.2. Conflicts and Deviations

If there is a conflict between the Standard Specifications and the Special Specifications, the provisions in the Special Specifications shall prevail over those in the Standard Specifications.

5. Specifications

5.1. Standard Specifications

The standard or the CPWD specifications and any amendments published by the CPWD are not attached to the tender documents and shall be procured by the Contractors. The applicable CPWD Specifications are as follows.

a. CPWD Specifications (Vol. I and Vol. II) 2019
b. CPWD General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) Works 2017
c. Amendment in General specifications for Heating, Ventilation & Air-Conditioning (HVAC) Works 2017
d. CPWD General Specifications for Electrical Works Part-I Internal 2013
e. Amendment in CPWD General Specifications for Electrical Works Part-I Internal 2013
f. CPWD General Specifications for Electrical Works Part-IV Sub Stations 2013
g. CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems) 2020
h. CPWD General Specifications for Electrical Works Part-VII DG Sets 2013
i. CPWD Delhi Schedule of Rates, Analysis of Rates and Specifications (Horticulture & Landscaping) 2018

5.2. Special Specifications

The Special Specifications have been prepared in case there have been modifications, deletions or additions to the CPWD specifications.

The Special Specifications provide the modifications (additions, deletions, changes) to the Standard Specifications applicable to this Contract.

The purpose of this section is to specify the Special Specifications that should be read in conjunction with the associated Standard Specifications and all other documents referenced and/or included in the Contract.

5.3. General

The Standard Specifications for items under this Contract shall be based on CPWD Specifications (Vol. I) 2019. Modifications to the Standard Specifications are as follows.

Item no.	**Particulars**
Item no. 0.4.1 [Contractor] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Delete item no. 0.4.1 [Contractor] in its entirety. Note: Definition of "Contractor" is as defined in the General Conditions of Contract.
Item no. 0.4.2 [Engineer-in-Charge] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Delete item no. 0.4.2 [Engineer-in-Charge] in its entirety.

	Note: Definition of "Engineer-in-Charge" is to read as defined for "Engineer" in the General Conditions of Contract.
Item no. 0.4.3 [Site] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Delete item no. 0.4.3 [Site] in its entirety. Note: Definition of "Site" is as defined in the General Conditions of Contract.
Item no. 0.4.4 [Store] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Delete item no. 0.4.4 [Store] in its entirety.
Item no. 0.4.7 [Department] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Replace in item no. 0.4.7 [Department], the words "Central Public Works Department (CPWD)" with "Employer"

5.4. Riverine Works

5.4.1. Introduction

The Government of Assam wishes to transform the quality of inland water transport services and integrate high quality passenger and vehicle ferry services, and inland water freight transport into Assam's wider transport network system. Hence, there is a need to develop ferry terminals at Neamati & Aphalamukh with all basic infrastructure and facilities. The riverine infrastructure at the terminals are planned accordingly.

The riverine infrastructure consists of a floating pontoon or main pontoon, floatation tank and a linkspan connecting to sloping approach bund on the riverbank for safe commute of the passenger and associated two and four wheelers' vehicles. The approach bund with pontoons are proposed for accommodating Ro- PAX vessels. Also, the terminal vicinity is protected with slope protection works preventing the terminal from erosion.

5.4.1.1. Floating Pontoon

5.4.1.1.1. Functional requirement

The functional requirement of the floating pontoon is that the facility shall be suitable for operations in inland waters to be stationed at one specific location and facilitate embarking/disembarking of passengers/vehicles from vessel to pontoon and vice versa. The pontoon is proposed to be moored at site catenary chains or mooring lines at bollards. floating pontoon shall be relocated along the approach bund length with respect to the seasonal water level variation. (lateral and vertical movement). The construction of the steel pontoon will be based on normal shipbuilding practices and IRS/classification rules. The Pontoon shall have following requirements, as a minimum:

- Type of pontoon: Box type steel all welded.
- A box type pontoon has been chosen as it has much better stability and provides adequate space for movement of passengers and cargo and thereby ease and safety of operations can be better ensured.
- The pontoon is expected to receive RO-Pax vessel with approx. 100-150 PAX capacity as well as 2 and 4 wheelers. The RO-Pax Vessel may also carry trucks (16.2 Tons) as per preliminary indications. The deck strength must be not less than 10 tons/square meters.
- The passage for movement of passenger to be anti-skid type
- Reserve Buoyancy of the pontoon shall be in accordance with statutory rules and regulations.
- A cabin on the deck as shown on the drawings for keeping stores, materials etc.
- Railing of at least 1.25 m height (fabricated out of IS 4923 grade steel) at suitable interval for safety parameters & the railing shall have minimum two (2) rows of bars/chains running throughout the pontoon. The railing on the receiving side of the pontoon to be of collapsible type.
- Lifesaving appliances (at least 8 Nos. lifebuoys) to be provided.
- At least 04 number of portable dry powder fire extinguishers of 9 liter capacity for all classes of fire to be provided. In addition, 04 numbers Fire buckets (9 lit. Capacity) and 04 numbers Sand boxes (0.5 m x 0.5 m x 0.3 m to be provisioned. 02 numbers of Fire Hose with nozzle to be provisioned with fitting on Main Deck with provision to be connected from shore supply.
- Tactile tiles to be provided for visually impaired people
- Electrical fittings such as lights bulbs installed on poles etc. be fitted as per requirements at storage cabin and general-purpose lighting for operations during night etc.
- The bottom should be strengthened for loading and unloading aground.
- Shore power line connection must be provided, with necessary cable and change over switches. The electric connections to be undertaken with duly approved P.V.C. insulated multi strand copper wire in flat casing capping conduit. The electric connections for deck fittings such as winches/davits to be provided as per requirement.
- One portable submersible pump of at least 10 tons/hr each along with discharge hose of adequate length to be provided for various pumping out purposes.
- Adequate number of double bollards of standard size or as suitable to be provided on the main deck distributed on the port and starboard side suitable spacing for effective mooring.
- The passage on the deck to be of non-skid type. The paint scheme on the top deck should be anti-skid type.
- Adequate number of fairleads as per number of bollards located on either side of bollards to be provided.

5.4.1.1.2. Statutory and Regulatory Compliance

The Pontoon shall be designed and built-in compliance with latest ‘Rules and Regulations for Construction and Survey of Inland Waterways Vessels’ and all the applicable statutory and flag regulations as applicable and appropriate. The pontoon shall be assigned with the class

notation 'PONTOON' including the notation for operation in 'Zone 1' (applicable where significant wave height does not exceed 2 m), or equivalent.

The hull form shall be of a flat bottom, cambered deck, with planar (and vertical) side shells. The fore and aft body of the pontoon with the raked bottom (swim ends) shall be provided.

Refer drawings no. DI1530-RHD-ZZ-NG-DR-C-1016 to 1017 of Aphalamukh & DI1530-RHD-ZZ-UA-DR-C-1516 to 1517 of Neamati for more details.

5.4.1.1.3. Main Particulars

The main dimensions of the pontoon as required by the customer are as follows.

S.No	Parameter Description	Value
1	Length	45.00 M
2	Breadth(Molded)	12.00 M
3	Depth (Molded)	01.80 M

Other particulars based on requirements and design are as follows.

S.No	Parameter Description	Values
1	River current speed	06.00 m/sec
2	River Water Density	1000 Kg/m^3
3	Design Draft	~0.88 M @ Fully Loaded Condition
4	Freeboard	0.92 M
5	Air Draft	04.10 M
6	Lightship Weight	409.80 Tonnes
7	Deadweight	33.95 Tonnes
8	Displacement	443.75 Tonnes
9	Deck Load Rating	~100 kN/m^2

S.No	Weight Description	Estimated Weight (Tonnes)
1	Steel Weight (Hull Structure and Structural reinforcements for strong points & berthing loads)	308.58
2	Outfittings (Incl. Equipment and Machineries)	101.22
3	Dead Weight	33.95
4	Displacement	443.75

5.4.1.1.4. Structure, Construction Material, Scantlings, and Framing System

The strength and material properties of ordinary hull strength steel shall be followed as specified in the following table-

Mechanical Properties	Values
Density	7.85 Tonnes/m3

Ultimate tensile strength	400 – 490 MPa
Yield tensile strength	235 MPa

S.No.	Item Description	Member Dimension / Scantling
A	**Shell and Bulkhead plating**	
	Deck plate	11.5mm
	Bottom plate	8mm
	Side shell plates	7mm
	FWD & Aft plates	
	Bulkhead plates	7mm
B	**Bottom Structure**	
	Floor Plates	W 0.48X0.008, FP 0.21X0.015
	Centerline Girder	
	Side Girder	
C	**Deck Structure**	
	Transverse Stiffeners	L – 0.13X0.13X0.008
	Transverse Girder	W 0.3X0.012, FP 0.125X0.05
	Centerline Girder	W 0.540X0.016, FP 0.21X0.018
	Side Girder	
D	**Side Structure**	
	Vertical Stiffeners	L – 0.13X0.13X0.008
	Web Frame	W 0.3X0.012, FP 0.125X0.05
E	**Bulkhead Structure**	
	Vertical Stiffeners	L – 0.13X0.13X0.008
F	**Other Structures**	
	Support Pillar	NB 6” - Sch STD Pipe sections

5.4.1.1.5. Deck Loading

For deck structures, a uniform loading of 100 kN/m2 shall be considered. A Wheel loading of 420 kN/m2 shall be considered as per class regulations because of four-wheelers that are envisaged to be moved across the pontoon while unloading/loading the berthing vessel.

5.4.1.1.6. Towing Lines Specifications

Towing lines specifications required are as follows when being pushed:

S.No	Parameter Description	Values
1	No. of Towing Lines	04.00 Nos
2	Min. Breaking Strength	440 kN

When the pontoon is towed, towing line on the tug is envisaged to be used.

5.4.1.1.7. Bollards and Roller Fairleads on Pontoons

12 Nos of Double Bitt Mooring Bollards (6 Nos each Side – Port and Stbd) and Roller Fairleads (6 Nos each Side – Port and Stbd) along with deck rollers for directional guidance, with Safe Working Load (SWL) of 50 T (Based on Min. Breaking strength of mooring lines) are envisaged as per IRS rules and regulations.

5.4.1.1.8. Towing Bitts

Mooring bitts that are arranged at the fore/aft ends shall be to be used during towing operations. The strength of the mooring bollards shall be based on bollard pull of the tug that will be used for towing operations

5.4.1.1.9. Anchor Windlass and Anchor

The catenary anchor chain cable will be connected the anchor windlass through the hawser pipe and the anchors dropped in a cross manner (Port anchor to Starboard and Starboard anchor to Port). An anchoring configuration of nature as depicted in the drawings is envisaged to facilitate keep the anchoring lines clear off the berthing vessel and following parameters shall be taken into account.

Parameters		**Remarks**
Anchor type	4 No of drag Anchors	HHP (high holding power) of ~5 Tonnes each
Chain cable Diameter & weight	34mm & 26 Kg/m	Grade 3 with breaking load of 937 KN)
Total Length of the one chain cable required (Riverbed and Suspended)	150.00 m	For one Chain cable
Length of the Catenary Arc (Radius equal to depth of the water)	15.7 m	For 10 m depth
Length of chain on the Riverbed	134.3 m	Excluding the Arc length of the Catenary

S.No	**Parameter Description**	**Chain cable**
1	Continuous Duty Pull (for 30 Mins)	81 kN
2	Hoisting speed	Shall not be less than 9m/Min.

5.4.1.1.10. Firefighting System

04 number of portable dry powder fire extinguishers of 9-liter capacity for all classes of fire shall be provided as per the requirement.

In addition, provision shall be kept for 04 Nos Fire buckets (9 lit. Capacity) and 04 Nos Sandboxes (0.5 m x 0.5 m x 0.3 m)

5.4.1.1.11. Fire pumps & Fire hoses and nozzles

Firefighting equipment(s) shall be as per the IRS Inland Waterways Vessels Rules.

Equipment	Specification
Fire pump	Bilge pump shall be used as fire pump (25 m3/h) & not to be less than 10 m3/h,
Fire hoses with nozzle	2 Nos. for dual purposes jet/spray (The length of the hose is not to exceed 18 m, and nozzle of not less than 12mm bore are to be provided.)
Jet throw required from the nozzle	> 12 m

Note: Each hose shall be provided with a nozzle and the necessary couplings. Fire hoses, together with any necessary fittings and tools, shall be kept ready for use in conspicuous positions near the water service hydrants or connections.

5.4.1.1.12. Life-Saving Appliances

A minimum of 08 nos. of life buoys shall be provided on the main deck for emergency scenarios.

5.4.1.1.13. Navigation and General Lightings

For general lighting and illumination purposes, 15 sets of floodlights shall be provided for onboard the pontoon, two LED lights for the storage space, and one for the restroom.

Navigational lights shall be as per applicable Statutory/Regulatory requirements (COLREG regulations/Flag regulations) considering the towed regimes that this pontoon may undergo.

Navigational light located at forward and aft end shall be marine approved with the following technical specifications-

i. 360deg,
ii. IP 66/67
iii. white,
iv. 230 V
v. 3Nm visibility

5.4.1.1.14. Bilge System

A portable bilge pump of capacity 22.5 m^3/hr shall be provided in the storeroom on main deck to facilitate in case de-flooding requirement scenarios that may arise during the operations.

5.4.1.1.15. Paint Scheme

A marine grade painting scheme as appropriate for the intended use of the pontoon shall be designed by the shipbuilder/paint specialist/paint contractor. Main deck shall be coated with anti-skid paint. A declaration by a paint specialist/contractor on durability of the paint shall also be ensured for class's reference or appraisal.

The pontoon shall be provided with sacrificial Magnesium anodes for protecting the underwater hull from corrosion, in addition to the marine grade painting.

5.4.1.1.16. Handrails

Handrails of height 1.25 m shall be provided all around the pontoon to guard the public and crew. Port side handrails shall be of removable type and made of stainless steel.

5.4.1.1.17. Fenders

Pneumatic fenders shall be fitted to absorb the berthing energy that will be imparted by the incoming vessels. A total 14 no. Yokohoma of 1.2m dia. and 2m length shall be mounted, also to protect the hull from damage, the rubber D fenders shall be fitted around the exposed hull plates.

For the purposes of testing the fenders, the Rated Performance Data (RPD) as defined in "Guidelines for Design of Fender Systems 2002" published by the International Navigation Association shall be followed.

One fender unit shall be selected at random from each batch of ten units produced of a particular size, grade and specification. Where different moulds are used or the manufacturing process is altered, this shall be treated as a new batch of fenders for the purpose of this clause. Where there are less than ten fenders in a batch, then one fender shall be tested from that batch.

The Manufacturer(s) shall apply a system of Quality Management which conforms to ISO 9000/9001 or a recognized equivalent. This system must be certified by an acknowledged and accredited organization, and proof of this system must be submitted with the Tender.

As part of the working design, Contractor shall detail out the fixings of the fender to the pontoon. The system shall be designed such that a minimum of maintenance shall be required and such that their removal for repair or maintenance work can be carried out quickly and easily.

Chain assemblies shall be designed with a minimum factor of safety of three on design loads, i.e. the loads due to the Design berthing energy taking into account temperature, velocity and manufacturing tolerances.

The supplier shall submit to the Employer, the certificate giving the following details:

- Type and quantity supplied
- Test load
- Linear dimensions of each fender noting deviation from the nominal dimensions
- Quality of rubber or any other material used with test results
- Method of manufacture

5.4.1.1.18. Mooring Bollards on Approach Bund

All materials and workmanship shall be in accordance with the appropriate Indian Standards, Codes of Practice and other specified standards.

Bollards shall be proprietary manufactured ductile Iron of Tee bollard or equivalent. Bollards shall be capable of 50 Ton SWL, and should be able to resist their rated capacity times the minimum factor of safety specified in the particular requirements over the stated operating ranges. Bollards shall be of new material. Bollards shall be provided with full set of anchor bolts and accessories.

Manufacturer's data of the bollard and its components shall be approved and provided prior to installation to demonstrate compliance with this Specification. Bollards and their components shall be handled, stored, and installed in accordance with the manufacturer's instructions. In addition to the above, supplier shall also submit Installation and Maintenance Manual of Bollards.

The supplier shall submit to the Employer, the certificate giving the following details:

- Type and quantity supplied
- Test load
- Linear dimensions of each bollard noting deviation from the nominal dimensions
- Quality of material used with test results
- Method of manufacture

5.4.1.1.19. Mooring Lines

Mooring lines shall be of polypropylene material. The diameter shall be of 36 mm diameter with breaking load of 22 Ton. The Contractor shall follow the same or equivalent size/ capacity of polypropylene line.

5.4.1.1.20. Deck House & Utilities

A deck house on the main deck as shown on the drawings shall be placed to utilize as a store and utility room, such as public restroom, battery, shore supply panel, and storage space.

Public Restroom shall be equipped with 1 x WC, 1 x Wash Basin, 1 x Mirror, with a Bio-Digester of at least 500 Liter installed underneath the main deck. A ventilator shall be fitted for air circulation.

5.4.1.1.21. Manholes

Manholes of standard size (600 X 400) shall be provided on the main deck to access the under-deck compartments. Watertight flush-type hatches have been envisaged to enable undisrupted movement of the passengers on the main deck.

5.4.1.1.22. Tactile Tiles

Tactile tiles shall be provided on the main deck for visually impaired people to be guided towards the access ramp.

5.4.1.1.23. Electricals

Shore supply connection shall be utilized for consumers/passengers onboard the pontoon such as General Lightings, Ramp Winches, Navigational Lights, Flood Lights, Bilge Pump, Anchor Windlasses, etc.

A 3 Phase & 400 Volt shore supply shall be setup for the shore supply connection box with 300A MCCB breaker to feed the heavy machinery that are available onboard as appropriate and applicable.

The provision for batteries 4 nos. of 12 V 200 AH Lead Acid Battery shall be kept for essentials when the pontoon is disconnected from its power supply from shore. Essentia
ls are Navigational lights and some of the general lightings on the deck of the Pontoon.

5.4.1.1.24. Working Design

The information shown on the drawings & in this specification provides tender level information thus allowing tenderers to base their bid, however, the Contractor shall prepare the working design & drawings with all the details, connections, anchoring, mooring etc., to meet the functional requirements. The Shop drawings of the pontoons shall include as a minimum a general arrangement layout, connection details, erection plans and miscellaneous design such as removable handrails design, drawings, and any other necessary details to meet the specified functional requirements. Contractor shall secure necessary approvals from the authorities towards the construction and installation of the Pontoon works.

5.4.1.2. Floatation Tank

The functional requirement of the floatation tank is to support one end of the linkspan and provide support to the floating pontoon or main pontoon in facilitating the embarkment & dismemberment of passenger/vehicles. The floatation tank moves in the vertical plane along with the water level fluctuations in the river during all the seasons. The elevation rise of the tank shall be inline with the main pontoon at all times so that the top surfaces of both the

structures are at the same level. The floatation tank shall be designed in such that the finished level of linkspan shall match the finished level of the pontoon at all times.

The floatation tank is designed for the overall buoyant capacity of 65 Tons. The contractor shall verify the requirement of the floatation tank to absorb the dead load and live load of linkspan, self-weight of floatation tank.

The floatation tank shall be designed with appropriate fittings to safely moor it with the main pontoon. Further, while towing a floatation tank it needs to be moored to the linkspan using mooing lines and its associated connection. Also, appropriate fenders shall be provided to minimize the force from the main pontoon.

The main dimensions of the pontoon as required by the customer are as follows.

- Size: 16m x 6m x 1.4m
- Fully laden draft: 0.88m considering/including a ballast of 0.2m
- Moulded depth: 1.4m
- Wing tanks: 2 no. each of size 6m x 4m x 0.5m on the sides
- Pumps: 2 no. each of capacity 12m3
- Ballast/De-ballast Requirement: 200mm or 20m3 to be facilitated by the 12m3 pumps operating simultaneously to ballast/de-ballast the wing tanks and to avoid differential levels

5.4.1.2.1. Working Design

The information shown on the drawings & in this specification provides tender level information thus allowing tenderers to base their bid, however, the Contractor shall prepare the working design & drawings with all the details, connections, anchoring, mooring etc., to meet the functional requirements. The Shop drawings of the floatation tank shall include as a minimum a general arrangement layout, connection details, erection plans and miscellaneous design, drawings, and any other necessary details to meet the specified functional requirements. Contractor shall secure necessary approvals from the authorities towards the construction and installation of the said works.

5.4.1.3. Linkspan

The linkspan is a steel access structure which connects the approach bund and the pontoon whose functional requirement is to allow the safe passage of the passenger and the wheeled vehicles at all river water conditions. The Linkspan can be repositioned along the bund based on the water level variation in the river with the help of a towing truck or mechanical means.

The minimum clear width of the linkspan required for accommodating wheeled vehicles and foot passengers has been arrived based on the IS or relevant codal guidelines. The length of the linkspan is based on the required gradient to allow the people and vehicle to pass from the pontoon to the approach bund at all river water conditions. One end of the linkspan will be on the wheels resting on the rails of the approach bund and the other end of the linkspan will be resting on the floatation tank with hinge connection. The linkspan will move in a vertical plane

with transition ramps at both the ends providing access towards bund side and towards pontoon side.

The grade of structural steel shall be as shown on the drawings. . Refer drawings no. DI1530-RHD-ZZ-NI-DR-C-1508 for Neamati & DI1530-RHD-ZZ-AH-DR-C-1006 for Aphalamukh for more details.

The information shown on the drawings provides tender level information thus allowing tenderers to base their bid, however, the Contractor shall provide working design & drawings for the junction connection details structural members , transition ramps, grating with anti- skid top steel plate and support connections with the wheels that are underneath the linkspan and also connections at the floatation tank. The junction connections need to be designed to the member's full capacity. The Contractor shall provide the shop drawings with a general arrangement layout, member details, member connection details and erection plans.

The Top Surface shall be comprised of Antiskid High Performance Heavy Duty Polyurethane based, combined water Proofing, Capable Of Withstanding Vehicular And Pedestrian Traffic.

The substrata for the antiskid surface can be of steel plate designed to withstand the vehicular & pedestrian traffic.

5.4.1.4. Approach Bund

The sloping access approach bund is planned protruding into the river. This is to accommodate the vehicles roll off and on activity on the vessel and for the passengers safe embarkment and dismemberment. The approach bund is the contact point for the linkspan with landside infrastructure. The passengers disembarked from the pontoon shall move through the linkspan and will reach the approach bund. The approach bund passage area is split into two parts, the area of the approach bund present on one side of bund planned for the movement of the foot passengers/pedestrian. The remaining area is proposed for the two/four vehicular movement.

To provide safety, the foot passenger area shall have a landing approximately at every 5 m along the length of bund. There are also stairs planned along the bund for use by differently abled person using dog legged pattern.

Fiber reinforced concrete deck is provided at the top of the bund. The bund will have guide rail/track arrangement for the movement of the linkspan along the length of bund. Either a mechanical winch or towing truck arrangement shall be used for the movement of the linkspan to cater for relocation of the linkspan during the seasonal water level variation. Underneath the rails, RC beams are provided to support the load from the rails/linkspan. Refer drawings no. DI1530-RHD-ZZ-NI-DR-C-1501 to 1505 for Neamati & DI1530-RHD-ZZ-AH-DR-C-1001 to 1003 for Aphalamukh for more details.

5.4.1.4.1. Working Design

The Contractor shall provide working designs showing the cross-sectional drawings and plan layout drawings for gabions, testing reports of Gabion mattress and Stone fill materials,

Connection arrangement drawings for Gabion mattress, and design section of gabion mattress. Contractor also needs to provide approach bund drawings (including layout plan & cross sections) chainage details in-line with the topography drawings, Submission of bund construction method statement, and As-built drawings.

5.4.1.5. Riverbank Protection

To protect the riverbank from the erosion and stabilize the riverbank bank protection works were proposed. The proposed ferry terminal infrastructure will be under risk without proper bank protection measures. There are various methods available for the riverbank protection and the same can be achieved by having gabion mattress a suitable solution for riverbank protection. Based on the available design conditions, it is opined that approach bund design solution can be implemented for the facility area as well. This shall be implemented all around the facility zone to provide bank protection in case of High flood condition. Refer drawings no. DI1530-RHD-ZZ-NI-DR-C-1501 to 1505 for Neamati & DI1530-RHD-ZZ-AH-DR-C-1001 to 1003 for Aphalamukh for more details.

5.4.2. Special Technical Information for Riverine Structures

The above listed items for which successful execution of the riverine works that require materials and the workmanship are provided below. The major riverine items include the following, but not limited to:

- Fiber Reinforced Concrete deck;
- Approach Bund & Riverbank Protection works;
- Structural Steel Works;
- Rail/Trackworks.

5.4.2.1. Fiber Reinforced Concrete

The Fiber Reinforced Concrete (FRC) shall be provided on top of the Approach Bund. Refer drawings no. DI1530-RHD-ZZ-NI-DR-C-1501 to 1505 for Neamati & DI1530-RHD-ZZ-AH-DR-C-1001 to 1003 for Aphalamukh for more details.

The Fiber Reinforced Concrete (FRC) are designed to accommodate the stairs, ramps with landing at regular intervals to ease the access for differently abled people and rails/track to support the linkspan.

5.4.2.1.1. Sub-Base

The sub-base shall be laid on a levelled and consolidated formation.

The sub-base shall consist of graded crushed basalt or other approved rock to CBM3 specification, rolled to produce a dense layer of the required consolidated thickness. The surface shall be blinded with rock dust, or approved sand, watered and rolled.

5.4.2.1.2. Waterproof Underlay

A waterproof underlay of plastic sheeting not less than 25 mm thick shall be laid on the base immediately prior to concreting. Laps are to be 150 mm minimum in both directions.

5.4.2.1.3. Concrete for Surfacing

Refer to Concrete Specification in CPWD, regarding materials, mixes, placing, compaction, curing, reinforcing steel, formwork, and surface finishes.

5.4.2.1.4. Steel Fiber

Supplying of Dramix fiber to be used as Steel Fiber Reinforcement for Concrete shall be produced from high tensile steel cold drawn wires and confirm to EN 14889-1, Low Carbon confirming to 10016-2-C9D and ISO 13270 Class A. Dosage approved under CE LABLE SYSTEM MARK I. The length of the fiber shall be 60 mm and dia. 0.75 mm making a wire network of 2.879 km per m^3 or 4.644 fiber/Kg for 10 Kg/m^3, shall be glued together to form bundles to provide homogeneous distribution and no fiber balling. Steel fiber used should be glued and shall have hooked end to develop better end anchorage. Aspect ratio (Length / Diameter) shall be 80 and Fiber tensile strength Rm Nom = 1800 N/MM^2 Tolerance ± 7.5 %.

5.4.2.1.5. Joints in Concrete Surfacing

The joints required to be formed are of four types:

(a) Expansion joints
(b) Isolation joints
(c) Contraction joints
(d) Longitudinal joints

The positions of the joints are shown on the drawings or as agreed with the Engineer.

5.4.2.1.6. Expansion Joints

Expansion joints shall comprise:

(a) A vertical pre-formed joint filler which shall be 20 mm thick fibre board of an approved type. The joint filler shall completely separate adjacent slabs.
(b) Dowel bars 32 mm dia. mild steel 650 mm long, placed centrally in the depth of the slab at 300 mm centers.
    i. Dowel bars shall be held accurately in position through holes in the shutter forms and shall lie parallel to the line and surface of the slab.
    ii. The free half of each dowel shall be covered with an approved bond breaking system and shall be provided with a waterproof close fitting cap 100 mm minimum length at one end. The end of the dowel bar in the cap shall be sawn cut. An expansion space 20mm thick shall be formed in the cap by inserting a suitable pad of joint filler.

(c) A groove in the surface of the concrete directly over the joint which shall have truly vertical and parallel sides 25 mm wide by 25 mm deep.

i. The arises of the groove shall be slightly rounded.

ii. The groove shall be thoroughly cleaned to the satisfaction of the Engineer before sealing. Sealing shall be carried out not less than 28 days after placing the concrete.

iii. Grooves shall be sealed with approved sealing compounds as previously specified.

5.4.2.1.7. Isolation Joints

Isolation joints shall be formed as expansion joints but without dowel bars.

5.4.2.1.8. Contraction Joints

Contraction joints shall comprise:

(a) 5mm wide saw cut to a depth of ¼ of the slab

(b) The reinforcement shall be stopped 50mm from each face of the joint

5.4.2.1.9. Longitudinal Joints

Longitudinal joints shall comprise T16 bars, 1000mm long at 600mm centers placed centrally in the depth of the slab.

5.4.2.1.10. Construction Joints

Construction joints shall be formed with a vertical face which includes a continuous recess measuring approximately one third of the depth of the slab thickness in depth and approximately one sixth of the depth of the slab thickness in width. The cast face shall be prepared as previously specified before placing adjacent concrete. Reinforcement shall be continuous through the joint.

Construction joints shall be formed in positions to be agreed with the Engineer.

5.4.2.2. Approach Bund & Riverbank Protection Works

This work includes the construction of a rock bund connecting the pontoon facility to landside facilities for passenger and vehicular movement. Details of the fill to the levels, widths and limits shall be followed as per the Drawings provided with the tender.

The information shown on the drawings provides tender level information thus allowing tenderers to base their bid, however, the Contractor shall provide working design & drawings The Contractor shall provide the shop drawings with a general arrangement layout, member details, member connection details and erection plans.

Y Refer drawings no. DI1530-RHD-ZZ-NI-DR-C-1501 to 1507 for Neamati & DI1530-RHD-ZZ-AH-DR-C-1001 to 1005 for Aphalamukh for more details.

5.4.2.2.1. Fill Materials

The fill materials used for the approach bund and riverbank protection works shall comprise of quarry run material as indicated in the drawings. The specification for the fill material shall be in accordance with latest revision of MORTH.

Quarry run is used as core material of the breakwater. The quarry run shall be a wide graded material with removal of dirt/dust, compliant with the requirements below:

- M5min > 0.1 kg
- M95max < 500 kg
- Compliance with the filter criteria with the overlying material
- Coefficient of uniformity shall comply to:

$$3.5 \div 4 < \frac{D_{60,f}}{D_{10,f}} < 10$$

An example of quarry run which fulfils the above is shown in Figure below. The Contractor shall submit the gradation curve of material to be used for the core for approval by the Engineer.

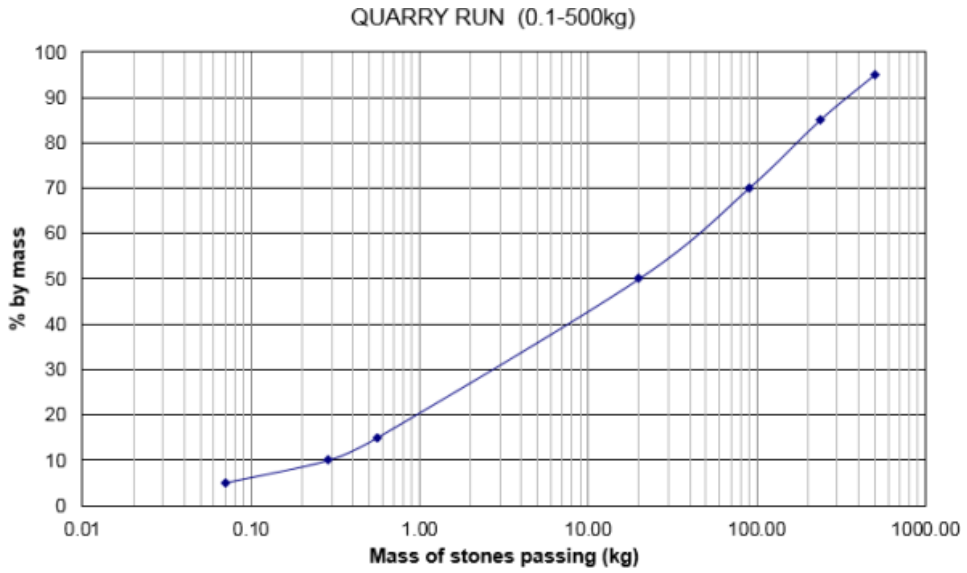

Figure 1 The blue line shows an example of quarry run that fulfils the requirements.

5.4.2.2.2. Tolerances

The level of the reclamation/slope preparations shall be as shown on the contract drawings. These levels shall refer to the final levels achieved at the end of the construction period. Milder slopes than shown on the drawings shall not be payable. In case of any steeper slopes observed during measurement at any section, contractor shall profile the slopes as indicated in the tender drawings.

The acceptable tolerance for the final surface level of completed fill shall be +100 mm from the specified final level. No extra payment shall be made over and above the levels shown in the drawings. Further, the average level (averaged over any square area measuring 100m x 100m) shall not be less than the specified final surface level for that area.

A period of three months commencing from the date of acceptance of the specified filling and compaction in the particular area shall be allowed for settlement before any measurement of levels is made in that area. Should any settlement occur during this period, or thereafter within the Contract and Defect Liability period the Contractor shall rectify with additional fill quantities until the specified levels are obtained, at no additional cost to the Employer.

The Drawings show the final surface level required in different areas ("platforms") of the overall reclamation area. The boundaries defined on the Drawings are the crest (higher) level of any slope between two adjacent platforms at different levels. The Engineer may vary the boundaries between platforms or the required final surface level of any individual platform or group of platforms during the course of the contract and, provided that the final surface level averaged over the whole of the reclamation area is not increased, the contractor shall not be entitled to claim any additional payment under the contract.

5.4.2.2.3. Testing at Source

A laboratory shall be set up at the quarry staffed and equipped for the sampling and testing of rock for the duration of the period of rock production for the works.

Compliance with the full suite of testing shall be undertaken for each source prior to supply. The contractor shall provide every facility to the employer to witness the sampling and testing at such times as it may reasonably require.

Table 1: Testing at the Quarry

Test	Frequency
Apparent relative density, oven dried (IS 2720 - PART 14)	1,000 tonnes, subject to min. 3 tests
Water absorption (IS 1124)	1,000 tonnes, subject to min. 3 tests
Resistance to abrasion, Los Angeles (IS2386 - Part 4)	2,000 tonnes
Magnesium sulphate soundness (IS2386 - Part 5)	1,000 tonnes, subject to min. 3 tests

Additional or more frequent testing may be required if the material varies, or the quarry is worked inconsistently.

5.4.2.2.4. Testing at Site

The contractor shall make facilities available on site, staffed and equipped, for additional testing of rock to check the full range of tests specified in the preceding section. The contractor shall undertake routine testing as follows:

- Grading, average weight, size distribution tests of core material: every 5,000 tonnes as a minimum, or more frequently as required depending on control of grading exercised.

The contractor can request a relaxation in these site testing requirements provided a consistent quality of rock is being delivered from the quarry.

If in the opinion of the Employer, any rock received at site is not in accordance with the Specification, either it shall be tested to prove compliance or it shall be rejected. If any fill material that is tested on site fails to meet the specified quality requirements, the employer, at his absolute discretion, shall be entitled to reject the whole of the batch from which that quarry run comes and/or to instruct such further testing of the batch as he requires. the Contractor shall keep sufficiently detailed records of the fill material/quarry run placed in the approach bund & bank protection location such that placed fill material at each chainage can be traced to a particular batch supplied by the quarry.

Any batch of quarry run material which is rejected by the employer because of not meeting the specified quality requirements shall be removed from the site immediately. All costs as a result of rejection of some or all of a batch of fill material, or further testing instructed by the employer in accordance with this clause, or removal and re-handling of fill material that has already been placed in the structure location shall be paid for by the contractor at no extra time and cost implication to the employer.

Rocks rejected for reason of size from one class may be incorporated in smaller classes in agreement with the Employer.

5.4.2.2.5. Armour Layer for Bund & Riverbank Protection Works - Gabion Mattress

The armour layer shall be placed on top of compacted fill material of approach bund and river-bank protection works such that it not only mitigates slope stability but also acts as scour protection material. Please refer the drawings for more details and understanding.

5.4.2.2.6. Material - Gabion mattress

The specifications shall be in accordance with latest revision of MORTH with Geotextile material.

5.4.2.2.7. Method of Measurement

The payment quantities shall be determined by the outside limits of the gabion mattress structure in accordance with latest revision of MORTH. Project conditions and material availability will determine the actual size of gabion mattress to be used.

Excavated material beyond the limits of the gabion mattress shall be backfilled with gravel, crushed rock or other material approved by the Engineer.

5.4.2.2.8. Basis of Payment

Accepted Gabion mattress will be paid as per the relevant BoQ item.

5.4.2.2.9. Testing and Acceptance criteria

The material should get approval from the Employer before the actual start of work. The manufacturer of the Gabion mattress unit should provide "Manufacturers Test Certificate' and Quality Conformity Certificate for the material with every lot/shipment.

The test should be done in a third-party accredited laboratory or in manufacturer's facility witnessed by Employer's representative.

5.4.2.2.10. Permissible Shear stress:

For the application of Gabion mattresses in river training works, the values of the permissible shear stress in unvegetated conditions shall be:

Thickness (cm)	Permissible Shear Stress (*) (N/m^2)
17	445
23	534
30	637

(*) Flume test values - Design values depend on installation procedures (use of vertical ties) and actual stones characteristics (D50, Cu)

The values of the permissible shear stress will be provided by the manufacturer but will have to be supported by full scale tests carried out at third-party accredited laboratory following the ASTM D6460 test methodology.

5.4.2.2.11. Eligibility of Manufacturer/Supplier of Gabion Mattress

Manufacturer of woven steel wire double twist hexagonal mesh gabions shall have:

- A valid ISO 9001:2015 accreditation for manufacturing facility from an internationally accredited organization.
- Manufacturing experience of mechanically woven Gabions of minimum 10 years internationally or in India as per International standards.
- The Manufacturer/Supplier shall have existence in India or abroad for more than 10 years from the date of this tender notice.
- Experience in Supply and installation of Gabions and mattress of quantity not less than 10,000 cum in a single project in India or abroad. Supplier shall provide work completion certificate.
- The Manufacturer/Supplier should not have a history of poor performance such as abandoning the works, financial failures, blacklisting. If it is observed, Manufacturer/Supplier will be automatically disqualified.

5.4.2.3. Structural Steel

Refer drawings no. DI1530-RHD-ZZ-NI-DR-C-1516 to 1517 for Neamati & DI1530-RHD-ZZ-AH-DR-C-1016 to 1017 for Aphalamukh for more details.

Please refer following Special Specification which shall be read in conjunction with clause number 5.1 “Standard Specifications” & 5.2 “Special Specifications”.

Item no.	Particulars
Chapter 10 [Steel Work] of CPWD Specifications 2019 Volume I and II	Before clause 10.2 [Steel work in single section fixed independently with connecting plate] of Chapter 10 [Steel Work] of CPWD Specifications 2019, add new clause “Preparation of Fabrication, Erection Drawings & Completion Documents” as elaborated in section below.

5.4.2.3.1. Preparation of Fabrication, Erection Drawings & Completion Documents

Fabrication drawings shall be prepared based on design drawings of steel structures.

Shop drawings shall be made in conformity with IS 962, IS 800-2007 and IS:813 1986. The fabrication drawings shall specify the following details:

a) Type, size and length of welds in case of welded connections, (specifying clearly shop or site weld). Length of weld specified shall be effective length (excluding end crates).
b) In case of bolted joints, arrangement of bolts and specification of bolts, nuts etc. (specifying clearly shop and site bolts).
c) Specification of electrode/wire flux.
d) If required special provision to be mentioned in the drawings for handling of structures during and after fabrication.
e) Specification of paint and corresponding surface preparation for painting.
f) General arrangement/marking plan.
g) Reference to design drawings.
h) Material list indicating mark number wise material requirement giving size, weight, material specification, identification number of each item, number of pieces required etc.
i) Layout with all connecting members with blown up joint details wherever required, in order to specify clearly various fabrication and erection requirements as per design drawings.
j) Specification of preparation of mating surfaces in case of connection by HSFG bolts if any as per drawings.
k) Appropriate edge preparation in case of butt/groove welds in accordance with IS:9595 1996, for all plates and sections having thickness greater than 8 mm.
l) Erection clearances in order to facilitate smooth erection at site shall be as per clause no.17.2 of IS:800-2007 and other relevant Annexure of this specification.
m) Each erection piece shall be clearly identified by an erection mark in these drawings.

All loose members shall be given part mark, which shall be 'wired on' the main erection piece for dispatch.

n) Fabrication drawings shall be prepared in such a manner that structures can be dispatched from fabrication shop to erection site with maximum economictransportable size, so as to reduce work involved at site to a minimum.
o) Joints shall be connected for 125% of the capacity of the member or the 1.25 time the design force specified in the design drawing, whichever is more. (For single angle bracing member, consider full area as effective for this purpose).
p) Standard simple beam connections, unless otherwise stated in the drawings, shall be designed, and detailed for 125% beam shear / moment carrying capacity.
q) Wherever there is risk of nuts becoming loose due to vibration, lock nuts shall be provided, or nuts shall be welded after alignment and tightening.
r) For all connections by permanent bolts, two nos. of washers shall be used. One washer bearing against the head and the other bearing against the nut.
s) Detailing of structural steel members subject to dynamic loading shall be such as to ensure smooth transition of load, as well as best behavior under stress due to fatigue.
t) The contractor shall be responsible for design and detailing all connections. The design of connection shall provide adequate strength for transfer of force in the structural elements, as indicated on design drawings. Detailing shall be such that erection shall be convenient and free from all interfaces, drilling and cutting at site.
u) Any member to be welded must be supported from all directions to avoid possible sag caused by induced heat during welding process. Assembly and welding shall be carried out in such a way to minimize distortion and residual stress and that the final dimensions are within appropriate tolerances.
v) Welding shall be in accordance with IS 816, IS 819, IS 1024, IS 1261, IS 1323 and IS 9595, as appropriate.
w) For detailing of connections and joints, the relevant clause of Section-10 of IS:800-2007 is to be followed.

Completion Documents

a) On completion of work, the Contractor shall submit to the Purchaser the following documents.
b) The technical documents according to which the work was carried out.
c) 5 Copies of the “As built" drawings showing thereon all additions and alterations made during the fabrication.
d) Manufacturer's test certificates for all brought out items including raw steel.
e) Certificates/documents on control checking.
f) Test reports / Radiography films of welds. (For welding of any particular type of joint, welders shall give evidence acceptable to the purchaser of having satisfactorily completed appropriate tests as prescribed in IS 817, IS 1393, IS 7307 (Part 1), IS 7310 (Part 1) andIS7318 (Part 1), as relevant).
g) DFT record of paint applied measured at random for each erection mark.
The Purchaser/Inspector shall issue inspection Certificates to the Contractor for the structures found acceptable.

5.4.2.3.2. Surface Preparation & Painting of Steel Structures

Surface Preparation for Painting

a) General

The steel surface which is to be prepared shall be cleaned of dirt and grease and the heavier layers of rust shall be removed by grinding prior to Actual surface preparation to a specified grade.

Surface preparation to be followed prior to painting shall be based on the requirement of a particular painting system as mentioned in subsequent paras below. Some of the specifications for surface preparation is given below for reference but the particular specification for surface preparation shall be followed as per schedule of works given to the Contractor for price bid.

b) Mechanical Cleaning

Manual/power tool cleaning.

Manual/power tool cleaning shall be done as per grade St-2 or St-3, of Swedish Standard Institution SIS 055900.

I. Grade St-2: Thorough scraping and wire brushing, machine brushing, grinding etc. This grade of preparation shall remove loose mill scale, rust and foreign matter. Finally, the surface is to be cleaned with a vacuum cleaner or with clean compressed air or with clean brush. After preparation, the surface should have a faint metallic sheen. The appearance shall correspond to the prints designated St-2.
II. Grade St-3: very thorough scraping and wire brushing, machine brushing, grinding etc. The surface preparation is same as for grade St-2 but to be done much more thoroughly. After preparing the surface, it should have a pronounced metallic sheen and correspond to the prints designated St-3.

c) Blast Cleaning

Blast cleaning shall be done by shot blasting as per following grades according to Swedish Standard SIS 055900.

I. Grade Sa-2. This involves light blast cleaning. Almost all mill scale, rust and foreign matter shall be removed. Finally, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. The surface shall look greyish in color and correspond in appearance to the prints designated as Sa-2.
II. Grade Sa 2½: This involves very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remain in the form of slight stains. Finally, the surface is cleaned with a vacuum cleaner, clean dry

compressed air or a clean brush. It shall then correspond in appearance to the prints designated as Sa 2½.

III. Grade Sa-3: This involves blast cleaning to pure metal surface. Mill scale, rust and foreign matter shall be removed completely. Finally, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. Then the surface shall have a uniform metallic color and correspond in appearance to the print designated as Sa-3

d) Flame Cleaning

Flame cleaning shall also be carried out with the help of a special oxy-acetylene torch and the loosened mill scale shall be removed with a wire brush. This process is not recommended for cleaning steel sheet or plates less than 6 mm in thickness as it may lead to buckling. The number of flames passes on such surface shall be limited to three. Theprimer coat of paint shall be applied when the surface is still warm, after removing thescales with brushing and wiping.

Surface preparation shall be done as shown in the schedule of works given to the Contractor for price bid. The contractor shall take OHS measures for appropriates to the risk involved in the Shot Blasting and Flame Blasting. The contractor shall take OHS measures for appropriates to the risk involved in the Shot Blasting and Flame Blasting.

Painting

a. For use of specific painting system, the paint manufacturer's specification shall prevail.
b. General compatibility between primer and finishing paints shall be established through the paint manufacturer supplying the paints.
c. Before buying the paint in bulk, it is recommended to obtain sample of paint and establish "Control Area of Painting". On control area surface preparation and painting shall be carried out in the presence of manufacturer of paint.
d. To ensure that the supplied paint meets the stipulation in design drawing/ specification, if required, samples of paint shall be tested in laboratories to establish quality of paint with respect to (i) Viscosity (ii) adhesion/ bond of paint in steel surfaces (iii) adhesion/simulated salt spray test (iv) chemical analysis (percentage of solids by weight) (v) normal wear resistance as encountered during handling & erection (vi) resistance against exposure to acid fumes etc.
e. Whole quantity of paint for a particular system of paint shall be obtained from the same manufacturer.
f. Thinners, wherever used, shall be as per recommendation of the paint manufacturer.
g. Areas which become inaccessible after assembly of structures shall be painted before assembly, after cleaning the surfaces as specified.
h. Wherever shop primer painting is scratched, abraded or damaged, the surfaces shall be thoroughly cleaned using emery paper and power-driven wire brush wherever warranted, and touched up with corresponding primer. Touching up paint shall be matched and blended to eliminate conspicuous marks.
i. If more than 50% of the painted surface of an item requires repair, the entire item shall be mechanically cleaned, and new primer coats shall be applied followed by subsequent coats as per clause
j. All field welded areas on shop painted item shall be mechanically cleaned (including the weld area proper, adjacent areas contaminated by weld spatter or fumes and areas

where existing primer, intermediate / finishing paint is burnt). Subsequently, new primer and finishing coats of paint shall be applied as per painting specification.

k. Application of paint shall be by spraying or brushing as per IS:487 1997 and in uniform layers of 50% overlapping strokes. Painting shall not be done when the temperature is less than 5ºC or relative humidity more than 85% unless manufacturer's recommendations permit. Also painting shall not be done in frosty or foggy weather. During application, paint agitation must be provided wherever such agitation is recommended by the manufacturer.
l. Paint shall be applied at manufacturer's recommended rates. The number of coats shall be such that the minimum dry film thickness (DFT) specified is achieved. The dry film thickness of painted surfaces shall be checked with ELCOMETER or measuring gauges to ensure application of specified DFT.
m. All structures shall receive appropriate number of primer and subsequent coats in order to achieve overall DFT as per design drawings/ specifications. First coat of primer paint shall be applied not later than 2-3 hours after preparation of surface, unless specified otherwise.
n. The finishing paint as specified shall be of approved color and quality. The under coat shall have different tint to distinguish the same from the finishing coat.
o. Edges, corners, crevices, depressions, joints and welds shall receive special attention to ensure that they receive painting coats of the required thickness.
p. Machine finished surface shall be coated with white lead and tallow before shipment or before being put into the open air.
q. Parts of surfaces embedded in concrete shall be thoroughly cleaned of grease, rust, mill scale etc. and shall be given a protective coat of Portland cement slurry immediately after fabrication. No paint shall be applied on this part.
r. Surfaces which cannot be painted but require protection shall be given a coat of rust inhibitive grease according to IS:958 2000 or equivalent international standard.

Painting System

(Normal Anti-Corrosive Paint)

The recommended painting system for 0-hour fire rating resistance i.e., without fire rating of steel structures covering surface preparation, application of primer coats, intermediate coats and final coats as indicated below to develop the required minimum dry film thickness (250 microns) on steel surface should be provided by the successful Contractor. The outline technical specification to be adopted is shown below:

Step-1: Surface preparation: Sa 2½ according to Swedish Standard SIS 055900.

Step-2: Primer Coat

Application of epoxy-based zinc phosphate primer coat (150 microns) for structural steel. The Primer coat shall be done immediately after surface preparation.

Step-3: Intermediate Coat

Application of one coat of epoxy polyamide micaceous iron oxide (75 microns).

Step-4: Final Coats

Final Coat-1 – Application of one coat high build epoxy polymer (90 microns)

Final Coat-2 – Application of one coat high build epoxy polyurethane (35 microns)

5.4.2.4. Rails/Trackwork

The Rails/track is on top of the Fiber Reinforced Concrete deck. Refer drawings no. DI1530-RHD-ZZ-NI-DR-C-1501 to 1505 for Neamati & DI1530-RHD-ZZ-AH-DR-C-1001 to 1003 for Aphalamukh for more details.

Rail/track arrangement is proposed for the movement of the linkspan along the length of the approach bund. Towing truck shall be used for the movement or relocation of the linkspan to position it at a particular location during the seasonal water level variation.

5.4.2.4.1. Rails/Track General

Rails/track shall consist of DIN 536 standard A120 appropriate to the design, supplied in 12.0m lengths, laid on a continuous resilient pad, on a continuous steel sole plate. The rail is held in position by adjustable clips fixed to the sole plate. The sole plate is held in position by holding down studs grouted into a concrete foundation and bedded on epoxy grout.

5.4.2.4.2. Rail/Track Recess

The rail/track recess must be formed with accuracy to line and level.

Before commencing installation of the rail:

a) the level of the base of the recess is to be checked and high spots reduced to achieve the specified level. The base is to be lightly scabbled to remove concrete laitance.
b) the setting-out of the vertical sides of the recess is to be checked and corrective action taken as necessary to achieve the specified line.
c) corrective action should not be required if specified construction tolerances are adhered to.

5.4.2.4.3. Grouts

The sole plate holding down studs are to be grouted in with Conbextra EP10 Tropical Grade Epoxy Grout or equivalent and the underside of the sole plates are to be grouted up with Conbextra EPR Tropical Grade Epoxy Grout or equivalent. Both these materials are manufactured by Fosroc Expandite Ltd.

The grouts are to be mixed and used strictly in accordance with the manufacturer's instructions.

5.4.2.4.4. Rail/Track Installation Procedure

Unless otherwise stated by the Contractor, it is deemed that the following procedure forms part of the Contractor's Method Statement for Installation of the Rails.

1. Establish and mark the true centerline of the rail on the concrete base of the rail recess.

2. Establish and mark offset centerlines on the concrete surface at the side of the recess. These lines are to enable the track width and rail alignment to be checked.
3. Mark the centerline position at both ends of the sole plates.
   (Note: If welded base clips are specified these will already be welded to the sole plate and the center line of the sole plate is defined as a line central between the two rows of clip bases)
4. Set the sole plates in the recess to the required chainage with the end centerline marks positioned over the centerline marked on the base of the recess and wedge the plates in position.
5. Mark on the base of the recess the position of the ends of the sole plates.
   Mark the position of the H.D. studs on the base of the recess using the sole plates as templates by drilling short 25mm dia. pilot holes. Ensure required spacing between sole plates is maintained to correct chainage.
6. Set aside the sole plates from the recess. Drill holes for the H.D. studs to the depth and diameter shown on the drawings using rotary percussion equipment.
   (The concrete reinforcement is to have previously been accurately fixed to the level and positioning shown on the drawings clear of the H.D. stud holes.)
   (Prior to casting the concrete, the position of the reinforcement bars shall have been checked against an accurately positioned soleplate or template to ensure the later holding down drill holes do not strike or cut through any reinforcement.)
   Thoroughly clean all dust and debris from the holes.
7. Lightly grease the levelling screws and fit them to the sole plates ensuring that they turn easily.
   Fit the clip fixing bolts and nuts to the sole plate with the bolt head on the underside. Nuts to be hand tight only (Note: If welded base clips are specified this does not apply).
   Replace the sole plates in the recess in line with the rail centerline and end plate marks.
   Level the sole plate laterally and longitudinally to ±5mm of the finished level using a level, staff and spirit level by adjustment of the levelling screws.
8. Fit the nuts to the H.D. studs ensuring they turn easily. Fit the studs through the sole plates to check that they hang freely in the drilled holes with sufficient length of stud above the nut for final level adjustment.
9. Remove the studs and lay them on the sole plate beside the holes. Mix the epoxy grout. Pour sufficient epoxy grout into the holes and replace the studs with washers fitted under the nuts. Gently agitate each stud to ensure even distribution of grout. Allow the grout to fully set. (The correct quantity of grout required for each hole can be determined from trial holes.)
10. Assemble the pad, rail and clips on top of the sole plate. Set the clips in the middle of their range of adjustment and tighten by spanner or hand socket wrench. Ensure that clips are tightened equally in opposite pairs to avoid any twist being imparted to the rail head. The rail is thus approximately aligned.
    Loosen the H.D. stud nuts.
    Level the rail longitudinally using the levelling screws also checking that the sole plate is level laterally. Hand tightens the H.D. stud nuts.
    When the levels are satisfactory, tighten the sole plate H.D. nuts adjacent the levelling screws lightly with a spanner to ensure no movement takes place during grouting. Do not overtighten to avoid altering the levels or bowing the sole plate.
    Levels will only be approved if they are within the specified tolerance.

Notes: For accuracy in levelling the rail and sole plates, the following should be adhered to:
Fit a small bolt or pin in the bottom of the surveying staff to assist with accurate positioning of the staff
Ensure the staff is fitted with a bull's eye bubble to enable the staff holder to keep the staff vertical in all planes.
Relate all levels to a nearby benchmark or to an accurate temporary benchmark (TBM) local to the rail being worked on.
Fit the staff with millimeter graduations to avoid estimating decimals of a centimeter.
Restrict levelling sights to a maximum viewing range of 25m.
Once the collimation has been determined, the required reading should be marked on the staff to avoid sighting errors. (Previous marks to be removed when instrument is relocated or a different TBM is used.)
Level in a number of rails and plates and grout them in the same day. (Do not leave grouting to the following day – thermal movement or accidents can take place.)
Staff to be used in conjunction with a spirit level or 'T' bubble level to ensure sole plate is level laterally. Also check that rail head is level laterally.
Start levelling at the end of the rail/sole plate next to the previously levelled rail/sole plate. Place the staff on the rail between a pair of levelling screws and adjust plate/rail to level. Hand tighten the H.D. stud nuts. Move the staff to the next pair of levelling screws and repeat.
Recheck levels at ends of sole plates and quarter point positions. When complete, hand tighten the intermediate H.D. stud nuts.

11. Thoroughly clean and blow out dust and debris from under the sole plates. Pour epoxy grout under and up the sides of the sole plate. Allow the grout to fully set.
    Use suitable material to seal drain outlets, etc. and stop ends.
    Tighten the H.D. stud nuts to the specified torque.
12. Remove or loosen and turn clips through 900 sufficient to allow rail ends to be set for welding if required.
    Weld rail joints as specified if required.
13. Reinstate clips, align rail and tighten clip nuts to the specified torque. It is essential that the clip is in contact with the edge of the rail flange. Refer to clip manufacturer's installation instructions. Remove levelling screws.
14. 'T' wash and coat sole plate H.D. studs and nuts with coal tar epoxy paint.

5.4.2.4.5. Rail/Track Tolerances

Gauge to be accurate to ±4mm. Line of rail to be accurate to ±2mm. Level to be accurate to ±2mm in any 10m length and accurate to ±5mm in the overall track length.

There shall be no discontinuity in horizontal or vertical alignment of the rail at joint positions.

5.4.2.4.6. Welded Rail/Track Joints

5.4.2.4.6.1. General

The welding of rail/track joints shall be carried out as follows: -

The rail joints shall be prepared and welded using low hydrogen electrodes using the Phillips `Enclosed Welding process' or similar approved process. Electrodes to be Filarc 56R low hydrogen to BS 1776, classification E5113B46(H) or similar approved: size 5mm: Amperage 210-350 positive. The degree of preheating required shall be fully compatible with the quality of the rail steel provided. Rail joints shall be welded consecutively working from one end.

The welding shall be carried out by a specialist welder experienced in the technique. During welding the rail/track pad shall be protected from damage.

Electrodes shall be stored in dry conditions.

Electrodes shall be dried immediately prior to use for a period not less than 2 hours and not more than 4 hours at a temperature of 120°-150°C.

Dried electrodes shall be used within 4 hours of removal from the drying oven.

Mould pieces shall be of copper 25-30 mm thickness.

Backing strips shall be of copper 5mm thick.

5.4.2.4.6.2. Welding Condition

Welding voltage and current shall be within the following limits for AC or DC use:-

Particulars	AC	DC
Welding voltage (O/C)	75-110 Volts	50-100 Volts
Welding current	250-320 Amps	250-320 Amps

When using DC welding, to avoid arc blow, the Contractor shall ensure that the two earthing connections share the current equally. The currents in each connection shall be measured with a tong-ammeter.

Earthing cables shall be of the same cross section and same length. Connections of earthing cables to the rail and welding plant shall be sound and of equal effectiveness.

Connections to the two rails to be joined shall be equidistant from the joint. Connection points shall be cleaned off by light grinding before attaching earthing cable.

NB. Welding shall NOT be used for attachments to rails - all attachments shall be bolted.

5.4.2.4.6.3. Preparation of Rail

The ends of the rails to be welded shall have vertical faces sawn cut. The faces of adjacent rails shall be set 16 mm apart.

Ensure faces are clean of all dirt, grease, and rust.

The ends of the rails shall be set up initially to a small camber as appropriate to the rail size being welded and as agreed with the Engineer.

The ends of the rails to be welded shall be preheated before welding to obtain a temperature of 200 degrees C. (or such greater temperature as required by the quality of the rail steel) at the extremities of the section. Thermo-sticks may be used to measure the temperature of the two pieces of rail. A gaseous burner may be used for preheating.

5.4.2.4.6.4. Moulds

The weld metal shall be contained during welding by means of copper mould pieces enclosing the sides and bottom of the gap. The mould pieces enclosing the sides are referred to as `side mould pieces and the plate beneath the rail the `backing strip'.

The side mould pieces shall be set 1 to 1.5 mm (maximum) clear of the sides of the rail to allow escape of slag.

5.4.2.4.6.5. Jointing Procedure

The rail shall be placed in the required lengths, accurately aligned as specified, and the ends of the rail jacked up on packing pieces to the required camber, with the backing strip placed so that it is tight up to the underside of the rail flanges and central about the joint. Care shall be taken to ensure that the underside of flanges is held at the same level and line.

After setting the rails in the required position for welding a 16mm wide x 3mm thick mild steel strip, length to suit the rail bottom flange, shall be placed centrally in the bottom of the joint. (This is to prevent inclusion of copper into the weld).

The ends of the rail shall then be preheated as described above. Side mould pieces shall be placed up to the sides of the rail.

The electrode shall be struck against the side of the rail – care shall be taken not to strike the arc on the copper moulds as this will cause copper pick up. De-slagging of the weld shall be made after the first run and after subsequent runs as found to be necessary.

Welding shall be continued moving the electrode slowly from one side of the rail to the other, gradually building up the mass of weld metal between the two parts of the rail.

Welding shall be continued moving the electrode slowly from one side of the rail to the other, gradually building up the mass of weld metal between the two parts of the rail.

When welding reaches the top of the flange, it shall be interrupted to allow de-slagging and placing of the upper side moulds.

Welding shall continue in the same manner until the weld metal is 10mm from the rail surface. The weld shall then be allowed to cool for 5 minutes and then again de-slagged.

Welding shall be continued to 1.0mm above the surface.

On completion of welding, the weld shall be ground flush with the surface and sides of the rail head and the rail shall be lowered onto the sole plate.

5.4.2.4.7. Storage of Rails and Fittings

Rails shall be carefully off-loaded and stacked on a firm level surface. Rails shall be stored with the flanges down and separated by timber with the mill marks at the same end of the stack. The rails shall be kept clean and protected against contamination. Clips, studs, bolts, washers, nuts, etc. shall be contained in boxes, none of the materials are to be tipped.

Galvanized items are to be handled with care so that the coating is not damaged.

5.4.2.4.8. Testing of Rail Welds

Testing of welds shall be undertaken by an independent accredited testing authority selected by the Contractor and to the approval of the Engineer.

Testing of welds shall be by ultrasonic testing (UT) examination and shall be carried out by the Contractor in accordance with standards to the approval of the Engineer.

All welds shall be tested. The Engineer shall have the opportunity to witness all of the tests. The Contractor shall give adequate prior notice of the commencement of any tests. All ultrasonic test equipment operators shall be fully qualified, and each weld shall be examined with sufficient probe angles to guarantee full coverage of the joint.

During production weld testing the Contractor shall produce a test report for each weld joint or weld repair examined in addition to a sketch of all flaw sizes and location and a note of the dB level for each flaw reported. The report shall include conclusions as to acceptance or rejection of the flaws with reference to these requirements.

The Contractor shall make an initial assessment of defects against acceptance criteria. All ultrasonic test (UT) reports including recommendations shall be submitted for review to the Engineer. Acceptance criteria shall be in accordance with Category B of BS EN ISO 5817, or other approved standard. The standard on which the slag indication acceptability is to be finally determined is to be agreed and confirmed prior to commencement of any UT. When positive flaw type interpretations cannot be ascertained in any instance the flaw shall be considered planar and in need of repair.

5.4.2.4.9. Joint Records

The Contractor shall provide joint records of the date and location of each weld made. The record shall also include the rail type, size, welding kit manufacturer's name, and weld portion batch number. Also, provide a record of the ultrasonic test date and acceptance date.

Weld Acceptance Criteria

- Cracks not acceptable
- Wormholes not acceptable
- Surface breaking inclusions not acceptable
- Undercut on exposed surface of welds 0.5 mm maximum
- Lack of face fusion not acceptable
- Internal inclusions 6.0 mm maximum

5.5. Building Civil Works

5.5.1. Overview

The overall scope of works withing project shall be as mentioned above. This section provides further information about contractor scope of works specific to Architectural and Structural for building works within landside facilities. This section shall be read in conjunction with other sections in this tender document.

As part of project following building shall have to be constructed under this contract.

Terminal Building

Terminal Building is G+1 RCC structure with steel roof on top. Refer Tender drawings numbers DI1530-RHD-ZZ-NI-DR-NI-1520 to 1527 & DI1530-RHD-ZZ-NI-DR-AH-1020 to 1028 for more details.

The building is designed to have clear and linear passenger movement. The ground floor of building houses areas line, waiting room, ticketing counter, security, back office, first-aid room, and toilet facilities. The first floor will have toilet facilities along with recreations areas, likes shops, restaurant, and extended waiting. The ground floor has been designed with barrier free environment for differently abled people.

The terminal sizing has been designed to accommodate waiting area for 450 and 225 passengers for Neamati and Aphalamukh site respectively.

Substation Building

Substation will be ground storey structure with RCC slab. The building will house equipment's such as Transformers, DG Set, Battery Room, Metering Room, and Panel Room. The working design will be based on equipment selection by the contractor. Refer tender drawing number DI1530-RHD-ZZ-ZZ-DR-A-1001 for layout of substation/electrical room for more details. The basic finishing for entire area is as provided in subsequent sections below.

Firefighting Building

Based on firefighting system a combined UG tank housing potable water storage, fire water storage and pump room shall have to be planned within terminal premises. The UG tank will be RCC above ground structure having base 1m below finished ground level. The pump house room level will be same as bottom level of tank. The working design will be based on equipment selection by the contractor. Refer tender drawing number DI1530-RHD-ZZ-NI-DR-A-1000 for layout of UG tank for more details.

The design and minimum requirements for the substation and firefighting building has been included in the tender. Once the equipment selection is finalised, the contractor will need to provide the working design complying to the requirements mentioned below.

Civil Requirements (Building Works)

All civil & structural work shall be carried out in compliances to BIS Codal provisions. International codal provisions (American, BS EN) can be accepted wherever any provisions not available in BIS norms.

All loading and load combination shall be as per BIS, IRC and IRS norms as applicable. The buildings shall be provided with adequate arrangements for all required services such as plumbing, sanitary, electrical fittings, illumination, water distribution etc as per prevailing standards and as elaborated in subsequent sections within this document.

Minimum building considerations shall be followed as:

- Floor to floor height shall satisfy the bylaws of National Building Code.
- A 750 mm wide plinth protection shall be provided around each building.
- Finished floor level of buildings shall be 500 mm above the finished ground level unless specified otherwise.
- Architectural finishing of building shall be as elaborated in subsequent paras.
- All external walls shall be of 230 mm thick, all partition walls shall be minimum 115 of designed class designation as per IS1905 and IS4326.
- Minimum design service life shall be 50 years.

All structures shall be analyzed as framed structure using STAAD.Pro connect (latest version) for governing load combinations from considered primary loadings used in the structural analysis. However, the design of the elements shall be carried out using approved method by either manually or standardized excel sheets or in-house software packages. All designs of RCC structures shall be carried out as per BIS, IRC or IRS norms as applicable. All underground RCC structures other than liquid retaining structures shall be designed for strength and service cases as per BIS norms. All Liquid Retaining Structures shall be designed in compliance to IS:3370.

As part of contractors working documents for above buildings, following documents shall have to be supplied by contractor.

- All layout plans
- Structural drawings with calculations
- Shop drawings
- MEP services layouts

The basic finishing for entire area is as provided in subsequent sections below.

General Finishing (Building Works)

Unless specified otherwise, Terminal buildings will follow general finishing as below but not limited to. All material mentioned below will be selected keeping sustainability as prime requirement. Contract to refer relevant Specification for further details.

Roofing/Cladding & wall finishes

- Roofing will be mainly of Zinc Alum sheets.
- RC buildings will be covered with RC slabs on top as indicated in Tender drawings. All terraces shall have waterproofing treatment.
- All RC building will be finished with concrete block walls plastered, finished with Emulsion paint, or as specified in Tender specifications.
- All wet areas will have Ceramic wall dado tiling up to 2.4m level. All wet areas shall water waterproofing floor as well as wall treatment as wall treatment.
- Locally available stone for wall cladding as decorative element.

Floor Finishing

The floor requirements shall be set out below.

- Vitrified tiles for office and waiting area.
- Non-metallic floor hardener for storage areas substations, Pump room, and MEP rooms.
- Ceramic tiles with anti-slip finish for toilets and change rooms.
- Granite flooring for lobby areas and primary staircase.

Doors & Windows

- All fire exit doors are made of steel with powder coated and fire rated as per standards
- All other doors wooden flush panel doors with vision panels
- FRP doors for wet areas
- GI Rolling shutter doors for shops and technical areas
- Aluminum powder coated windows as per design

Ceiling Finishes

- No ceiling for waiting on first floor areas
- Gypsum board with a paint finish on metal stud as per requirement (moisture resistant board to be specified for all wet areas)
- RC slab shall be painted underside with emulsion paint
- all office facilities to have grid gypsum board false ceiling

Staircases and Platforms

- All internal office building staircases shall be made of RC with Granite stone flamed finish with stainless steel handrails
- All access staircases to platforms will be of SS handrails and granite flooring

Furniture Works

Unless specified otherwise, the Contractor shall procure, install, and fix below mentioned furniture in given quantities as part of Contractor's scope of works,

Furniture					
Sr. No.	**Items**	**Quantity**		**Model**	**Make**
		Neamati	**Aphalamukh**		
1	Public Seating	139	76	similar to- 3 seater Chrome plated made of cold rolled steel with armrest, model-'Perch' from Godrej interio or equivalent	Godrej, Featherlite, Ergo Furniture, Supreme, Nilkamal
2	Cushion Back chairs	20	20	similar to- Cushion Back chairs colour grey, Model - Beat Visitor, from Godrej Interio or equivalent	Godrej, Featherlite, Ergo Furniture, Supreme, Nilkamal
4	Working Table with Drawer	11	11	similar to- Office Desk Model Enterprise length 1.65m , with wire slot, wooden modesty, CPU mount and storage space, colour LM94 - Siam Teak, + PW81 - Sepia Brown, from Godrej Interio or equivalent	Godrej, Featherlite, Ergo Furniture, Supreme, Nilkamal
6	Ticket counter storage	3	3	similar to- Enterprise Pedestal, Model Enterprise, colour LM94 - Siam Teak, + PW81 - Sepia Brown, from Godrej interio or equivalent	Godrej, Featherlite, Ergo Furniture, Supreme, Nilkamal
7	Stretcher bed	1	1	Model Ayush Plus, colour Ral white with fowler bed mattress , from Godrej or equivalent.	Godrej, Featherlite, Ergo Furniture, Supreme, Nilkamal
8	Full ht. steel storage	4	4	similar to- Conventional Storage model KD plain, size	Godrej, Featherlite, Ergo

				1.83 x 0.9x0.45m , color cloud grey, from Godrej Interio or equivalent.	Furniture, Supreme, Nilkamal
9	Drawers' underside working table	11	11	similar to- Enterprise Pedestal, Model Enterprise, colour LM94 - Siam Teak, + PW81 - Sepia Brown, from Godrej Interio or equivalent	Godrej, Featherlite, Ergo Furniture, Supreme, Nilkamal
10	Low ht. storage	5	5	similar to- Mayfair-Credenza size 75x42.5x75 cm, colour LM91 Malaga Cherry + LM09 Cloud Grey from Godrej Interio or equivalent	Godrej, Featherlite, Ergo Furniture, Supreme, Nilkamal

Residual Works

The Contractor shall complete the following and all necessary residual works to execute the project following the Employer provided design.

Rolling Shutters	Vendor drawings
Structural Glazing/Curtain Walls	Vendor drawings
False Ceiling	Vendor drawings. Coordination drawings showing arrangement of T-grid (if applicable), diffusers, lighting fixtures, and all other devices integrated in the ceiling
Wall Partitions	Vendor drawings, Frame arrangement, Connection details, openings and other construction details
Carpentry and Joinery, Doors & Furniture	Shop drawings
Aluminum Works, Doors, Windows, Louvres	Shop drawings showing, complete elevations, full scale details for doors, windows and louvre frames, details of connections with other construction elements
Metal works, Doors, Windows, Frames, Platforms, Stairs, etc.	Shop drawings showing full scale details for doors, windows, louvers, frames etc, Connection details with other construction elements
Furniture	Vendor drawings, Installation details, Procurement and installation

5.5.2. Special Specifications for Building Civils

Please refer following Special Specification which shall be read in conjunction with the Standard Specifications defined above.

Item no.	Particulars
Chapter 10 [Steel Work] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Before clause 10.2 [Steel work in single section fixed independently with connecting plate] of Chapter 10 [Steel Work] of CPWD Specifications 2019, add new clause "Preparation of Fabrication, Erection Drawings & Completion Documents" as elaborated in section below.
Chapter 10 [Steel Work] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Replace clause 10.2.2 [Painting] with below mentioned clause number 5.5.2.2 [Surface Preparation & Painting of Steel Structures] as elaborated in section below.
Chapter 10 [Steel Work] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Add new sub-clause 10.23 [GI rolling shutter] as elaborated in clause 5.5.2.3 [GI Rolling Shutters] below.
Chapter 11 [Flooring] of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Add new sub-clause 11.31 [Flamed Finish Granite Slab Flooring in risers of steps] as elaborated in clause 5.5.2.4 [Flamed Finish Granite Slab Flooring in risers of steps] below.

5.5.2.1. Structural Steel

5.5.2.1.1. Preparation of Fabrication, Erection Drawings and Completion Documents

Fabrication drawings shall be prepared based on design drawings of steel structures. Shop drawings shall be made in conformity with IS 962, IS 800-2007 and IS:813-1986. The fabrication drawings shall specify the following details:

a) Type, size and length of welds in case of welded connections, (specifying clearly shop or site weld). Length of weld specified shall be effective length (excluding end crates).

b) In case of bolted joints, arrangement of bolts and specification of bolts, nuts etc. (specifying clearly shop and site bolts).

c) Specification of electrode/wire flux.

d) If required special provision to be mentioned in the drawings for handling of structures during and after fabrication.

e) Specification of paint and corresponding surface preparation for painting.

f) General arrangement/marking plan.

g) Reference to design drawings.

h) Material list indicating mark number-wise material requirement giving size, weight, material specification, identification number of each item, number of pieces required etc.

i) Layout with all connecting members with blown up joint details wherever required, in order to specify clearly various fabrication and erection requirements as per design drawings.

j) Specification of preparation of mating surfaces in case of connection by HSFG bolts if any as per drawings.

k) Appropriate edge preparation in case of butt/groove welds in accordance with IS:9595-1996, for all plates and sections having thickness greater than 8 mm.

l) Erection clearances in order to facilitate smooth erection at site shall be as per clause no.17.2 of IS:800-2007 and other relevant Annexure of this specification.

m) Each erection piece shall be clearly identified by an erection mark in these drawings. All loose members shall be given part mark, which shall be 'wired on' the main erection piece for dispatch.

n) Fabrication drawings shall be prepared in such a manner that structures can be dispatched from fabrication shop to erection site with maximum economic transportable size, so as to reduce work involved at site to a minimum.

o) Joints shall be connected for 125% of the capacity of the member or the 1.25 time the design force specified in the design drawing, whichever is more. (For single angle bracing member, consider full area as effective for this purpose).

p) Standard simple beam connections, unless otherwise stated in the drawings, shall be designed, and detailed for 125% beam shear / moment carrying capacity.

q) Wherever there is risk of nuts becoming loose due to vibration, lock nuts shall be provided, or nuts shall be welded after alignment and tightening.

r) For all connections by permanent bolts, two nos. of washers shall be used. One washer bearing against the head and the other bearing against the nut.

s) Detailing of structural steel members subject to dynamic loading shall be such as to ensure smooth transition of load, as well as best behavior under stress due to fatigue.

t) The contractor shall be responsible for design and detailing all connections. The design of connection shall provide adequate strength for transfer of force in the structural elements, as indicated on design drawings. Detailing shall be such that erection shall be convenient and free from all interfaces, drilling and cutting at site.

u) Any member to be welded must be supported from all directions to avoid possible sag caused by induced heat during welding process. Assembly and welding shall be carried out in such a way to minimize distortion and residual stress and that the final dimensions are within appropriate tolerances.

v) Welding shall be in accordance with IS 816, IS 819, IS 1024, IS 1261, IS 1323 and IS 9595, as appropriate.

w) For detailing of connections and joints, the relevant clause of Section-10 of IS:800-2007 is to be followed.

Completion Documents

a) On completion of work, the Contractor shall submit to the Purchaser the following documents.

b) The technical documents according to which the work was carried out.

c) 5 Copies of the "As built" drawings showing thereon all additions and alterations made during the fabrication.

d) Manufacturer's test certificates for all brought out items including raw steel.

e) Certificates/documents on control checking.

f) Test reports / Radiography films of welds. (For welding of any particular type of joint, welders shall give evidence acceptable to the purchaser of having satisfactorily completed appropriate tests as prescribed in IS 817, IS 1393, IS 7307 (Part 1), IS 7310 (Part 1) andIS7318 (Part 1), as relevant).

g) DFT record of paint applied measured at random for each erection mark.

The Purchaser/Inspector shall issue inspection Certificates to the Contractor for the structures found acceptable.

5.5.2.2. Surface Preparation & Painting of Steel Structures

Surface Preparation for Painting

a) General

The steel surface which is to be prepared shall be cleaned of dirt and grease and the heavier layers of rust shall be removed by grinding prior to Actual surface preparation to a specified grade.

Surface preparation to be followed prior to painting shall be based on the requirement of a particular painting system as mentioned in subsequent paras below. Some of the specifications for surface preparation is given below for reference but the particular specification for surface preparation shall be followed as per schedule of works given to the Contractor for price bid.

b) Mechanical Cleaning

Manual/power tool cleaning

Manual/power tool cleaning shall be done as per grade St-2 or St-3, of Swedish Standard Institution SIS 055900.

I. Grade St-2: Thorough scraping and wire brushing, machine brushing, grinding etc. This grade of preparation shall remove loose mill scale, rust and foreign matter. Finally, the surface is to be cleaned with a vacuum cleaner or with clean compressed air or with clean brush. After preparation, the surface should have a faint metallic sheen. The appearance shall correspond to the prints designated St-2.

II. Grade St-3: very thorough scraping and wire brushing, machine brushing, grinding etc. The surface preparation is same as for grade St-2 but to be done much more thoroughly. After preparing the surface, it should have a pronounced metallic sheen and correspond to the prints designated St-3.

c) Blast Cleaning

Blast cleaning shall be done by shot blasting as per following grades according to Swedish Standard SIS 055900.

I. Grade Sa-2. This involves light blast cleaning. Almost all mill scale, rust and foreign matter shall be removed. Finally, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. The surface shall look greyish in color and correspond in appearance to the prints designated as Sa-2.

II. Grade Sa 2½: This involves very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remain in the form of slight stains. Finally, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It shall then correspond in appearance to the prints designated as Sa 2½.

III. Grade Sa-3: This involves blast cleaning to pure metal surface. Mill scale, rust and foreign matter shall be removed completely. Finally, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. Then the surface shall have a uniform metallic color and correspond in appearance to the print designated as Sa-3

d) Flame Cleaning

Flame cleaning shall also be carried out with the help of a special oxy-acetylene torch and the loosened mill scale shall be removed with a wire brush. This process is not recommended for cleaning steel sheet or plates less than 6 mm in thickness as it may lead to buckling. The number of flames passes on such surface shall be limited to three. The primer coat of paint shall be applied when the surface is still warm, after removing the scales with brushing and wiping.

Surface preparation shall be done as shown in the schedule of works given to the Contractor for price bid.

Painting

a) For use of specific painting system, the paint manufacturer's specification shall prevail.

b) General compatibility between primer and finishing paints shall be established through the paint manufacturer supplying the paints.

c) Before buying the paint in bulk, it is recommended to obtain sample of paint and establish "Control Area of Painting". On control area surface preparation and painting shall be carried out in the presence of manufacturer of paint.

d) In order to ensure that the supplied paint meets the stipulation in design drawing/ specification, if required, samples of paint shall be tested in laboratories to establish quality of paint with respect to (i) Viscosity (ii) adhesion/ bond of paint in steel surfaces (iii) adhesion/simulated salt spray test (iv) chemical analysis (percentage of solids by

weight) (v) normal wear resistance as encountered during handling & erection (vi) resistance against exposure to acid fumes etc.

e) Whole quantity of paint for a particular system of paint shall be obtained from the same manufacturer.

f) Thinners, wherever used, shall be as per recommendation of the paint manufacturer.

g) Areas which become inaccessible after assembly of structures shall be painted before assembly, after cleaning the surfaces as specified.

h) Wherever shop primer painting is scratched, abraded or damaged, the surfaces shall be thoroughly cleaned using emery paper and power-driven wire brush wherever warranted, and touched up with corresponding primer. Touching up paint shall be matched and blended to eliminate conspicuous marks.

i) If more than 50% of the painted surface of an item requires repair, the entire item shall be mechanically cleaned, and new primer coats shall be applied followed by subsequent coats as per clause

j) All field welded areas on shop painted item shall be mechanically cleaned (including the weld area proper, adjacent areas contaminated by weld spatter or fumes and areas where existing primer, intermediate / finishing paint is burnt). Subsequently, new primer and finishing coats of paint shall be applied as per painting specification.

k) Application of paint shall be by spraying or brushing as per IS:487-1997 and in uniform layers of 50% overlapping strokes. Painting shall not be done when the temperature is less than 5°C or relative humidity more than 85%, unless manufacturer's recommendations permit. Also painting shall not be done in frosty or foggy weather. During application, paint agitation must be provided wherever such agitation is recommended by the manufacturer.

l) Paint shall be applied at manufacturer's recommended rates. The number of coats shall be such that the minimum dry film thickness (DFT) specified is achieved. The dry film thickness of painted surfaces shall be checked with ELCOMETER or measuring gauges to ensure application of specified DFT.

m) All structures shall receive appropriate number of primer and subsequent coats in order to achieve overall DFT as per design drawings/ specifications. First coat of primer paint shall be applied not later than 2-3 hours after preparation of surface, unless specified otherwise.

n) The finishing paint as specified shall be of approved color and quality. The under coat shall have different tint to distinguish the same from the finishing coat.

o) Edges, corners, crevices, depressions, joints and welds shall receive special attention to ensure that they receive painting coats of the required thickness.

p) Machine-finished surface shall be coated with white lead and tallow before shipment or before being put into the open air.

q) Parts of surfaces embedded in concrete shall be thoroughly cleaned of grease, rust, mill scale etc. and shall be given a protective coat of Portland cement slurry immediately after fabrication. No paint shall be applied on this part.

r) Surfaces which cannot be painted but require protection shall be given a coat of rust inhibitive grease according to IS:958-2000 or equivalent international standard.

Painting System

(Normal Anti-Corrosive Paint)

The recommended painting system for 0-hour fire rating resistance i.e., without fire rating of steel structures covering surface preparation, application of primer coats, intermediate coats and final coats as indicated below to develop the required minimum dry film thickness (250 microns) on steel surface should be provided by the successful Contractor. The outline technical specification to be adopted is shown below:

Step-1: Surface preparation: Sa 2½ according to Swedish Standard SIS 055900.

Step-2: Primer Coat

Application of epoxy-based zinc phosphate primer coat (50 microns) for structural steel. The Primer coat shall be done immediately after surface preparation.

Step-3: Intermediate Coat

Application of one coat of epoxy polyamide micaceous iron oxide (75 microns).

Step-4: Final Coats
Final Coat-1 – Application of one coat high build epoxy polymer (90 microns)

Final Coat-2 – Application of one coat high build epoxy polyurethane (35 microns)

5.5.2.3. GI Rolling Shutters

5.5.2.3.1. Performance Characteristics

Profile Height	78mm
Roller Curtain	• The shutter curtain is constructed from single skinned galvalume steel laths. • Each lath is retained by interlocking with each other
Surface	Galvalume with two coats of Polyurethane spray paint over one coat of epoxy primer.
Material Thickness	1.0mm
Curtain Weight	13 kg/m2 approx.
Structure Shape	Curved
Support Brackets	• Mild Steel with two coats of Polyurethane spray paint over one coat of epoxy primer.

	• Shaft is manufactured from mild steel tube of suitable outside diameter and wall thickness to suit the shutter application and is unsprung
Finish	Two coats of Polyurethane spray paint over one coat of epoxy primer.
Side Guides	2.0mm thick heavy duty TG Galvanised Steel
Finish	Two coats of Polyurethane spray paint over one coat of epoxy primer.
Hood & Motor Cover	Pressed galvalume steel hood box complete with reinforced bracket as required to suit the shutter width.
Finish	Two coats of Polyurethane spray paint over one coat of epoxy primer.
Bottom Profile	• Bend-resistant double-skinned extruded Aluminium profile for additional strength. • The bottom rail is fitted with extruded rubber bottom seal that will seal against the floor when the door is fully closed.
Finish	Two coats of Polyurethane spray paint over one coat of epoxy primer.
Locking arrangement	Optional
Seals	Optional on side guides

Wind lock-Storm anchors to be Included wherever applicable.

CE Certified CRS Compact Gear P.R.C. Make Indirect Drive Operator for rolling shutter size less than 6000mmX 6000mm.

Drive Unit	Indirect drive operator System power supply wired with industrial plug
Safety mechanism	Patented safety mechanism for chain failure with inbuilt limit switches
Control Switch	Three station push button with dead man control
Emergency manual operation	Emergency operation by means of chain

CE Certified CRS Compact Gear P.R.C. Make Indirect Drive Operator for rolling shutter size of 6000mmX 6000mm and bigger.

Drive Unit	Indirect drive operator System power supply wired with industrial plug
Safety mechanism	Safety brake in accordance with EN 14121-1: 2007 Safety of machinery

	The installation of safety brake for heavy rolling shutters performs two functions: • A bearing support for the shutter's shaft • A mechanical brake blocking the descent of the shutter if sudden acceleration occurs This is a safety feature that will eliminate the possibility of the curtain free falling in the event of a motor failure.
Control Switch	Three stations push button with dead man control
Emergency manual operation	Emergency operation by means of chain

5.5.2.3.2. Fixing

The arrangement for fixing in different situations in the opening shall be as per IS 6248.

a) Brackets shall be fixed on the lintel or under the lintel as specified with rawl plugs and screws bolts etc. The shaft along with the spring shall then be fixed on the brackets.

b) The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels, and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and bracket shall be fixed by means of steel screws bolts, and rawl plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in workers like manner that the operation of the shutter is easy and smooth.

5.5.2.3.3. Measurements

The rolling shutter shall be measured in numbers.

5.5.2.3.4. Rate

The rate shall include the cost of materials and labour involved in all the operations described above.

5.5.2.4. Flamed Finish Granite Slab Flooring in risers of steps

5.5.2.4.1. Scope of Work

To lay flamed finish granite in tread and riser with surface preparation, laying, curing, grouting of joints etc.

5.5.2.4.2. Material

The slabs shall be of selected quality shall be smooth and of even surface without holes or pits. They shall be machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or bill of quantities or as instructed by the Engineer-in-Charge.

The slabs shall have the top (exposed) face flamed before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work, the contractor shall get the samples of slabs approved by the Engineer-in-Charge.

The thickness of the slabs shall be 18 mm or as specified in the description of the item. The materials shall comply to IS 14223 (Part 1)

5.5.2.4.3. Surface Preparation

Refer to CPWD Specification 2019 item no.11.20.2.

5.5.2.4.4. Laying

Refer to CPWD Specification 2019 item no.11.20.3.

.

5.5.2.4.5. Curing

Joints shall then be grouted with grey or white cement mixed with pigment to match the shape of the topping of the wearing layer of the tiles. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge. Joint thickness shall not be more than 1 mm. Surface shall be thoroughly washed to remove all mud, cleaned and mopped as instructed by the Engineer-in-Charge.

5.5.2.4.6. Measurement

Refer to CPWD Specification 2019 item no.11.20.5.

5.5.2.4.7. Rate

Refer to CPWD Specification 2019 item no.11.20.6.

5.5.2.5. Passenger lift

The Contractor shall meet all requirements, described in the General Specifications and in the Schedules of Prices.
The Contractor shall, enclosed with the Contract, submit his specification for Data on Manufacturers and Materials. The Contractor shall also include the required drawings, specifications and/or data sheets mentioned in the specific paragraphs and tables.

5.5.2.5.1. General requirements

(a) This specification covers design, manufacture, fabrication / assembly, shop testing, painting, packing and forwarding, supply, storage at site, erection, testing, commissioning and handing over of the Passenger Elevator complete

with electrical equipment and standard accessories as covered under this specification.

(b) Data sheet enclosed along with this specification shall form part of this document.

(c) The passenger lift and its components shall confirm to the latest edition of the following and also other Indian and International standard as applicable.

(i) IS-14665 : 2001 (Part-1) Electric Traction Lifts - Part 1 : Outline Dimensions
(ii) IS-14665 : 2001 (Part-2) Electric Traction Lifts - Part 2 : Code of Practice for Installation, Operation and Maintenance
(iii) IS-14665 : 2001 (Part-3) Electric Traction Lifts - Part 3 : Safety Rules
(iv) IS-14665 : 2001 (Part-4) Electric Traction Lifts - Part 4 : Components
(v) IS-14665 : 2001 (Part-5) Electric Traction Lifts - Part 5 : Inspection Manual
(vi) IS-2365 : 1977 Steel wire suspension ropes for lifts, elevators and hoists.
(vii) IS-4289 -1984 & 2000 Flexible cables for Lifts and Other Flexible Connections

Further the elevator shall fulfil the requirements of the technical specification elaborated in the subsequent chapters and data sheet enclosed.

(d) In the event of conflicting statements appearing in various documents, the following order of precedence will govern:

(i) This document.
(ii) Indian Standards as applicable.

(e) The offer shall be complete in all respects and any additional equipment, accessories, auxiliaries, services, work etc. which are not specifically mentioned in the specification but are required for smooth and trouble-free operation and to achieve performance required to be guaranteed in terms of the Tender Document, shall be included by the Contractor in the offer.

(f) The price being quoted shall be inclusive of the charges for training of Purchaser's personnel in all disciplines connected with the operation and maintenance of the equipment.

(g) The price being quoted for the main equipment shall be inclusive of charges for carrying out maintenance of the Elevators during the guarantee period. During this period, supplier to ensure visit of their service personnel to the site minimum once in a month, apart from the breakdown call for carrying out regular maintenance work. The fee quoted shall include cost towards consumables such as lubricants, oils, etc.

(h) The Contractor shall also consider Annual Maintenance Contract (AMC) in his offer on comprehensive basis for 2 (two) years after the guarantee period inclusive of applicable taxes and duties, cost towards spares, replacement of worn out parts, consumables such as lubricants, oils, etc.

(i) The Contractor shall submit the drawings and documents, Technical data / information along with the tender and relevant Annexures, time bar chart etc. as asked for under relevant chapters of this document.

(j) The offer submitted by the Contractor shall submit one signed copy of this technical specification as acceptance of all parameters/data mention therein, without which the offer is liable to be rejected. The Contractor shall clearly specify clause wise list of deviations from the specification on particular items. Noncompliance with this and generalized statements like. "The equipment shall be manufactured as per IS standard / our specification etc." may result in rejection of the tender.

(k) The equipment shall be inspected during different stages of its manufacture till the completion of manufacture, by the Purchaser / his authorized representative at the Contractor's or his sub Contractor's works as per the inspection procedure mutually agreed between the Purchaser or his authorized representative and the Contractor. Inspection shall be regarded as a check-up and shall be in no way binding on the Purchaser.

(l) Painting shall be as per relevant chapter of this specification.

(m) Approval of drawings will not relieve the Contractor of his responsibilities for correctness, adequacy of the design and completeness of his work as per contract and he shall be wholly and solely responsible for the satisfactory operation and guaranteed performance of his supply. The contractor is solely responsible and accountable for any defects and subsequent delays in supply due to re-inspection.

(n) The contractor shall ensure that minimum amount of assembly at site is necessary for early commissioning after delivery. Site welding & riveting shall be avoided as far as possible. The contractor before proceeding with design details shall satisfy himself about site conditions to avoid any difficulty in erection.

(o) Metric system & English language shall only be used in the drawings.

(p) Scope of Work

(i) The scope includes design, engineering, fabrication/ assembly, manufacture, shop testing, supply, packing and transport to site, unloading, safe storage at site, erection, testing and commissioning and handing over of the elevator/s complete in all respects as covered under this specification, clearance drawing and data sheet.

(ii) The Scope shall also include the following:

(aa) Supply of counterweight, counterweight buffers, counter weight guide rails with suitable fixtures, machine beams, hitch beams and connected cleats, bolts, plates, entrance vertical and sill supports etc. that are required for the elevator.

(ab) Supply of car, car guide, car buffers, door and landing door frames and doors complete with all accessories, header, track, controls etc.

(ac) All preparatory work such as scaffolding, builder's work, hoist way wiring including lighting, scaffolding, painting, buffer support channels, pit ladder, etc.

(ad) All necessary Civil, Mechanical and Electrical works connected with the design, manufacture, supply at site, erection, painting, testing and commissioning of the Elevator

(ae) Supply of oils/ lubricants and other commissioning spares.

(af) Supply of special tools for maintenance.

(ag) Car floor provided with finishes as specified in the tender.

(ah) Car Interior with proper illumination and fan.

(ai) Stainless steel fixtures

(aj) Luminous hall buttons at all floors.

(ak) Digital luminous car position indicator with direction arrows in car and at all floors.

(al) Battery operated alarm bell and emergency light along with battery & battery charger.

(am) Automatic rescue device

(an) Overload warning indicator in the car in audio-visual mode.

(ao) Fire man's switch.

(ap) Drive (Motor with pulley) mechanism with rope and sheaves – placed in hoist way of elevator for machine room less type Operating device at landing and necessary indicating devices

(aq) Landing doors with necessary contacts

(ar) Landing doors with emergency unlocking facility

(as) Over speed safety mechanism

(at) Fire detector in hoist way

(au) Cables (including laying and termination) from Contractor's distribution board.

(av) Distribution board consisting of AC 23 category isolator as incomer and MCCB/MCBs for outgoing feeders for lighting, elevator drives, exhaust fans, etc.

(aw) The elevator electrics including protective switchgear, motors, motor control panels, fail-safe electromagnet brakes, limit switches, landing stop switches, door contacts, cables, lighting of car/cage, push buttons, emergency switch, signaling devices and other necessary equipment required for efficient operation of the elevator.

(ax) Complete lighting of elevator shaft, car and well/pit etc and plug point at each landing and pit.

(ay) Earthing and connection to main grid.
(az) Communication telephone cabinet in car operating panel and announcement system.
(aaa) Telephone in car
(abb) Travelling communication cable
(acc) Two nos. of earthing terminals

(iii) Scope further includes the following:
(aa) Operation and Annual Maintenance of the Elevators under scope of supply.
(ab) Maintenance of the Elevators during the guarantee period.
(ac) Necessary tools like torque wrench, hand grease gun, set of spanners, screw drivers etc in tool box and tackles for each equipment required for maintenance, testing or inspection of the equipment. List of such tools, instruments shall be furnished along with the Tender. No of sets of tools shall be supplied for each supplied elevator.
(ad) Required quantity of initial fill of oil, grease, lubricants, etc. and other consumables which are necessary for cleaning / flushing including erection, testing and commissioning the machines.
(ae) All items essential for the desired operation of these equipment whether specifically mentioned in this specification or not.
(af) The Contractor shall take full responsibility for obtaining approvals / clearances from lift inspectorate and other Government agencies before and after erection/commissioning of the elevator.
(ag) Drawing and documents as detailed in relevant chapter.
(ah) Training of Purchaser's personnel in all disciplines connected with the operation and maintenance of the Elevators.
(ai) All miscellaneous items and spares required for commissioning of the equipment. Commissioning spares shall include 25% extra of each type of cable lugs and double compression glands.
(aj) All electrics/ electrical equipment as indicated under relevant clauses. (ak) The equipment supply shall be complete in all respects including its structural, mechanical and electrical components and standard accessories such as electricals, flexible trailing power / control cables, etc.

5.5.2.5.2. Design basis for various components of Lift

(a) All the items included under this specification must be equipped with safety devices and clearances to comply with recognized standards and purchaser's requirements along with safety codes and statutes prevalent at the place of installation of equipment.

(b) Complete inspection & testing of the Elevators shall be carried out in presence of PURCHASER's representative as stipulated in chapter "Inspection."

(c) The equipment after erection at site shall be tested as stipulated in chapter "Erection, Testing & Commissioning."

(d) Type and quantity of Lift shall be as per Data sheet enclosed.

5.5.2.5.3. Specific Requirements – Mechanical

(a) Drive Unit

(i) The Drive Unit shall be of the single wrap traction type, and shall include a motor, electro-mechanical brake, sheave, shaft, all compactly mounted on a single base plate

(ii) The driving motor shall be of energy efficient A.C. induction type and shall be designed to operate for an unlimited period according to the expected duty i.e. intermittent duty with frequent starting and stopping of the lift. The A.C. motor may be supplied and controlled by static A.C. Variable Voltage & Variable Frequency (VVVF) drive with feedback loop and shall have integral drive sheave and brake disc. The main brake shall be of the Disc type with independent dual action capable of arresting the load on any single caliper. In the event of undetected brake wear, the brake shall not lift and thereby automatically prevent further lift operation.

(iii) An AC Closed Loop, regenerative type Variable Frequency drive with vector control technique shall be considered. The micro-computer based speed control system shall incorporate a digital closed loop feedback system ensuring the actual lift speed is in line with a dictated pattern during all phases of travel, namely acceleration, full running speed and deceleration. All phases of travel shall be controlled regardless of load or direction of travel. The drive configuration shall be such as to provide low harmonic distortion and reduced radio frequency interference

(iv) The acceleration and deceleration rates shall be as per relevant IS and shall be easily adjustable on site by qualified personnel.

(v) The closed loop control shall provide stopping accuracy well within ± 3 mm at every landing. The mechanical brake shall not be operative before the car has been electrically stopped and the speed at zero.

(vi) To compensate for rope stretch under various load conditions, an automatic re levelling system is to be furnished to ensure the car stays within the floor levelling zone at all times

(vii) Thus in VVVF controls pulse width modulation control of AC motors has following advantages compared with the older servo controlled elevators:

(aa) Total control at all stages of the motion cycle.
(ab) A consistent fully adjustable smooth ride.
(ac) Better levelling accuracy under all conditions.
(ad) A higher power factor.

(ae) Lower starting currents.
(af) Energy saving through reduced power consumption.

(b) CONTROLLER

An automatic controller shall be provided which shall control all the operations starting/ stopping, application of brake in case of power failure etc. An automatic rescue device shall be provided, that will move lift to the nearest upward and downward landing (subject to load) in the event of power failure.

(c) LIFT CAR

(i) Passenger Lift
(aa) Car enclosure shall be Stainless steel with hairline finish (scratch proof) interior.
(ab) Non-slip vinyl floor covering or marbonite flooring shall be provided in the lift car.
(ac) The car roof shall be of sufficiently robust construction and design to withstand, without deformation, the weight of two men and tools.
(ad) Car enclosure including door shall be designed to withstand without deformation a thrust of 35 kg applied normally at any point.
(ae) Ventilation shall be provided at the top and bottom of the car operating panel.
(af) During travel the car door shall be mechanically locked.
(ag) LED lamp luminary and one 300-mm sweep ceiling fan shall be provided in the car.

(d) Lift Control

(i) Passenger Lift
(aa) The operation shall be Simplex Full Collective Automatic type. Battery Alarm bell, UP / Down direction indication at all landings, Digital floor luminous position indicator in car and all floors, Pre-announcing indicator with arrival / going, Over- load indicator in car signals shall be provided. All signal fixtures shall be in stainless steel face plates. Arrow shaped signal lights in conjunction with audible single stroke gong above each landing shall be provided.
(ab) All stops registered by the momentary pressure of the car buttons shall be made in the order in which the landings are reached after the buttons have been pressed but irrespective of the sequence in which calls were registered.
(ac) Stops registered by the momentary pressure of the buttons at the landings shall be made in the order in which the landings are reached in the down direction of travel after the buttons have been pressed. All landing calls shall be answered when the car is travelling in the down

direction, except in the case of the terminal floor calls which shall be answered as soon as it is reached.

(ad) Load Non-Stop Option - The landing calls shall be bypassed but not cancelled if the load in the car is approximately 80% of the contract load.

(e) CAR AND LANDING EQUIPMENT

(i) Landing equipment, mounted to the side of each door, contained within a flush mounted stainless-steel panel, shall comprise a call illuminated push button.

(ii) Car equipment, mounted in a stainless-steel finish, flush panel, shall comprise: -

(aa) Call pushes button, illuminated, for each floor.

(ab) Car position indicator, illuminated, for each floor, to indicate car position.

(ac) Alarm push button.

(ad) A door open push button to re-open the doors when closing.

(ae) Key operated Priority call in the car

(iii) A digital dot matrix display shall be incorporated; Character heights shall be 25 mm.

(iv) The Car Operating Panel shall be of convex design located within the car wall in accordance with the requirements of the Building Regulations to ensure that it is also suitable for use by disabled persons.

(v) The car panel shall include circular (micro movement) halo illumination of the button, which will indicate that it has been pressed. Buttons (Tactile in compliance with Building Regulations) shall be provided for entering floor calls, door open and alarm.

(vi) A position indicator providing a digital display shall be included. The panel shall also include:

(af) Emergency Car Lights.

(ag) Passenger inter-communication units

(ah) Independent service key switch.

(ai) Car overload indicator.

(aj) Announcement system

(f) CAR AND LANDING DOORS

(i) Passenger Lift

(aa) The landing doors, at each level, shall be three-hour fire rated, two panels, center opening power operated fully automatic. Doors shall bestainless steel, not less than 16 SWG and shall be silent in operation.

(ab) All doors shall be fitted with a combined mechanical and electrical interlock.

(ac) The landing door locks shall be configured such that it shall not be possible to open the doors from the landing side, unless the car is at the

particular landing level. Nor shall it be possible to start the lift, or keep it in motion, unless all landing doors are closed.

(ad) Provision shall be incorporated for opening the landing doors by emergency key, irrespective of car position.

(ae) An electric infrared screen curtain type detector (3D) shall be provided (Curtain of light). This shall provide protection across the full width and height of the entrance. Interruption of the curtain beams shall cause the doors to reopen. An adjustable timer shall be provided, to adjust the opening and closing time of the car doors, and of the landing doors.

(g) COUNTERWEIGHT

The counterweight shall be of metal and constructed from multiple sections, contained and secured within a steel frame, and shall be equal to the weight of the complete car plus approximately 50% of the Contract Load.

(h) SUSPENSION ROPES

(i) Cars and counterweights shall be suspended from steel wire ropes of best quality, the size and number being in accordance with applicable standard.

(ii) The safety factor of the suspension ropes shall conform to relevant part of IS 14665

(iii) In case of flexible coated steel belt, pulse belt monitoring system to check belt condition shall be considered.

(i) Additional features

(i) Passenger lift shall have handrails.

(ii) Following facilities shall be considered:

(aa) Battery operated Emergency light.

(ab) Adjustable door open time for each floor.

(ac) Parking key switch

(ad) Intercom system for seeking outside assistance in the event of emergency.

(ae) Fireman switch

(iii) Battery operated rescue system for trapped passenger in the event of power failure shall be considered. For the car, emergency operation is performed at low speed and all safety functions shall be working. The resetting into normal operation is made automatically when the power supply is restored. Both battery unit and control module shall be located in the shaft.

(iv) Overload detection device should restrict the car to operate, and the doors remain open. The lift operation resumes only after removal of overload

(v) If car door does not close completely within predetermined time, the door should open and sound buzzer. It should attempt to close again. After three unsuccessful attempts, the car should shut down with door open and all the calls should be cancelled.

(vi) The Fire detection feature returns all the lifts to a specified floor and lets passengers out of the car when there is a fire detected in the building. The lifts remain on the specified floor until the fire situation is resolved.

(vii) Nudging: If the doors are prevented from closing for a fixed period of time, a buzzer is activated, and the doors begin to close at a reduced speed.

(viii) An over speed safety device to stop the car whenever the car achieves runaway speed limit resulting from high-speed descending of the car, shall be provided. The device shall be operated by a centrifugal governor, which continuously and automatically senses the car speed. The actuation of the safety device shall cut off the power supply to the motor and apply the brake immediately. An alarm shall be activated. Afterwards it shall be possible to bring the car safely to the nearest landing to rescue men and materials.

(j) MACHINE ROOM LESS LIFT

(i) All drive equipment shall be mounted in the lift shaft. The control panel will be mounted outside of the lift shaft within a lobby area of the building; it shall be aesthetically pleasing and preferably only 400 mm wide. If there is an existing plant room at an acceptable distance from the lowest level served, this may be used for housing the control panel.

(ii) The control panel shall be suitable for mounting up to 15 meters from the lowest floor served and housed within a sheet steel enclosure, with a minimum protection rating of IP54, suitable for floor mounting, with front access only.

(iii) When located within the lift shaft, the control panel, due to its location, must be capable of being closed and locked without the use of a key.

5.5.2.5.4. Specific Requirements – Electrical

(a) The equipment offered shall be suitable for trouble free and efficient service in the following site conditions:

Altitude: Less than 1000 m
Humidity: 95% (Max temperature) Max humidity does not occur simultaneously.)
Design temperature for equipment and systems: 45 deg C
Incoming Power Supply: 415 ±10 %, 50Hz± 5%,

	Combined voltage and frequency variation ± 10 %, 3 phase 4 wire system
Short circuit level:	50 kA for 1 second.

(b) The electrical equipment shall comply with the latest revision of relevant standards and wherever such Indian Standard is not available, International codes and practices shall be followed. The equipment shall be dust and waterproof.

(c) Electrical equipment shall conform to latest Indian electricity rules and regulations and the statutory requirement of Government of India and the Government of the State as regards to the safety requirement, earthing and other essential provisions specified therein.

(d) The operating voltage for control supply shall be indicated by the Supplier. The contractor shall include suitably rated control transformer / rectifier, etc. to meet the control voltage.

(e) The distribution board to be provided shall be suitable for wall mounting and mounted at 1.2M from FFL. This shall be fabricated from sheet steel of adequate thickness of minimum 2.0 mm thickness. The bottommost equipment shall be mounted at least 380 mm above the bottom level of the panel. Enclosure class shall not be less than IP-54.

(f) The minimum rating of the isolating switch and contactor shall be 63 A and 32 A or 125% the full load current of the drive, whichever is higher.

(g) The switches shall be suitable for AC 23 duty

(h) The contactor shall be suitable for AC 3 or AC4 duty as applicable. The overload relay shall have in-built single phasing protection.

(i) The distribution board shall use MCCB/MCBs.

(j) The motors shall be Class-F insulated. The temperature rises above the design ambient shall be limited to class – B.

(k) The motors offered, shall be in IEC frame size with pull-out torque of not less than 275% of the full load torque. The motor shall conform to IS:325-78. Duty cycle and number of switching per hour for the selection of the motor frame size shall be based on the most stringent duty that the elevator is required to perform. The enclosure class for motor shall be IP-54. There shall be an earthing terminal inside the terminal box.

(l) Control of AC motors shall be through Variable Voltage Variable Frequency (VVVF).

(m) Suitable DC electro-magnetic brake shall be provided to hold the drive when it is switched off. Necessary equipment along with protective gear for the brake shall be in the scope of supply of elevator manufacturer.

(n) All limit switches and other control equipment shall be heavy duty type.

(o) An automatic floor-leveling device shall be incorporated in the elevator control.

(p) There shall be a provision of initiating audible and visible signals from inside the cabin in the event of elevators getting stuck up between the landings due to break down. The source of supply for these signaling devices shall be through a suitable battery source with its own charger unit. A push button and a bell in the cage and a bell in the control shall be provided along with battery. Emergency lighting fed from battery source shall also be provided in the cage.

(q) Contractor shall also include "AUTOMATIC RESCUE DEVICE (ARD)SYSTEM "with suitably rated battery back up and charger. In case of power failure, if the elevator car is stuck between floors, the ARD device shall move theElevator to the nearest floor level and opens the automatic doors. If the car is in atfloor level, the doors are opened by the ARD Device.

(r) In addition to the ARD, there shall be a provision to operate the elevators manually to the nearest landing in case of power failure. Necessary devices to release the brake and turn the traction pulley shall be built into the drive. Necessary interlocks shall be provided to cut off the control supply during such manual operation. It shall not be possible to operate the elevator after power supply is resumed unless these devices are put back properly.

Call indicators to inform the attendant, under attendant mode that the elevator car is required at a certain floor shall be provided.

(s) Indicators to show the position of elevator car and the direction in which it is traveling shall be provided both inside the cabin and at each landing.

(t) The elevator cars, elevator shafts and elevator well shall be adequately illuminated by electric light. Elevator cars shall also be provided with ventilating fan.

(u) Fire extinguisher of suitable type and size shall be provided in the elevator cars.

(v) The cables used in the elevators installation shall be FRLS PVC outer sheathed and shall conform to IS:4289(PART-1)-84.

(w) The circuit which supplies current to the motor shall not be included in any multicore cable used in connection with the control /safety devices/signaling equipment.

(x) A traveling cable with conductors for the control circuit shall be separate and distinct from that of cables used for lighting and signaling circuits. All control and

signaling cables shall have stranded copper conductor of minimum size 2.5 sq. mm. 20% spare cores shall be provided in each control/signaling cable. All power cables shall be of 650/1100V grade PVC insulated unarmored with stranded copper Conductor.

(y) Earthing of all electric equipment shall be done as per relevant BIS, including IS 14665, latest IE rules and statutory regulation of the Govt. of Assam.

5.5.2.5.5. Specific Requirements – Safety

(a) Every electric lift shall be provided with upper and lower normal terminal limit switches arranged to stop the car automatically within the limits of top carclearance and bottom run by (over travel) from any speed attained in normal operation. Such limit switches shall act independently of the operating device, theultimate or final limit switches and the buffers.

(b) Ultimate or final limit switches shall act to prevent movement of the lift car under power in both directions of travel and shall, after operating, remain open until the lift car has been moved by a hand winding to a position within the limits of normal travel.

(c) A manually operated mains disconnecting switch shall be installed in the main circuit cables of each electric lift machines. This switch shall be placed close to and visible from the machine it controls.

(d) It shall not be possible to start the lift car under normal operation unless every landing door and car door is in the closed position.

(e) The landing push buttons shall remain inoperative until the person or persons, using the lift, have vacated the lift car and the landing door has been again closed, except that with the collective control, the push button may be utilized for this purpose provided they do not in any way interfere with the direction of current journey and that provision shall be made for a reasonable time lag between the stopping of the lift car and its being restarted.

(f) An emergency stop switch may also be fitted on top of every lift car for use by persons working thereon.

(g) Communication port shall be provided in each lift car.

(h) Every lift car under automatic attendant control shall stop at landing with car sill fairly in level with the landing sill. The difference in levels shall not exceed the distances mentioned in IS 14665: 2000.

(i) Fire detection device shall be provided in lift shaft.

(j) All lights, power & control shall be provided from Class III power supply.

5.5.2.5.6. Drawings / Documents to be furnished by the Contractor

(a) General Arrangement drawing for the Lift along with the technical specification.

(b) Detailed catalogues of the equipment and attachments, if any.

(c) Material & other test certificate for attachments / accessories.

(d) Routine test certificate for electric drive motor.

(e) Type and routine test certificate for batteries as per IS: 5154 -1990.

(f) Test certificate for battery charger unit.
(g) Type test and relative test certificates for equipment of standard and proprietary categories.
(h) Required QAP's
(i) Any Other information useful for better operation maintenance and life of the equipment.

5.5.2.5.7. List of approved vendors

(a) M/s OTIS, INDIA
(b) M/s Kone India
(c) M/s Thyssenkrupp India
(d) M/s Schindler India
(e) M/s Mitsubishi Electric India

5.5.2.5.8. Data sheet for reference.

Title		**Lift/Elevator EQ-01-PL**		
Equipment ID:		**EQ-01-PL**		
SI. No.	Description	Unit	Required Value	Specification offered by Contractor
1	Type	[-]	Machine room less and Gearless passenger Lift	
2	Duty (When Connected)	[-]	Continuous	
3	Capacity of elevator	persons	10 persons	
4	Speed	m/sec	1	
5	Number of landings	[-]	Ground + 1	
6	Travel	m	Approx 4.2	
7	Machine	-	Placed in the hoist way	
8	Car well size (W x D)	mm	2000 x 2000	
9	Allowable level difference between car floor & landing.	mm	3	
10	Arrangement for moving the car in case of power failure	[-]	Automatic rescue device system in addition to Hand winding facility	
11	Max. Temperature	Deg.c	50	
12	Max. Humidity	%	100	

13	Spare parts and required tools, supplied by a contractor for operation period (at least)	year	2	

5.5.2.6. List of Approved Makes

Note: The quality of all Materials intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract, shall conform to the Specifications, Bill of Quantities and Drawings.

The list(s) of manufacturer(s)/supplier(s) given in this clause for various Materials are not exhaustive. The Contractor shall procure Materials preferably from the manufacturers stated in the relevant sections. Nevertheless, in case the Contractor wants to procure such Materials from manufacturer(s)/supplier(s) not listed in this clause, the Contractor may procure Materials from other supplier(s)/manufacturer(s) provided that the Materials procured conform to the Specifications, Bill of Quantities and Drawings and are from the reputed manufacturers.

Notwithstanding the above, the Contractor shall submit sample(s) as well as technical data of all materials to be procured for the Works and any more information requested by the Employer, to the Employer for his consent and the Contractor shall obtain such consent of the Employer at least 28 days before his intended date of placing the order for the materials. The decision of the Employer shall be conclusive, final and binding.

Unless Specified otherwise Contractor shall use the following list of approved vendors for the mentioned materials as per the below table.

Architecture, Civil & Structural		
S. No.	**Description**	**Make**
1	Emergency Fire Exit Doors	Shakti Hormann/Avians/Metaflex/Ozone
2	Sliding Gate	Shakti Hormann/Avians/Metaflex/Ozone
3	Boom Barrier	Gandhi/ParknSecure
4	Floor Hardner	Sika/BASF mastertop 100/Equivalent
5	Floor Sealant	SIKA/BASF/Fosroc/STP/Euclid Chemicals
6	Curing Compound	SIKA/BASF/Fosroc/Pidilite
7	Water Proofing Chemicals	SIKA/BASF/Fosroc/Dr. Fixit
8	Grouting Material	SIKA/BASF/Fosroc/Dr. Fixit
9	Aluminium Extrusion	Jindal/Hindalco
10	Glass Work	Saint Gobain/Modiguard/Asahi India Glass/Ozone
11	Sanitary Fixtures	Hindware or Equivalent

12	Toilet CP Fitting	Jaquar Industrial Grade.
13	Tiles	Nitco/Kajaria/Somany/Orient Bell/CERA
14	Toilet Cubicles	Merino Industries Limited/Century Doors/Greenlam
15	Doors Hardware	Doorset/Ace Hardware/Ozone/Hardwyn/Dorma/ KICH
16	False Ceiling	Gyproc/Armstrong/India Gypsum/Oscott/USG
17	Paints	Asian/Berger/Snowcem Paints/Nerolac
18	ACP Cladding	Alstrong/Eurobond/Alex Panels
19	Rolling Shutter	Gandhi or Equivalent
20	Structural Steel	TATA/SAIL/JSW/ESSAR/JSPL
21	Purlins and Girts/ Secondary Roof Members/ Secondary Mezzanine Numbers	ESSAR/JSW Steel/Uttam Galva/Bhushan Power/ POSCO
22	FRP/ Polycarbonate Sheet	Tufflite or Equivalent
23	Zincalume/Galvalume Profiled Sheets (Pre Painted Colour Coated Sheet)	Tata Blue Scope/LLOYD Insulations (India) Ltd/Shiv Shakti Fibre Udyog/Colour Roof India/Japan Metal Building/Multicolor Steel/Bhushan Steel/GK Roofing India Pvt Ltd
24	Welding Electrodes	GEE/D&H(INDIA)/D&H(SACHERON)/ADOR/ESAB/L&T/ HONAVAR/BOHLER
25	Paints for Structural Steel	Asian Paints/ Berger/ ICI Paints/Shalimar/ Garware /I-Can Nano Paints/Kansai/Nerolac Paints/Jenson Nicholson Paints/British Paints/Aksonnobel/JSW Paints
26	Bolts & Nuts for Structural Steel	In general MS Foundation Bolts/Anchor Bolts to be fabricated from MS rods conforming to IS:2062 procured from any manufacturers listed above under S. No. 1. Erection & Permanent Bolts shall confirm to the Technical Specification. S.S. Industrial Corporation/Rudraksh International/Precision Fasteners/Auto Lims Corporation may be considered.

5.6. Building Firefighting Works

5.6.1. Overview

The scope of work comprises procurement, supply, installation, testing and commissioning of the following.

- Fire protection system of various rooms in the building with internal hydrant, sprinklers and fire extinguishers as per the layout.

The General requirements and the scope of work to be carried out under this contract is illustrated in the drawings and specifications attached herewith. All work under the contract

shall be carried out in conformity with the rules and regulations of the local authority. All labour, materials, appliances, tools, and equipment necessary for Firefighting services installation including testing and commissioning as specified herein, and as per the relevant Bureau of Indian Standards (BIS) and as shown on the drawings shall be provided.

This also includes any material, appliances and equipment not specifically mentioned herein or noted on the drawings as being furnished or installed which are necessary and customary to make a complete installation properly connected and in working order.

Contractor to carryout all incidental works connected with firefighting services installation, such as excavation and backfilling etc. cutting/drilling holes through walls and grouting for embedding of fixing of Pipes so forth.

Complete installation of the sprinkler piping and Firefighting appurtenances in the building. Complete installation of all Sprinklers in all the floors of the building.

The Contractor shall co-operate with other contractors in putting the installation in place as required. Any work done without regard for or consultation with other contractor, shall be removed without additional cost to the project.

Have to repair all damage done to the premises because of this installation and remove all debris left by those engaged in this installation.

Testing, commissioning, and proving the satisfactory performance in all areas at the time the buildings are handed over.

To take care of all the fixtures fitted until the time of handing.
Painting of all GI Piping, Wrapping, and coating must be done for all underground GI pipes if any.

Contractor shall submit the technical data sheets and drawings of the various materials to be supplied for approval of client before procurement.

The contractor is responsible for getting the entire installation duly approved by the authorities concerned and for all expenses in connection with the same. Further, the contractor is responsible for obtaining and delivering certificates of final inspection and approval by the concerned authorities.

5.6.2. Shop Drawings

The contractor shall prepare the final detailed shop drawings based on the tender drawings and submit the same in three copies. Shop drawings shall be submitted as follows:

- Drawings showing any change in layout in the contract drawings.
- Floor plans, schematic showing firefighting network installations.
- Three copies of catalogues, manufacturer's drawings, equipment characteristic data or performance charts/data as required by the Employer/Engineer.
- The contractor shall provide a Quality Assurance Plan, Test certificates, and a list of spare parts together with the name and address of the manufacturer for all mechanical equipment provided.

5.6.3. As Built Drawings

- On completion of works, Contractor shall submit complete set of original tracings and two prints of "As built" drawings.
- The contractor shall also submit all drawings / information in AutoCAD latest version. These drawings shall have the following information:
    - Exact sizing and Sprinkler point details of all areas.
    - Locations of all valve Chamber details, Zone control valves and connections.
    - Layout with location of all mechanical equipment and piping connections.
- All "Warranty Cards" given by the manufacturers shall be handed over.
- Three sets of Operation and maintenance manuals in the desired format shall be handed over.
- Orifice plates of suitable design shall be provided in the landing valves, wherever necessary, to limit the operating pressures. The design and specifications shall be submitted for client's approval.

5.6.4. Basis and Guidelines

All the Firefighting works shall be carried out strictly as per specifications, IS codes and CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems) 2020 with amendments up-to date. The Fire Protection System is designed keeping in view the following:

- Provision of Landing valves sprinkler system, and fire extinguishers based on NBC-2016.

5.6.5. Hydrants and Sprinkler System

- To provide fire protection inside the building internal hydrants, sprinkler system and fire extinguishers are to be provided.
- The pipeline for the internal hydrants and sprinkler system is tapped off from the external hydrant line routed around the building.
- 1 No. Single hydrant valve of 63mm (2 ½") as per IS 5290; at outlet is provided at the landing area of the staircase along with 1 Nos of Fire Hose with Delivery Coupling along with 1 No of Branch Pipe. Internal hydrant is considered in the first-floor staircase only, as ground floor protection shall be achieved using external hydrants

provided around the building. Wall mounted hose box is provided to accommodate Fire Hose and Branch pipe.

- Fire water sprinkler system consisting of Pendent type sprinklers covering certain area of the terminal building such as office areas, security cabin, feeding area, first aid room, restaurant, shops, and ticket counters is provided.
- Fire extinguishers of ABC type as per IS 14609 are provided at the entry and exit of the building and near restaurant along with exit signages.

5.6.6. Material

All the modifications to the Standard Specifications are as follows.

Item no.	**Particulars**
Item 7.3 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	In addition to item 7.3, add requirement 7.3.1 as below: Pipes of following types are to be used: Galvanized iron pipes as per IS:1239 heavy grade (C-CLASS for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside to prevent soil corrosion. G.I pipes buried below ground shall also suitably be lagged with 4mm thick protection coating over 2 coats of primer. G.I Pipes up to 150 mm dia shall be as per IS: 1239, Part-I (heavy grade) while pipelines above 150 mm dia shall be as per I.S.:3589. All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanized before use at site. Welding of galvanized clamps and supports shall not be permitted.
Item 8.6 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	In addition to item 8.6, add item 8.7 as below: **8.7 Hose Box** Hose box made of 1-gauge MS Sheet 750mm X 600mm X 250mm with double door with 4 mm thick glasses and door frame and Box made of 14-gauge MS sheet painted. All external hydrants shall have an associated Fire Hose Box that shall house two numbers of 63 mm dia x 15 m long Fire Hose with a short branch pipe. All hydrants shall be readily accessible to the fire appliances and for firefighting operations. These shall be as per IS: 904.

	Material of Construction – M S Sheet Box should be painted with red color shade No. 536 of IS:5.
Item 8.7 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	Add new item no. 8.7 as follows: **Flexible Connectors** On all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors shall be provided. Connectors should be suitable for maximum working pressure of each pipeline on which it is mounted and tested to a test pressure of 1.5 time the operating pressure. Length of the connector shall be as per manufacturers standard.
Item 8.8 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	Add new item no. 8.8 as follows: **ABC Type Dry Powder Extinguisher** The Extinguisher shall be filled with ABC grade 40, Mono Ammonium Phosphate 40% from any approved manufacturer. The capacity of the extinguisher when filled with Dry Chemical Powder (First filling) shall be 6kg +/-2%. The distribution of fire extinguishers to be as per IS 2190 – 1992. It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety clip, fitted with a pin, to prevent accidental discharge. It shall be pressurized with Dry Nitrogen, as an expellant. The Nitrogen to be charged at a pressure of 15 Kg/cm2. Body shall be of mild steel conforming to relevant IS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling. The Neck Ring shall be externally threaded - the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm. Discharge nozzle shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents up to a throw of 4 mtrs, continuously, at least for

	15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 5 Kg capacity and 12 mm for 10 Kg capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and it shall be labelled with words ABC 2.5 cm long, within a triangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 Kg/cm2 for a minimum period of 2 minutes. The pressure gauge shall be imported and suited for the purpose.
Item 1.13.3 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	In addition, in item 1.13, add item 1.13.3 (sub clause) as below: **Painting** All Hydrant and Sprinkler pipes shall be painted with red colour paint, shade No. 536 of IS:5 as per clause 1.13.1. All GI/MS pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat two coats of enamel paint shall be applied. Each coat shall be given minimum 24 hours drying time. No thinners shall be used. Min. 35DFT per each coat to be applied. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "HYDRANT LINE", "SPRINKLER LINE" etc. Painting shall be expertly applied; the paint shall not over run-on surfaces such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.
Item 8.9 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	In addition, in item 8, add 8.9 item as below: ***Brick Masonry (Valve Chamber)*** The size of the valve chambers shall be as specified in the drawings. It shall be constructed of brick masonry walls 230 mm thick in CM 1:4 (1 cement:4 sand) resting on M-15 concrete foundations. The inside and outside faced of the masonry wall shall be plastered with 13 mm thick plaster of cement mortar 1:3 (1 cement: 3 sand). The top of the chamber shall be provided with reinforced concrete M-20 grade slab as per drawing and directions of the Engineer in charge.

	The top of chamber shall be provided with reinforced cement concrete M-15 grade or as per the direction of the Engineer in charge. The frame shall be fixed in position during concreting of top slab, inside faces of frame and cover shall be given two coats of approved anti-corrosive paint.
Item 19.3.1.1, (vi) of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Item 19.3.1.1, (vi) to be read as: Size and shape and performance requirement of manhole covers and frames shall conform to IS 1726 and following sizes to be added: 300 mm X 300 mm 600 mm X 600 mm 900mm X 800 mm

5.6.7. Preferred Make

The MOC of various equipment and supplies in respect of imported/indigenous equipment/components/materials are listed out in this document. It is essential that the equipment/component/materials to be supplied from imported/indigenous sources by the Contractor will be of any one of the makes listed against that equipment/ component/material in these documents.

In case the Contractor/ Contractor intends to substitute any make of equipment/components/ materials by a make other than that listed in this document, the Contractor shall follow the procedure for additional makes clearance.

FIREFIGHTING MATERIAL LIST		
Sl. No.	**Item description**	**Make**
1	G.I. / M.S. Pipes (IS: 1239 / IS: 3589)	APL-Apollo
		AST Pipes
		Hitech
		Jindal Hissar/Jindal star
		TATA
2	Paints	Asian Paints
		Berger
		ICI
		Shalimar Paints
		Johnson & Nicolas
3	Double / Single Headed Landing Valve	Eversafe
		Newage, Surendranagar
		Safeguard
		Safex
		Safefire
4	Fire Hose	Eversafe
		Mitras
		Safeguard
		Safex
		Safefire
5	Hose Box (ISI marked)	Geetech
		Safeline
6	Photo Luminous Signages	Autolite
		Legrand
7	First Aid Hose Reel (LPCB Approved)	Eversafe
		Newage, Surendranagar
		Safefire
		Safex
8	Hose Reel Drum (ISI marked)	Eversafe
		Newage, Surendranagar
		Safex
		Safefire
		Safeline
9	Sprinkler Heads	HD
		Newage, Surendranagar
		Safex
		Tyco
		Victaulic
		Viking
10	Flexible Drop Connection	Flexhead
		Minimax
		Newage, Surendranagar

		Safex
		Tyco
11	Fire Extinguishers	Eversafe
		Dupont
		Kanex
		Navbharat
		Safex
12	Pipe Protection Wrapping & Coating	IWL - Pypkote
		Neotape
		Rustech - Coatek
		STP Ltd.
13	Pipe clamp & supports	Chilly
		Euroclamp
		Easyflex
		Gripple
14	GM / Forged Brass Valves	Jayhiwa
		Kitz
		Sant
		UTAM
		Zoloto
15	Cast Iron Sluice Valves	Indian Valve Company
		Kirloskar
		Marck-Cair
		Sant
		UTAM
16	Butterfly Valve	Jayhiwa
		Marck-Cair
		Sant
		UTAM
		OR
17	Check Valve – Wafer Type	Kirloskar
		Jayhiwa
		Marck-Cair
		Normex
		UTAM
18	Check Valve – Dual Plate	Marck-Cair
		Normex
		UTAM
19	Air Release Valve	OR
		Zoloto
		ITAP
		Marck
20	Y Strainer	Emerald
		Sant
		SKS
		Zoloto

21	Pressure Gauge	Aquamet
		Emerald
		Fiebig
		H Guru
		Wika
22	Fastener	Fisher
		Hilti

5.7. Building Plumbing and Sanitary Works

5.7.1. Overview

The scope of work comprises procurement, supply, installation, testing and commissioning of the following.

- Water supply System from tie in point near the building to Over Head Tank (OHT) and from OHT to the fixtures inside toilets and other fixtures which require water in the building.
- Sewage and waste collection from toilets and transferring it to the external network.

The General requirements and the scope of work to be carried out under this contract is illustrated in the drawings and specifications attached herewith. All works under the contract shall be carried out in conformity with the rules and regulations of the local authority. All labor, materials, appliances, tools, and equipment necessary for plumbing services installation including testing and commissioning as specified herein, and as per the relevant Bureau of Indian Standards (BIS) and as shown on the drawings shall be provided.

This also includes any material, appliances and equipment not specifically mentioned herein or noted on the drawings as being furnished or installed which are necessary and customary to make a complete installation properly connected and in working order.

Contractor to carryout all incidental works connected with plumbing services installation, such as excavation, backfilling etc. Cutting and chasing in concrete or brick and making good, cutting/drilling holes through walls, floors, and grouting for embedding of fixing of fixtures/equipment and so forth.

Contractor to furnish and install complete workable, plumbing services installation as shown on the drawings and described in this specification and as per the latest Bureau of Indian Standards (BIS), including all that which is inferred to all the buildings, internally and externally.

Complete installation of the sewerage and sewerage appurtenances in the building. Complete installation of all sanitary and plumbing fixtures in all the floors of the building.

The Contractor shall co-operate with other contractors in putting the installation in place as

required. Any work done without regard or consultation with other contractor, shall be removed without additional cost to the project.

Have to repair all damages done to the premises because of this installation and remove all debris left by those engaged in this installation.

Cleaning of all plumbing and sanitary fixtures, testing and proving the satisfactory performance of all fixtures at the time the buildings are handed over.

To take care of all the fixtures fitted until the time of handing.

The contractor shall submit the technical data sheets and drawings of the various materials to be supplied for approval of client before procurement.

The contractor is responsible for getting the entire installation duly approved by the authorities concerned and for all expenses in connection with the same. Further, the contractor is responsible for obtaining and delivering certificates of final inspection and approval by the concerned authorities.

5.7.2. Shop Drawings

The contractor shall prepare the final detailed shop drawings based on the tender drawings and submit the same in three copies. Shop drawings shall be submitted as follows:

- Drawings showing any change in layout in the contract drawings.
- Floor plans, enlarged toilet details, schematic showing water supply and sanitary installation works.
- Three copies of catalogues, manufacturer's drawings, equipment characteristic data or performance charts/data as approved required by the Employer/Engineer.
- The contractor shall provide Quality Assurance Plans, Test certificates, and a list of spare parts together with the name and address of the manufacturer for all mechanical equipment provided.

5.7.3. As Built Drawings

- On completion of works, Contractor shall submit complete set of original tracings and two prints of "As built" drawings.
- The contractor shall also submit all drawings / information in AutoCAD latest version. These drawings shall have the following information:
    - Exact run and sizes of all piping on all floors and vertical stacks.
    - Ground and invert levels of all drainage pipes together with location of all Chambers and connections.
    - Run of all water supply lines with diameters, location of control valves, access panels.

- Layout with location of all mechanical equipment and piping connections.
- All "Warranty Cards" given by the manufacturers shall be handed over.
- Three sets of Operation and maintenance manuals in the desired format shall be handed over.

5.7.4. Basis and Guidelines

All the water supply and sanitary works shall be carried out strictly as per specifications, IS codes and CPWD specifications 2019 (VoI.2) with amendments up-to date. The Plumbing, Drainage System for the project is designed keeping in view the following:

- Domestic water supply through transfer pump to fill the overhead tank System for making water available at different locations.
- Sewage collection system based on applicable standards for domestic drainage and connected to external sewage network as per NBC (Part-IX).
- Storm / Rainwater drainage system from various levels of the building and disposal.

5.7.5. Water Storage and Distribution

- The water requirement for the project is based on the provisions of NBC 2016.
- To meet the drinking water and toilet requirements of Neamati & Aphalamukh Terminal buildings tap offs are considered near the building from the external potable water line to fill the overhead tanks.
- The estimated requirement of water per day for the Terminal is based on the number of users.
- Overhead tank (OHT) is provided on the terrace to feed water to various points of consumption by gravity.
- A panel tank of (L) 4.7 m X (W) 3 m X(H) 2 m is considered on the terrace of Neamati.
- 2 No's PVC circular water tanks of 2 m dia. with a height of 2 m are provided on the terrace of Aphalamukh.
- Isolation valves and check valves are located strategically throughout the distribution network to isolate any branches in building in case of maintenance.
- Level indicators are to be provided for OHT to automate the tank filling whenever required.
- Water supply pipes and fittings of CPVC material are routed from the overhead tank to the building shaft and connection sizes to various fixtures are provided as per NBC.

5.7.6. Materials

Materials shall be of approved make and quality specified. They shall conform to the respective Bureau of Indian Standards and supported by Manufacturing Certificate/test certificate.

Samples of all materials shall be as per the first choice of the list of approved brand manufacture, the sample of which shall be approved by the Engineer before placing the order.

In any case of non-availability of materials in metric sizes, the nearest size of FPS units shall be provided with prior approval of the Engineer at no extra cost to the Employer.

Colour code shall be used to identify pipe material, Contractor shall be able to identify on request all random piping prior to any field installation.

As far as materials bearing I.S. certification marks shall be used.

Unless otherwise specified and expressly approved in writing, materials of makes and specifications mentioned in this document/BOQ shall be used.

Samples of all materials shall be approved before placing order and the approved samples shall be deposited.

5.7.7. Internal Drainage and Sewage Disposal

Modifications to the Standard Specifications are as follows:

Item no.	Particulars
Item 19.2.6 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	In place of items no. 19.2.1 to 19.2.3 the following shall be used. Add new item no. 19.2.6 as follows: **UPVC Pipes for sewage and drainage works:** **General:** This section of the specification covers the supply, delivery, installation, testing, commissioning of Sanitary Plumbing Installation of all soil, waste, and vent pipe as well as the installation and connection of all sanitary fitments to the plumbing system. **Rules and Regulations:** The sanitary plumbing and drainage work shall be executed by a licensed plumber and in accordance with the latest edition of IS 5329(Code of practice for sanitary pipe work above ground for buildings), IS 12251(Code of practice for drainage of building basements) and other relevant codes as specified in codes and standards to be followed. **Materials for Piping:** Unless otherwise stated in the drawings or elsewhere in the specification, all sanitary piping shall comply with the following: a) Soil and Waste Pipes inside toilets i. UPVC pipes confirming to IS 13592- 1992 ii. b) Vent Stacks, Piped Anti-Siphon Pipes c) Soil Stacks, drain stack lines and Rainwater down takes i. UPVC pipes (SWR class) Type B confirming to IS 13592- 1992.

The contractor shall supply the test certificates or manufacturer's certificates showing that the piping complies in all respect with the provisions of the relevant Standards as stated above.

Handling:

Because of their lightweight, reasonable care should be taken in handling and storage to prevent damage to the pipes and others. The pipes shall be stored as per the manufacturer's specification. The contractor will hold full responsibility in this case. On no account the pipes should be dragged on the ground. Pipes should always be given adequate support.

Laying:

The UPVC pipes shall be laid under the floors below slab or on walls either buried or exposed, as shown in the drawings. The fittings shall be of injection mould type suitable for solvent cement joint or rubber ring joint. The pipes and fittings shall be capable of withstanding the sun's rays. UPVC pipes laid below slab or suspended in ceiling shall be supported by angle brackets/ supports as detailed in the drawings. All external pipes shall be mounted on special sliding brackets of Galvanized MS grouted to the duct wall, with the pipes being held to it using GI "U" clamps. These brackets shall provide for at least 50mm clear working space behind the pipes.

Joints and fittings for UPVC Pipes:

The jointing of pipes to fittings shall be done as per the manufacturer's instructions/ recommendations. The UPVC pipes and fittings shall be joined (pasted joint) with Solvent cement; this method of jointing shall be used for piping below slab or at sunken floor and jointing shall be carried out as follows:

a) Cut the spigot end of the pipe square.
b) All burrs from the internal and external surfaces should be removed.
c) The spigot should be marked with a pencil line and a distance equivalent to the socket depth. Clean the surface within the marked area.
d) Apply a uniform coat of solvent cement on the external surface to the pipe and a lighter coat on the internal surface of the fitting.
e) Insert the pipe end into the socket of the fitting and push it in up to the mark.
f) Remove the excess solvent cement and hold the joint firmly in position as per solvent manufacturer's recommendation.
g) Every joint shall be made air-tight and water-tight.
h) The method of jointing shall be by rubber rings and all the external pipe jointing and in stacks shall be by this method. The material of rubber ring should conform to IS 5382. The

ring is housed in groove formed in a plastic housing. The rubber is compressed and makes a seal between the pipe and housing. Lubricating paste should be applied before compressing the rubber. Where natural rubber rings areused, mineral oil or petrol or grease should be used.

Internal toilet and kitchen pipe work

a) All waste pipes of 40mm-160mm diameter shall be of 6 Kg/cm2 or 10kg/cm2 classification.
b) All such pipes shall be supported and clamped as per the table below.

Maximum support distance in meters						
Size in mm	**40**	**50**	**75**	**90**	**110**	**160**
Horizontal	0.4	0.5	0.75	0.9	1.1	1.6
Vertical	1.2	1.5	2.0	2.0	2.0	2.0

All waste pipes being connected to a floor trap shall be connected only through an inlet receiving cap, with an inlet connection joint of appropriate diameter, capable of being pasted to the floor trap providing for a leak proof joint.

c) The inlet receiving pipes shall extend to the toilet finished floor where its joints with the floor shall be sealed with Silicone Sealant.
d) All pipes being used on exposed surface shall be UV protected with a UV inhibitor built in during extrusion.
e) WC Pan Connectors shall be as to suit the requirement with 110mm dia, vent horn for connection to the anti-siphonage pipe with pan connector of PVC.
f) Connection of the branch pipes to main or other branch pipes shall be so arranged as to prevent cross flow from one appliance to another.
g) Connection to the sewage or storm water collection sumps to be perfectly watertight and as specified in the drawing.
h) The floor traps for toilets shall be moulded PVC or fabricated from UPVC 6kg/cm2 pipes with or without an inlet receiving cap. The traps shall have a minimum water seal of 50mm (deep seal).
i) The pipes shall be laid to a slope of minimum 1 in 75 and connected to the stack.
j) Sufficient access shall be provided to enable all pipe work to be cleared and tested. Access openings of adequate size shall be provided on the vertical stack directly opposite a branch line, at the junction of a subsidiary branch and at bends.
k) All bends and junctions of the soil and waste fittings shall be provided with access doors, fitted with washers and gun metal set screws, provided on the heel or the front of the

fitting.

l) Bends shall be of a long radius of two 45° short radius bends, and these shall be separated by a 300 mm straight length of pipe.
m) Use reducers or increasers when changing pipe sizes.
n) All soil, waste and vent pipes shall normally be placed in ducts or brick encasement with means of access at each floor level for branch connections.
o) The main vent stacks shall be extended through the roof to the required height, with the open end protected by means of an UPVC vent cowl or to have air vent with diaphragm.
p) Open ends of all piping shall be covered with wood or metal plugs or caps during construction, to prevent foreign matter falling in.
q) The top of every discharge stack shall be at the same height as the parapet on the roof.
r) The top of every discharge stack shall be provided with UPVC cowl for UPVC stack. The cowls shall be installed at the height above the parapet on the roof.

Floor Waste:

a) All floor traps, outlets gratings and gully traps shall be suitably protected from the ingress of cement grout and foreign objects during construction stage which will choke up the traps. All traps must be cleaned before fixing or grating covers.
b) All wastes or floor trap shall have a minimum of 50 mm water-seal.
c) Grating covers shall be of stainless-steel type (with perforated holes) as indicated in drawings.
d) All wastes, floor traps and gulley traps shall come complete with cockroach/insect trap.

Testing of pipes:

Water tightness of Joints – Water test.

a) Hydraulic performance discharge test shall be made from all appliances, single and collectively.
b) Obstruction in any of the pipelines shall be traced and the whole system examined for proper hydraulic performance, including the retention of an adequate water seal in trap.
c) Any defect revealed by the test shall be made good and the tests repeated until a satisfactory result in obtained.

The assembly of pipes and fittings shall be tested for water tightness in a apparatus which consist of two end sealing devices for the open ends

	of the fittings, one end connected to a hydraulic pressure source shall be capable of allowing the system to bled and the other end blanked. Assemble the fittings with the sealing devices, fill with water ensuring all air is removed. Apply a pressure of 0.5 MPa for a period of 15 minutes and there should be no leakage at any joint.
Item 19.18.1 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	In addition to item 19.18.1, the following size to be considered in sewage chambers**.** **Brick Masonry (Inspection Chamber)** The size/dimensions of the Inspection Chambers shall be as specified in the drawings. All other details are to be as per clause 19.18.1.
Item 19.3.1.1, (vi) of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Item 19.3.1.1, (vi) to be read as: Size and shape and performance requirement of manhole covers and frames shall conform to IS 1726 and following sizes to be added: 300 mm X 300 mm 600 mm X 600 mm 900mm X 800 mm

5.7.8. Internal Water Supply System

Modifications to the Standard Specifications are as follows:

Item no.	**Particulars**
Item 18.3.9 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Item 18.3.9 to be read as 18.3.9; (E) - CPVC pipes – IS 15778. Details pertaining to CPVC pipes are to be considered for all internal piping works.
Item 18.40 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Add new item no. 18.40 as follows: **18.40 Glass fiber reinforced polyester resin (FRP/GRP) water storage tanks** **General item description:** The requirements for the panels of glass fiber reinforced polyester resin (GRP) tanks are meant for storing potable water under pressure not exceeding the static head corresponding to the depth of the tank and temperature of water not exceeding 50°C.

	GRP panels used in manufacturing tanks are hot compression moulded, using sheet moulding compound (SMC). **SMC**: A hot compression mouldable moulding compound based on polyester, fiberglass, fillers, high temperature catalysts, etc, pre-thickened chemically to a non-tacky sheet form. Panels for the water tanks are of GRP composite produced by hot compression moulding of SMC into specified dimensions. These panels are of different types based on the purpose where it is used i.e., Side panels, bottom panels, Half, and quarter panels, Drain panel assembly and Manhole panels. These water storage tanks shall confirm to IS:14399 (Parts 1 and 2). **Materials:** The material to be used shall be composed of unsaturated thermosetting polyester resin reinforced with glass fiber. Glass fiber reinforcement shall be of commercial grade E type and shall conform to IS-11273: 1992, IS-11320: 1985 or IS-11551: 1986 as appropriate. **Dimensions:** **Panels:** The panels shall be manufactured with a combined double flange at an angle of 45° and 90° to face of the panels on all four sides or a single flange at an angle of 90° to the face of the panels on each of the 2, 3 or 4 sides. The flange shall be provided with holes to accommodate fasteners according to the position of the panels in the tank and they should be free from irregularities. The joint width (land width) of the flanges shall not be less than 45 mm (see Fig. 1). The nominal external size of the unit panels shall be 1 meter square or 1 m x 0.5 m or 0.5 m x 0.5 m or any other size as agreed to between the purchaser and the manufacturer. Tolerance in the external dimensions of each panel shall be within ± 0.2 percent of the external dimensions. Tolerance on the angles shall be within ± 0.3°.

	Tanks: The length and breadth of water tanks shall be specified as multiples of 0.5 m or 1 m. Depth of water tanks shall be in multiples of 0.5 m Subject to maximum of 3 m. **Leakage Test:** After assembling, the tank shall be fined with water up to the overflow level and after 48 h there shall be no visible sign of leakage.
Item 18.41 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Add new item no. 18.41 as follows: **Sink Cock** The chrome plated brass Sink cock shall be of chromium plated copper alloy and external and internal surface shall be clean, smooth and free from sand. The 15 mm nominal bore shall be designated which are normally fitted to the sink counter. Each chrome plated brass sink cock shall be legibly marked with the manufacture's name and trademark. The rate shall include the cost of material and labor involved in fixing the same.
Item 18.42 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Add new item no. 18.42 as follows: **Commercial Water Dispenser** Drinking water dispensers shall be Touchless Water Coolers for high water consumption areas like industrial canteens, factories, offices, and restaurants. Along with fast cooling capabilities, these water coolers give you big storage capacity as well. Equipped with robust motion sensors these water coolers provide cool water automatically on placing a cup, bottle or container below the faucet. With their touchless operation, they minimize the risk of viral transmissions which is of the highest priority for all of us. Some of the key specifications and details are as follows: 1.Sensor-based touchless water dispensing 2.IP67 rated sensor protects against dust and water 3. Food grade stainless steel body and tank 4. Sturdy compressor for trouble-free operation 5. Rugged anti-corrosive plastic legs 6. Tropicalized for harsh Indian weather conditions Number Of Taps 4 Body Material Stainless Steel

Item 18.43 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Add new item no. 18.43 as follows: **Air Release valve** An air release valve has a small venting orifice that releases air entrained in water under pressure. The air release valve is normally open and closes as soon as liquid rises in the system and lifts a float within the valve. Depending on the application, it should be mounted at high points in the piping system. Air valves can open against internal pressure because the internal lever mechanism multiplies the float force to be greater than the internal pressure. This greater force opens the orifice whenever air pockets collect in the valve. The orifice size varies between 1/16" and 3/8" depending on valve design and working pressure. The air release valve is 25mm screwed inlet forged brass single ball type & shall be fixed on all high points in the system (water supply pipe) with ball valves. Air release valves shall be confirmed to IS:14845. **Nominal Pressures**: Air valves shall be designated by nominal pressure (PN) defined as maximum permissible gauge working pressure In MPa as follows: PN 1.0 and PN 1.6.

5.7.9. Preferred Makes

The MOC of various equipment and supplies in respect of imported/indigenous equipment/components/materials are listed out in this document. It is essential that the equipment/component/materials to be supplied from imported/indigenous sources by the Contractor will be of any one of the makes listed against that equipment/ component/material in these documents

In case the Contractor/ Contractor intends to substitute any make of equipment / components/ materials by a make other than that listed in this document, the Contractor shall follow the procedure for additional makes clearance.

PLUMBING MATERIAL LIST		
Sl. No.	**Item description**	**Make**
1	Sanitary ware	1.TOTO 2.Hindware 3. Jaquar

2	Toilet Accessories	1.TOTO 2.Hindware 3. Jaquar
3	UPVC pipes	1.Ashirvad 2.Supreme 3. Prince
4	CPVC	1.Ashirvad 2. Supreme
5	Pipe supports	1. Hi-tech supports 2. Easy flex
6	Kitchen Sink	1.Nirali 2. Thermoset
7	Commercial water dispenser	1.Blue star 2. Voltas
8	Ball Valve	1.Zoloto 2. SANT
9	Butterfly valve	1.Zoloto 2. SANT
10	Gate valves/non-return valves	1.Zoloto 2.SANT
11	Air release valve	1.Zoloto 2.MAFCO
12	Pressure Gauge & Pressure switch	1.H-Guru
13	Floor Drain Fixture	ACO Neer
14	Urinal Trap	Chilly Neer
15	Brackets	Mupro
16	Panel tanks	Sintex Rostfrei Steels Eratoz

17	PVC Water tanks	Sintex Plasto

5.8. Building HVAC Works

5.8.1. Overview

The overall scope of works withing project shall be as mentioned in clause 2.2 above. This section provides further information about contractor scope of works specific to HVAC SYSTEM for building works within landside facilities. This section shall be read in conjunction with other sections of tender documents i.e. tender drawing, tender BOQ and CPWD general specifications

5.8.2. Special Specifications for HVAC Works

<table>
<tr><th>Item no.</th><th>Particulars</th></tr>
<tr><td>Chapter1 [General]</td><td>In item no 1.2 [Conformity with Statutory Acts, Rules, Standards and Codes], add new subclause “(v)” with following new text after the end of subclause (iv):

“Following codes and standards are used in the development of basis of design:

<table>
<tr><th colspan="2">Design Condition</th></tr>
<tr><td>ISHRAE Position Paper on Indoor Environmental Quality</td><td>August 2015</td></tr>
<tr><td>Indoor Environmental Quality Standard ISHRAE Standard-10001: 2019</td><td>2019</td></tr>
<tr><td>Code of Practice for Industrial Ventilation</td><td>IS:3103</td></tr>
<tr><td>ISHRAE HVAC Handbook</td><td>2014</td></tr>
<tr><td>ASHRAE Standards</td><td>2019</td></tr>
<tr><td>National Building Code of India</td><td>NBC-2016</td></tr>
<tr><td>National Fire Protection Association Code _92</td><td>NFPA 92 _2015</td></tr>
</table>
</td></tr>
</table>

Indoor Air Quality as per ASHRAE 62.1	2007
SMACNA Standards	2005
Fire Damper, CBRI approved	UL555
Energy standard for buildings except low rise residential buildings	ANSI/ ASHRAE/ IESNA standard 90.1-2009
AMCA: Air Movement and Control Association	-
NEMA standards	-
Air Conditioning Equipment	
Packaged Air Conditioners – Specification (First Revision)	IS 8148: 2003
Room Air Conditioners – Specification Part 2 Split Air Conditioners (Second Revision)	IS 1391 (Part 2): 1992 (Reaffirmed 1999)
Testing of Refrigerant Compressors (First Revision)	IS 5111: 1993 (Reaffirmed 1999)
Packaged Air Conditioners	IS8148
Requirements for Refrigerants Condensing Units	IS11327
Safety standard for refrigeration systems	ANSI/ASHRAE Standard 15-2010
Designation and safety classification of refrigerants	ANSI/ASHRAE Standard 34-2010
Fans	
Electric Axial Flow Fans	IS3588
Specifications for Centrifugal Fans	IS4894
Ductworks	

	<table><tr><td>Air Ducts – Specification (second revision)</td><td>IS 655: 2006</td></tr><tr><td>Sheet Metal and Air Conditioning Contractors' National Association</td><td>SMACNA</td></tr><tr><td>Safety Code for Air Conditioning (Revised)</td><td>IS 659-1964 (Reaffirmed 2012)</td></tr><tr><td>Galvanised steel sheets</td><td>as per IS 277</td></tr><tr><td colspan="2">Noise</td></tr><tr><td>(NANMN/02/2015-16) Status of Ambient Noise level in India & Status of Ambient Noise level in India - 2015</td><td>Central pollution control board reports</td></tr><tr><td>Noise Pollution (Regulation and Control) Rules, 2000</td><td>-</td></tr><tr><td>Code of Practice for noise reduction in industrial buildings</td><td>IS3483</td></tr><tr><td colspan="2">Special Provisions</td></tr><tr><td>ISHRAE COVID-19 Guidance Document for Air Conditioning and Ventilation</td><td>2020</td></tr></table> Revisions or alterations to the above standards and regulations that are published during the installation of the work shall be brought to the attention of the Engineer/Employer. The appropriate instructions may then be issued. Contractor to follow above codes and standards as a guideline for residual working design.”
Chapter 2 [System and System Requirements]	In item no 2.9.2.1 [Ventilation Requirement for various areas in various buildings:], values stipulated in table shall be considered as per the latest NBC 2016 codes.

Chapter 2 [System and System Requirements]	In item no. 2.9.2.2 delete the following text: "CMM required for ventilation system is thus calculated Based on the volume of the room and from the above table as- $CMM = \frac{\text{(no. of air changes/ hour) X (volume in cu. m of space to be ventilated)}}{60}$ " and replace with following new texts: "Ventilation /Exhaust system shall be designed based on the equipment heat loads and other loads or number of air change per hours as per NBC /ASHRAE/ ISHRAE standards whichever is higher. 10% extra shall be taken on the calculated value and accordingly, the capacity of ventilation/exhaust equipment shall be determined. For large areas/rooms, there shall be provision of fresh air supply system. Fresh air fan supply capacity shall be 50% of total capacity of exhaust fan capacity whereas remaining 50% fresh air supply can be maintained by opening windows inside the premises. Contractor to follow above criteria for residual working design."
Chapter 2 [System and System Requirements]	In item no 2.9.2 [Design Considerations], add new clause "2.9.2.7" with following text after the clause of"2.9.2.6": "Noise level: For internal and external noise criteria (specific to limiting parameters for noise) shall be checked and followed the rules and regulations of Central Pollution Control Board (CPCB). The internal noise level inside the respective premises shall maintain by proposing suitable sound reducing devices/equipment like sound attenuator or acoustic insulations etc. Contractor to follow above consideration for residual working design."

Chapter 2 [System and System Requirements]	In Chapter 2 [System and System Requirements], add new clause "2.12 [General design criteria for all HVAC equipment]" with following new text after the clause of "2.11": "General design criteria for all HVAC equipment A) Green building criteria: For Green Building approach, HVAC system shall be designed for lower emissions and higher efficiency by maintaining the interior conditions at a comfortable level. • Fan capacities shall be reduced, and energy saved by using variable speed drives to control their speed. Reductions in both peak and off-peak energy costs shall be obtained by using variable speed drives on fans that operate at varying loads. • The CO2 Sensors shall be installed in the occupied areas to ensure proper Indoor Air Quality. The fresh air flow & CO2 level information is fed to Building Automation System (BAS) to trigger corrective action, if applicable. • Adopting Lower Power Density (LPD) for lighting as compared to the recommendation from ECBC & ASHRAE standard. • Energy efficient motor (IE-3) shall be selected. • Refrigerant shall be of CFC free in refrigeration and air-conditioning equipment and applications. Refer recommendation of ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers) Guideline to reduce emissions of CFC refrigerants. B) All HVAC equipment shall be suitable for marine corrosive atmosphere. Following life factors shall be taken care while designing the system: • The site locality. • Salt laden marine atmosphere. • High humidity conditions during prolonged periods.

	• Location of respective building, i.e., terminal building, substation, UG tank locations. • Corrosion resistance specification shall provide at least 15 years of product life. C) Special provisions: All HVAC systems shall be designed with the consideration of COVID-19 guidelines given by ISHRAE standards. Contractor to follow above consideration for residual working design."
Chapter 2 [System and System Requirements]	In Chapter 2 [System and System Requirements], add new clause "2.13 [General Description of HVAC System]" with following new text after the clause of "2.12": "Proposed HVAC system: Toilets, feeding rooms, shops, cloak room, stores etc. shall be provided with exhaust fans. The toilet area shall consist of Exhaust fan with ducting or exhaust fan (as shown in tender drawing), Sound attenuator (if required), bird screen /louver arrangement, cowl. For natural ventilations, openable windows shall be used. Electrical room/ pump room/substation, storeroom, feeding area, shops, UG Tank room shall be mechanically ventilated by provision of exhaust fans. The proposed system shall consist of Exhaust fan, Sound attenuator (if required), bird screen /louver arrangement, cowl, weatherproof canopy (if required). Enclosed waiting areas shall be mechanically ventilated by provision of exhaust fans & fresh air fans with air distribution system (refer tender drawings). The exhaust fan assembly shall be consisting of exhaust fan, Sound attenuator (if required), bird screen /louver arrangement, cowl, weatherproof canopy along with ductworks. The fresh air fan assembly shall be consisting of fresh air fan, 10-micron pre-filter, Sound attenuator (if required), bird screen /louver arrangement, cowl, weatherproof canopy along with ductworks.

<table>
<tr><td></td><td>Office areas, ticket counters, first aid room, restaurant, security room, police office, communication room (if any) shall be air conditioned by Split air conditioning system. The proposed system shall consist of outdoor units for split unit, indoor units, grilles/diffusers, panel, wiring, control wiring and earthing.

Natural ventilation will be there inside the premises (which are proposed with exhaust system) through louvers, openable windows etc.

Ceiling fans shall be provided to all areas including air conditioned & forced ventilated areas.”</td></tr>
<tr><td>Chapter 2 [System and System Requirements]</td><td>In item no 2.1.2 [Design Parameters], add new clause “2.1.2.7” with following new text after the clause of “2.1.2.6”:

“Design conditions:

Based on weather data published by ISHRAE-2014 Standards, the outdoor design conditions for various seasons for different stations/regions of Assam state are as follow (reference only):

<table>
<tr><th rowspan="3">Sr. No.</th><th rowspan="3">Stations/ Regions/ City</th><th colspan="9">Outside design data (as per ISHRAE standards)</th></tr>
<tr><th colspan="3">SUMMER</th><th colspan="3">MONSOON</th><th colspan="3">WINTER</th></tr>
<tr><th>DB (deg. F)</th><th>WB (deg. F)</th><th>RH (%)</th><th>DB (deg. F)</th><th>WB (deg. F)</th><th>RH (%)</th><th>DB (deg. F)</th><th>WB (deg. F)</th><th>RH (%)</th></tr>
<tr><td>1</td><td>Guwahati</td><td>90</td><td>78</td><td>59</td><td>82</td><td>78</td><td>84</td><td>52</td><td>51</td><td>95</td></tr>
<tr><td>2</td><td>Dibrugarh</td><td>90</td><td>78</td><td>59</td><td>82</td><td>78</td><td>84</td><td>52</td><td>51</td><td>95</td></tr>
</table>

Indoor Design Conditions (for Air conditioning area):</td></tr>
</table>

	A) For Neamati site outdoor design condition: The outdoor design conditions (as stated above) of Dibrugarh (which is nearer site to Neamati site), shall be considered for equipment design or load calculations for air conditioning areas. B) For Aphalamukh site outdoor design condition: The outdoor design conditions (as stated above) of Dibrugarh (which is nearer site to Aphalamukh site), shall be considered for equipment design or load calculations for air conditioning areas."
Chapter 2 [System and System Requirements]	In item no 2.4 [Split Type A.C.], add new clause as "General system description" with following new texts: "All units shall be suitable for operation with 415 V + 10%, 50 Hz + 3%, 3 Phase supply for outdoor units & 220 V + 10%, 50 Hz + 3%, 1 Phase supply for indoor units. The AC units shall have BEE Energy Efficiency rating of 5 stars with inverter technology. These shall have standard components such as air-cooled condensers, refrigerant compressors, interconnecting refrigerant piping, condensate drain connections, thermostat etc., to make the system complete & give trouble free and satisfactory operation. The units shall also be provided with handheld remote control, air swing, filter, deodorizing filter, anti-fungi or Bacteria fill, Ionization, Auto restart, Timer etc. Eco friendly refrigerant shall be used –R134A or R410A or R-32 for this system. Each split type of air conditioner shall have one outdoor unit and one indoor unit. The indoor unit shall be of Wall

	Mounted type. The outdoor units shall be installed on the wall/floor. The drain from the indoor units is to be inter-connected & properly led to the nearest drain point."
Chapter 4 [Package Type Air Conditioning Plants and Variable Refrigerant Flow Volume System]	Delete the Chapter 4 [Package Type Air Conditioning Plants and Variable Refrigerant Flow Volume System] in its entirety.
Chapter 5 [Central Air Conditioning Plant]	Delete the Chapter 5 [Central Air Conditioning Plant] in its entirety.
Chapter 7 [Cooling Towers]	Delete the Chapter 7 [Cooling Towers] in its entirety.
Chapter 15 [Mechanical Ventilation System and ETAC Plants]	In Item no. 15.1 [Scope], add following new texts: "The Ventilation System shall be envisaged to remove excess heat from the premises by maintaining the rooms at a temperature not exceeding 4°C over and above the prevailing ambient temperature. The Fresh air /Exhaust system shall be provided with fans of appropriate capacity, Sound attenuators (if required) along with weatherproof arrangement i.e., with bird screen, canopy, and louvers. Filters (as per COVID-19 guidelines) shall be proposed for fresh air fan system. All louvers shall be designed for zero rainwater ingress in the building."
Chapter 15 [Mechanical Ventilation System and ETAC Plants]	In Item no.15.2 [Centrifugal Fans], add new clause "(ix)" with following text after the clause of "(viii)": "(ix) Centrifugal fan/Axial Fan shall be able to withstand a temperature up to 250°C for 120 minutes in case of fire. Fan motor shall be VSD, flame proof squirrel cage, Screen Protected Drip Proof, suitable for 415 +/- 5% volts, 50 Hz, 3 phase power supply. Motor nameplate horsepower will be more than brake horsepower by a minimum of 10%. Motor speed will not exceed 1450 RPM. In normal condition, exhaust fans (Centrifugal/Axial) shall be used for air extraction from given premises (waiting rooms) and during fire event, same fans

<table>
<tr><td></td><td>(Centrifugal/Axial) proposed in waiting room areas shall be used for smoke extraction.

During fire event, fresh air fan system shall be closed. HVAC system shall be interconnected with Fire detection system.”</td></tr>
<tr><td>Chapter 15 [Mechanical Ventilation System and ETAC Plants]</td><td>In item no. 15.3 [Axial Flow Fans], add new subclause “(vi), (vii) & (viii) “with following new text after the end of subclause (v):

“vi) Fresh air fan assembly (axial fan) shall be provided with prefilter with 10 microns of 50 mm thickness including channels in Al frame for ease of removal and renewal of filter cells. The filters shall be designed at 2.5m/s to give 90% efficiency down to 10 microns.

vii) Axial fan shall be suitable for smoke application i.e., 250 deg. C for 2 hrs.

viii) Fan assembly shall be provided with cowl piece, louvers, and bird screen.”</td></tr>
<tr><td>Chapter 15 [Mechanical Ventilation System and ETAC Plants]</td><td>In item no. 15.11 [Painting], add following new text:

“Equipment Painting shall be suitable for corrosive atmosphere.”</td></tr>
<tr><td>Chapter 16 [Cold Rooms]</td><td>Delete the Chapter 16 [Cold Rooms] in its entirety.</td></tr>
<tr><td>Appendix F [Proforma for Schedule of Technical Particulars]</td><td>In Appendix F [Proforma for Schedule of Technical Particulars], add following new clause “(M) Ventilation Fans (Exhaust Fresh Air System) & (N) Split AC Units” after the clause of “(L)” with following new text:

“(M) Ventilation Fans (Exhaust Fresh Air System)

<table>
<tr><td>Sr. No.</td><td></td></tr>
<tr><td>Application - Exhaust /Fresh air system</td><td></td></tr>
<tr><td>Manufacturer</td><td></td></tr>
<tr><td>Application area/served area of fans</td><td></td></tr>
<tr><td>Air Volume (CFM)</td><td></td></tr>
<tr><td>St. Pr. (Pa)</td><td></td></tr>
<tr><td>Unit Qty. (Nos.)</td><td></td></tr>
<tr><td>Fan certification (AMCA)</td><td></td></tr>
</table>
</td></tr>
</table>

Fan Type (Centrifugal / Axial / Inline / Propeller)	
Fan Model	
Outlet Vel. (m/s)	
Abs. Power (Bkw)	
Total fan Eff. (%)	
Noise Level dB(A) @ 1m	
Noise Level dB(A) @ 3m	
Fan RPM (1440 OR 950)	
Motor (IE3)	KW
	Pole (4 /6)
	Phase
	Type of motor - VSD
	Insulation
Fan assembly weight (kg)	
Fan material	
Fan accessories like belt guard, belt sheaves, flexible connection	
Framework painting	
fan coating paint	
Vibration mount -spring type /cushy foot type	Min Deflection
Sound attenuator/ acoustic insulation (if required- if FAN noise level above acceptable limit)	
Fan assembly provided with cowl piece, bird screen & louver	
Fan prefilter -(10 micron) for fresh air assembly	
Air distribution accessories like VCD /FIRE DAMPER	
Overall dimensions of fan assembly (mm)	

(N) Split AC Units

Sr. No.	
Manufacturer/ Make	
Application area/served area of Split AC unit	
Indoor unit (IDU)	
Model No.	
Cooling capacity	

TR	
Kw	
Power Supply	
Air Flow (CFM) HIGH / MEDIUM / LOW	
Sound Level (dBA)	
Fan Motor Input Power (Watt)	
Fan Motor Rated Current (Amp)	
Refrigerant pipe Connections (mm)	
Liquid (Inch)	
Gas (Inch)	
Type of Connection	
Drain Pipe Dia. (mm)	
IDU Dimensions (mm)	
Grill Dimension (mm)	
Net Weight (kg) Indoor Unit	
Net Weight (kg) Grill	
Outdoor Unit (ODU)	
Model No.	
Capacity	
HP	
TR	
Kw	
Btu / hr	
Operating Ambient Temp Range	
Power Supply	
Refrigerant	
Ref. Pre-charge Quantity (kg)	
Overall Dimensions (mm)	
Net weight (Kg)	
Sound Level (dBA) Noise Level mentioned in TDS is at 1 meter Distance.	
Compressor Type	
No of Compressor	
Air Cooled Condenser	
Type	
Fan type	
No of Fans	
Air Quantity (cfm)	
Motor Type	
Motor Quantity	
Power Supply Controller type	

<table>
<tr>
<td>Appendices</td>
<td>Add new “Appendix-O List of Preferred make” after the “Appendix-N”:

“Appendix-O List of Preferred Make

<table>
<tr><th>Sr. No.</th><th>Description</th><th>Make</th></tr>
<tr><td>1</td><td>EXHAUST/VENTILATION FANS /PROPELLER FANS</td><td>KRUGER/NICOTRA/ SYSTEMAIR/ CARYAIRE/AIRFLOW</td></tr>
<tr><td>2</td><td>SPLIT AC UNIT</td><td>CARRIER/TOSHIBA/ HITACHI/BLUE STAR/LG/DAIKIN /VOLTAS</td></tr>
<tr><td>3</td><td>FIRE DAMPER AND VOLUME CONTROL DAMPER</td><td>CARYAIRE/ SYSTEMAIR /AIRFLOW/GREENHECK</td></tr>
<tr><td>4</td><td>GRILLS/ DIFFUSERS/ FIRE DAMPERS/LOUVER</td><td>RAVISTAR/ DYNACRAFT/COSMOS/ AIRFLOW/CARYAIRE/ AIRMASTER/SYSTEM AIR/RUSKIN TITUS/ SOUTHERN COUGEN/ AQUAFLEX</td></tr>
<tr><td>5</td><td>DUCT INSULATION</td><td>ARMACELL/K FLEX/ SUPREME</td></tr>
<tr><td>6</td><td>MOTORS</td><td>ABB/CROMPTON/ SIEMENS/HAVELLS</td></tr>
<tr><td>7</td><td>GI SHEETS</td><td>JINDAL, SAIL, TATA, ISPAT</td></tr>
<tr><td>8</td><td>ALUMINUM SHEET</td><td>BALCO/HINDALCO/ JINDAL</td></tr>
<tr><td>9</td><td>CONTROL VALVE</td><td>HONEYWELL/JOHNSON CONTROLS/SIEMENS</td></tr>
<tr><td>10</td><td>FABRICATED DUCT</td><td>ROLASTAR/CAMDUCT/ ZECO/VEDHA ENTECH</td></tr>
</table>
.”</td>
</tr>
</table>

5.8.3. Inspection, Testing and Dispatch

HVAC equipment shall be subjected to inspection at manufacturer’s works in the presence of Employer/Engineer. Contractor to read clause in conjunction with Chapter 17 (Inspection, Testing and Commissioning) of CPWD general specification HVAC works.

During inspection following routine tests shall be carried out:

- Visual inspection for workmanship and verification with respect to specifications.
- Performance testing at Factory.
- Functional test for control circuits.
- Tightness of screwed/bolted Connections, Mechanical operation of valves etc.

The Contractor shall supply to the Employer, 3 sets of the certificates of internal routine tests.

5.8.4. Drawings and Documents

The Contractor shall supply to the Employer, 3 sets of following deliverables:

A) Drawings

- GA Drawings, Engineering Drawings (For approval, Approved, as built, as installed)
- Electrical Circuit Diagrams
- System schematics

B) Manuals and Procedures

- Operation and Maintenance manuals
- Specialized procedures, if applicable (such as Calibration, Cleaning, etc.)
- Specifications and sources of some important materials, if applicable (such as lubricants, cleaning agents, etc.)

C) Lists

- Equipment and Instrument list with component descriptions
- Electrical component parts list with descriptions, if applicable
- Spare parts list with appropriate identification nos., if any
- Change parts list with appropriate identification nos., if any

D) Factory Acceptance Test Certificates

- Detailed list of modifications after contract &/or in final approved design
- Material specifications and test certificates, if applicable.
- Instrument Calibration certificates.
- Functional/ Factory acceptance certificates (such as weld inspection, passivation, pressure/ vacuum holds, etc.).
- Warranty certificates.

E) Site Acceptance Test

- Installation and commissioning report.
- Site performance test

5.8.5. Packing

Equipment shall be dispatched to site packed in full wooden case (Seaworthy). It shall be wrapped in polythene sheets before putting in cases and it shall be ensured that damage to the equipment does not occur during handling/transportation. Lifting hooks shall be provided for unloading at site.

5.8.6. Spares

Commissioning Spares

The Contractor shall include in the quoted price enough quantities of commissioning spares required for erection and commissioning of the equipment. These shall include such items as Bolts and other miscellaneous parts.

Essential Spares

The Contractor shall supply separate spare's part list along with prices required for two years trouble free operation and maintenance.

Residual Works

The Contractor shall complete the following and all necessary residual works to execute the project following the Employer provided design.

HVAC (Internal)	
Air Conditioning & Ventilation system for Terminal Building	a) Verify and update final engineering calculations including cooling load calculations for all zones, pressure drop calculations and control system of air conditioning & ventilation system
	b) Preparations of final shop drawings for air conditioning & ventilation systems, P&ID, GA drawings of equipment, Equipment disposition layout drawings.
	c) Preparation of Civil foundation drawings of equipment along with supporting details (see also structural clauses)
	d) Preparation of Technical data sheet for HVAC equipment and its electrical & instrumentation items
	e) Preparation of QAP and carry out Factory Inspection accordingly.
	f) Procurement, Installation, testing, commissioning of HVAC equipment at site with Performance Guarantee as per Tender Specifications
	g) Handing over of operational spares, O & M spares, manuals, first-fill-in refrigerant, preparation of as-built documentation, etc.,

Air Conditioning & Ventilation system for Substation Building	Complete working design & calculations, GFC Layouts, Shop drawings & data sheets as per tender design requirement & specs, equipment requirements, design requirements and Specifications. Contractor to refer clause 5.8 in its entirety while designing his residual working design scope.
Air Conditioning & Ventilation system for UG tank	Complete working design & calculations, GFC Layouts, Shop drawings & data sheets as per tender design requirement & specs, equipment requirements, design requirements and Specifications. Contractor to refer clause 5.8 in its entirety while designing his residual working design scope.

5.9. Building Electrical Works

5.9.1. Overview

5.9.1.1. Special Specifications Structure

This Specification shall be read in conjunction with the associated Standard Technical Specifications and all other documents referenced and/or included in the Contract.

5.9.1.2. Compliance with Specifications

All equipment accessories & services offered under the package shall conform to "Technical Specifications" elaborated in detail in subsequent chapters.

The design, manufacture, erection, and installation (including safety, earthing and other essential provisions) of equipment and accessories covered under this specification shall, in general comply with the latest Issue of applicable standards and Codes of Practices published by Bureau of Indian Standards, Indian Electricity Act, Indian Electricity Rules.

It is the responsibility of the Contractor to see that the electrical installation supplied and erected by him shall be to the entire satisfaction of Employer and are in conformity with direction and guidelines including modifications suggested during inspection by Chief Electrical Inspector Central Electricity Authority / any other statutory body having jurisdiction in the area at all times.

5.9.1.3. Makes and Interchangeability

The make of major equipment shall be limited to that indicated in the "List of Recommended Makes for Electrical Equipment". Makes of Equipment and accessories, which are not figuring in the "List of Recommended Makes for Electrical Equipment" shall be subject to prior approval by Employer.

Similar parts of all switches, lamp holders, distribution fuse boards, switchgears, ceiling roses, brackets, pendants, fans, and all other fittings of the same type shall be interchangeable in each installation.

5.9.1.4. Safety

All equipment shall be complete with approved safety devices and with provision for safe access of personnel to and around the equipment for operation and maintenance.

When the work is carried out at night or in the obscure daylight, adequate flood lighting in the working area shall be made available by Contractor at his own cost and got approved by the Employer.

The safety posters/regulation for prevention of accidents shall be displayed by the Contractor at appropriate places. Notices and warning signs shall be displayed for all sources of dangers.

All safety measures as required to be adopted as per the statutory regulations and the safety rules of the plant shall be strictly followed by the Contractor during the execution of the Contract. Adequate number of first aid boxes shall be provided and maintained at work site.

5.9.1.5. Datasheets

Contractor shall submit all equipment and materials data sheet for engineers or consultant approval.

5.9.1.6. Drawings

The contract drawings shall serve as guidelines for general layout of the piping and various items of equipment.

The Contractor shall prepare detail drawing along with section, schedule, reports and calculation and submit for approval, detailed good for construction drawings of all items, setting drawings, clearance drawings, etc.

It shall be the Contractor's responsibility to see that all deviations from drawings and specifications, shall be specifically noted on the drawings and brought to the attention of the Engineers, otherwise approval shall be automatically voided.

5.9.1.7. Product Validity

Any product shall not be procured and installed after discontinuation date of the product, the successor product of the discontinued product shall be provided at no extra cost or at the same as the discontinued product. The letter of discontinuation shall be provided from manufacturer mentioning discontinuation and termination date.

If at latter stage after the installation it is found out that product is installed after discontinuation date, then the Contractor shall dismantle and install new product at no additional cost, including all accessories and terminations as required, and damaged accessories and cables associated or connected to the product.

5.9.1.8. Conflicts and Deviations

Any inconsistency, conflict or disagreement between the requirements specified in this Standard Technical Specifications and the Special Technical Specifications or defined elsewhere in Contract, shall be brought to the attention of the Engineer in writing by the Contractor.

The Contractor shall be responsible to assist the Engineer in resolving any conflicts such that the work shall be completed in a timely manner as per schedule, minimizing interfaces and impact on cost and schedule.

5.9.2. Electrical Power Distribution and Wiring System

5.9.2.1. Introduction

The design and construction of the electrical installations shall be such as to facilitate and, so far as is reasonably practicable, to always ensure the safety of personnel and plant, particularly:

- in construction of the installations and associated plant.
- in testing and commissioning of the installations and associated plant.
- in operation and use of the installations and associated plant.
- in maintenance and repair of the installations and associated plant.
- in eventual dismantling of the installations and associated plant at the end of its useful life.

Facilities shall be incorporated in the detailing of the electrical installations to enable appropriate parts of the installations to be made safe, preferably by all conductors.

Power Supply Distribution system for the buildings include internal electrification, power & control cabling / wiring, distribution boards, internal Illumination associated with earthing and lightning protection system.

Major equipment for Electrics is furnished below:

- Power shall be sourced through cable from nearest Tap – off point.
- Low voltage distribution panel - Main Distribution Boards for each building shall provide power supply to different distribution boards/equipment's, etc.
  - LDB (Lighting Distribution Board) catering to lighting loads
  - PDB (Power Distribution Board) catering to small power sockets
  - Lift Distribution board
  - HVAC DB (HVAC System Distribution Board) catering to HVAC units and exhaust fans
  - Ventilation Unit
  - Other required utility
- Independent UPS System with inbuilt battery backup shall be provided to each workstation.

- LED luminaires, Modular Switch-Socket considered.
- Extra low voltage system such as Data and Telephone.
- Provision of Wi-Fi point made at different intervals.
- Cable Tray layout and conduit considered for low voltage cables.
- Security and Communication system considered.

5.9.2.2. Design Parameters

Sr. No.	Description	Parameters
1.	Design Ambient temperature	45° C
2.	Power supply voltage	415V, 3 Phase, 50 Hz 240V AC Control supply
3.	System earthing: a) At 415V level	Effectively earthed

5.9.2.3. Short Circuit Current Ratings

All short circuit, calculation for arriving at the time constant to justify breaker selection in accordance with IEC-56 shall be furnished.

5.9.2.4. Continuous Current Rating

The continuous current rating of the switchgear buses, and their incomer breaker shall be the maximum load on the bus due to all the working consumers plus 20% margin rounded to next higher standard rating.

The continuous current rating of the Incoming & Outgoing feeders shall be based on the name plate current rating of the connected equipment with 20% margin.

5.9.3. Low Voltage Switchgear

Section 3. 18 “General CPWD Specification Part-I Internal Electrical Works 2013” shall be replaced with below special specifications.

5.9.3.1. Scope

This Section covers the detailed requirements of Low Voltage Switchgear Panel for 415 V, 3 phase 50 Hz 4 wire system. All switchgears shall be fully rated at an ambient of 45° C.

These Specifications are applicable for LV Panel as specified in SLD.

Each switchboard shall be provided with 100% rated incoming. The breakers selected for incoming & outgoing feeders shall be rated 1.25 times the continuous current it is required to carry.

5.9.3.2. General

This section follows the guidance in IEC 61439 and provides essential information to enable to provide fit for purpose equipment in accordance with IEC 61439, IEC 61641 and defines the Employer's additional requirements.

The switchboard shall be floor mounted free standing totally enclosed and extensible type. The switch board shall be dust & vermin proof and shall be suitable for the climate conditions as specified. The design shall include all provisions for safety of operation and maintenance personnel.

5.9.3.3. Applicable Codes and Standards

IEC 60947, IEC 61439	Specification for components of Low Voltage Switchgear & Control gear (all parts)

5.9.3.4. Constructional Features

The switchboard shall be in metal enclosed, fixed/draw out type, multi-tier, compartmentalized, type tested design and shall be fabricated from sheet steel with 2 mm thickness for load bearing members and 1.6 mm thickness for non-load bearing members. The enclosure class shall be IP 54 or better.

The form of construction shall be 3B as IEC standard. LV Panel shall be tested in accordance with design verification parameters of IEC 61439.

Enclosure shall be fabricated out of CRCA Sheet steel. Doors shall be provided with stiffeners concealed hinges and captive screws along with base channel of minimum size ISMC 75 for fixing on the inserts on the floor.

The 415 V switchboard shall comprise of Moulded case circuit breaker (MCCB) at the incoming feeder and TPN Moulded case circuit breakers (MCCB) for outgoing feeders as indicated in respective Single Line Diagrams. MCCBs with shunt trip releases shall be provided.

Designation plate for switchboard & Inscription plates for each module of Black PVC/ lamicoid sheet with white engraved letters showing feeder designation / description / rating shall be provided ON, OFF indication shall be through LED type indication lamps. gland plates of 2 mm thick to be provided as per requirement.

5.9.3.5. Busbar

Bus bars shall be suitable for 3 phase, 4wire system. Bus bar material shall be of high conductivity Electrolytic grade Aluminium (as specified in respective SLD) conforming to Indian Standards.

Temperature rise, under continuous loading condition ambient temperature of min 45° C . Power bus bar joints shall be bolted type with spring washers. Bolts and washers shall be

cadmium plated. Bus bars shall be insulated by color-coded Heat Shrinkable PVC sleeves. Taping is not permitted.

Earth bus shall run throughout the length of switchboard at bottom and for each vertical section.

Bus bar configuration shall be red-yellow-blue (from left to right, front to back and top to bottom as viewed from front) for 3 phase AC power supply. Removal of bus bars shall be possible without disconnecting external cables. Bus bar support insulators of non-hygroscopic cast resin material having high impact and dielectric strength with an anti-tracking contour.

Three phase and neutral main busbars shall be provided in a separate compartment as per standard. Vertical busbars shall be provided for the outgoing feeders, and they shall be in a separate compartment.

5.9.3.6. Cable Terminations

The power connections shall be through XLPE cables as indicated in the SLD. Sufficient space for connection for these cables shall be provided at the rear of the switch gears. Suitable barrier shall be provided to avoid accidental contact in the cable compartment while carrying out inspection by opening the rear cover.

Cable entry position shall generally be from top indoor type panels for unless otherwise specified.

Power cable termination arrangement shall be suitable for specified cable type and conductor size. Each section shall be equipped with a metal gland plate at the cable entrances of the section, to accommodate cable glands.

Non-magnetic gland-plate shall be provided for single-core cable terminations. Terminal blocks shall be arranged and positioned to provide ready access for carrying out external cable termination, testing, inspection, and maintenance.

5.9.3.7. Surface Treatment and Painting Requirement

All metal sheets shall undergo tank metal treatment, thorough de rusting-rinsing-degreasing-rinsing phosphating-rinsing and then Passivation. All metal surfaces shall be thoroughly cleaned and degreased to remove all scales, rust, grease, and dirt. Fabricated structures shall be pickled and treated to remove any trace of acid. The under surface shall be made free from all imperfections before undertaking powder coating. The panel shall be powder coated.

The Vendor shall be at least applying the following finishes at the equipment:

- Clean surfaces before applying paint.
- Apply corrosion-resisting primer to surfaces.
- Apply finish coat of baked enamel paint to 0.5 mm thick.
- Finish Color: Colors shall be Vendor’s standard shall be specified.

All galvanizing shall be carried out by the hot dip process in accordance with specialization ISO 1460.

The weight of zinc deposited shall be in accordance with BS 729 and shall not be less than 0.61kg/m^2 with a minimum thickness of 86 microns for items of thickness more than 5mm, 0.46kg/m^2 (64 microns) for items of thickness between 2 mm and 5 mm and 0.33kg/036 (47 microns) for items less than 2 mm thick.

All damages to painting during transport ad installation shall be set rights to the satisfaction of the Engineer in Charge before handing over. All structure framework for support of various items of equipment shall be given the final coat of approved shade at site after erection is complete.

5.9.3.8. Specifications of Major Components

5.9.3.8.1. MCCB

Moulded Case Circuit Breaker (MCCBs) shall have uninterrupted duty, withdrawable and utilization category-A per IEC 60947-2.

MCCB's as part of motor starter module shall be encapsulated double break roto mechanism & current limiting type and type tested for type-2 coordination as per IEC 60947 and shall comply with the environmental directives like RoHS and WEEE.

MCCB shall be fully rated as per above mentioned ambient temperature. MCCBs shall be provided with motorized closing mechanism to make them suitable for remote closing operation.

'ON' and 'OFF' position of the operating handle of MCCB shall be displayed and the operating rotary handle shall be mounted on the door of the compartment housing MCCB.

5.9.3.8.2. MCB

Unless specified, MCB rating as per details (Single, Double or Triple Pole) given in single line diagram and minimum short circuit rating of MCBs shall be minimum 10 kA and shall correspond to the short- circuit rating of the connected bus or to the let-through energy of the protective device upstream of the MCB.

MCB shall be suitable for mounting on rails. MCB terminals shall have minimum IP20 protection from human contact. MCB shall be provided with in built features of fault indication with R, Y, B.

ON, OFF and TRIP positions of the MCCB/MCB shall be clearly indicated and visible to the operator after installation and in service. Front-of-board operating access shall be provided for MCCB.

MCBs shall conform to IEC 60898.

MCB shall be with tripping characteristic C for general circuits and for control transformer protection or for power outlets it shall be with tripping characteristics of ‘C’ curve. MCB shall be provided with in built features of fault indication with R, Y, B.

5.9.3.8.3. Magnetic Contactors (wherever required)

- Shall be capable of interrupting ten times the rated current for sizes up to 100A and eight times the rated current for larger sizes.
- Suitable to carry the prospective short circuit without damage or injurious heating till the protective device operates.
- Insulation for coils shall be class ‘E’ or better.
- Shall pick up Positively between 85%-110% of rated control voltage.
- Drop out shall be not more than 70% of rated value.
- Minimum 2NO + 2NC auxiliary contacts with minimum rating of 10A, 415V for rated duty AC-11.
- Contactor duty shall be AC-3A.

5.9.3.8.4. Current Transformers

Current transformers shall comply with IEC 61869.

5.9.3.8.5. Selector Switches

All switches shall be located at a convenient operating height and so constructed, mounted and wired to facilitate the maintenance of contacts without the need to disconnect wiring. Switches shall have locks incorporated in the design. Control switches must be lockable in the inactive or neutral position and selector switches in all positions

Selector switches shall have spade type handles. Where key operated switches are incorporated these shall be operated by inserting and turning the key to the required position. The key shall be removable in the 'off' position only.

5.9.3.8.6. Push Button

Push Button shall be stay-put & lockable type, red coloured mushroom head with cover. Release of the emergency 'stop' control should not cause re-energization of equipment concerned.

5.9.3.8.7. Metering

Metering equipment shall be provided within the electrical equipment for the display and recording of essential electrical parameters. Class of accuracy of all meters shall be as per IEC standards. Metering shall be Digital, and Microprocessor based.

5.9.3.8.8. Indications Lamps

Indicating lamps shall be cluster LED type with low power consumption conforming to IEC60947-5-1, class 2. All lamps operating at the same voltage shall be interchangeable. It

shall be possible to replace the lamps from the front without dismantling the lamp holder. All lamps shall be protected by MCB.

5.9.3.8.9. Small Wirings

All small wiring for controls, indications, etc. shall be suitable to FRLS copper conductor cables. Wiring shall be suitably protected within switchboard. Runs of wires shall be neatly bunched, suitable supported and clamped. Means shall be provided for easy identifications of the wires.

5.9.3.9. Test at Manufacturers Work

Vendor shall allow for Factory Acceptance Test to be witnessed at Vendor's work factory by the Engineer, Employer and Contractor (all necessary arrangements bound by vendor.)

Inspection and tests shall be carried out on the complete equipment's and associated components.

Vendor shall provide at least of one (1) months' notice of inspection and test dates.
Vendor shall submit a detailed test program for approval by the Engineer at least one (1) month prior to FAT.

Methods of testing and inspection shall be in accordance with the requirements of the applicable codes and standards.

5.9.3.10. Testing And Commissioning

Switchgear assemblies shall undergo routine testing in accordance with IEC 61439-1, Clause11 at the Vendors works.

Design verification is intended to verify compliance of the design of an equipment with the requirements of IEC standards.
The Vendor shall provide certificate of Quality Management System for manufacture and operate in accordance with ISO 9001 standards.

5.9.3.11. Rating Plates, Nameplates and Labels

Rating plate shall contain all information in line with clause 6.1 of IEC 61439-1.

5.9.3.12. Documentation

The SI system of units shall be used. English language shall be used for all drawings, texts and communications.

In General, the Vendor shall submit the following information:

- Indicate outline dimensions, Enclosure construction, shipping splits, lifting and supporting points, electrical single line diagram and equipment electrical ratings.
- Product data: Datasheet for components and accessories.

- Test Report: Indicate procedures and results for specified factory and field testing and inspection

The Vendor shall submit for each supplied equipment (and components) the following documentation, but not limited to:

1. General Arrangement drawings with typical sections and elevations.
2. Foundation Plan
3. Front and Side Panel Layouts.
4. Weight and lifting.
5. Single Line Diagrams
6. Schematic Diagrams,
7. Wiring diagram
8. Control diagram
9. Logic diagram
10. Component List (or Bill of Materials)
11. Equipment's and Components Datasheets
12. Test Reports
13. Quality Assurance Books (or Vendor Data Book)
14. Maintenance Manual
15. Installation/Erection field handling procedures
16. Detailed maintenance schedule
17. Programming Manual (where applicable)
18. List of special tools or equipment
19. Manufacture authorization form/certificates for brought out sub-components/parts.
20. Operation Spare Parts List for 2 years

5.9.4. Distribution Boards

5.9.4.1. General

These boards are meant for use in buildings. These boards shall be readymade, or factory built standard boards / fabricated at factory based on specification and approved drawing.

5.9.4.2. Technical Requirements

5.9.4.2.1. Distribution Board Constructional Features:

The distribution boards (DB) shall be wall / recess mounted type made of minimum 1.6 mm thick sheet steel totally enclosed, dust and vermin proof construction having separate chambers for incoming, sub incomers and outgoing feeders.

The DB shall conform to IP: 42 class of protection.

The DB shall be fabricated using high quality CRCA sheet steel.

Suitable neoprene gaskets shall be provided for all doors and covers for making the board dust proof. The incomer chamber and outgoing shall be as detailed in SLD and shall be suitably mounted on DIN Rail / channel

All DBs shall have double door system. The outside(front) door shall be hinged door. The inside door shall be fixed / bolted type. The operating knobs of then MCB/MCCBs shall be accessible only after opening its front door

The Incoming, sub incoming and outgoing MCCBs/MCB's shall be housed in a separate chamber, Bus bars shall be of Tinned copper bus of suitable rating as per approved drawings/ specification. Bus bars shall be shrouded and phase neutral and Busbars shall have the same cross sections up to 100 A rating

The board shall have knockout holes / undrilled gland plates at top and bottom for cable entries. The board shall be factory built and shall be pre-wired internally with FRLS wires/cables.

Coloured/colour identified flame retardant terminal blocks shall be provided for easy identification of R, Y, B phases & Neutral.

All the incoming and outgoing feeders shall have specially designed termination arrangements to accommodate multiple cables or higher size cables required as per schedule of items / approved drawings.

Safety clearances as per IE rules shall be provided for various components in the Board. Board shall have continuous earth bus of size same as that of neutral Link between neutral and earth shall be provided

For details of MCCB's, MCB's, RCBOs refer to the specifications given elsewhere. Necessary Mounting Bracket / fixing accessories shall be provided All live parts shall be shrouded with 3mm thick FRP / Hylum sheets. Distribution boards shall be provided with two separate earth terminals on either side of the board. An earth busbar of appropriate cross section shall be provided inside the lighting board and brought out to the earth terminals. Adequate number of holes/terminals shall be provided on earth bus with suitable provision for terminating the earth wire.

- Din Channel for Mounting MCBs
- Copper Bus bar
- Earthing Terminals
- Wiring from MCBs to phase terminal block
- Interconnection between terminal block/incoming switch/bus bar/neutral terminal block/earth terminal

Nomenclature & Numbering for Lighting Distribution Boards and Sub Lighting Distribution Boards shall be as per approved drawings.

5.9.4.3. Major Components

5.9.4.3.1. Miniature Circuit Breaker (MCB)

Unless specified, MCB rating as per details (Single, Double or Triple Pole) given in single line diagram and minimum short circuit rating of MCBs shall be minimum 10 kA and shall correspond to the short- circuit rating of the connected bus or to the let-through energy of the protective device upstream of the MCB.

MCB shall be suitable for mounting on rails. MCB terminals shall have minimum IP20 protection from human contact. MCB shall be provided with in built features of fault indication with R, Y, B.

ON, OFF and TRIP positions of the MCCB/MCB shall be clearly indicated and visible to the operator after installation and in service. Front-of-board operating access shall be provided for MCCB.

MCBs shall conform to IEC 60898.

MCB shall be with tripping characteristic C for general circuits and for control transformer protection or for power outlets it shall be with tripping characteristics of 'C' curve.

MCB shall be provided with in built features of fault indication with R, Y, B.

5.9.4.3.2. Residual current circuit breaker (RCBO)

RCBOs shall have electrically operated with short circuit, overload, and earth leakage protection. The earth leakage sensitivity range shall be 30 mA – 100 mA. Rated short circuit breaking capacity shall be 10 kA. RCBOs shall be DP or 4P as per approved SLD.

5.9.5. Power Cables

5.9.5.1. General

Power cables shall be sized/selected based on the following requirements:

- Power cables shall carry the full load current of the circuit/equipment continuously under site conditions.
- Continuous current carrying capacity arrived at after applying de-rating factors for grouping, ambient air temperature/soil temperature/ soil thermal resistivity, duty factor etc. as per manufactures recommendations.

The cables shall be suitable for use where combination of ambient temperature and temperature rise due to load, results in conductor temperature not exceeding 90° C (For Power Cables) and 70° C (For Control cables) under normal operation. The cables shall be capable of continuous operation at their rated currents.

Unless otherwise specified, Cables sizes up to and including 25 sq.mm shall be copper conductor only. Cable sizes from 35 sq.mm shall be Copper/ Aluminium conductor Copper cables shall be used for all relevant applications.

Voltage dip at motor terminals during starting of motors will be limited to the following values:

- For all motors– 15% of the rated voltage.
- Voltage drop in feeder cables shall be limited to 3% during full load running condition

5.9.5.2. Applicable Codes & Standards:

Following list of applicable standards and codes are given for reference purpose only. The list, in no way, shall be construed as full and confined. In case, Indian Standards are not issued in respect of the equipment, IEC and other equivalent international standards, CEA, shall be followed. The equipment shall also conform to the IE Rules and other statutory regulations in force, in the country.

IS 7098	Cross linked polyethylene insulated PVC sheathed cables-part-1
IS 10418	Drums for electric cables
IS 3975	Mild steel wires, formed wires and tapes for armouring of Cables
IS 10810	Method of tests for cables
IS 5831	PVC insulation and sheath of electrical cables
IS 8130	Conductors for insulated electric cables and flexible cords
IS 2629	Recommended practice for hot dip galvanized of iron and steel
IS 4759	Specifications for Hot dipped galvanized coatings on round steel wires
IEC 60502	Power Cables with extruded insulation and their accessories for rated voltages from 1 kV up to 36 kV.
IEC 60228	Conductors of insulated cables

5.9.5.3. Technical Requirements:

LV Power Cable shall be 1100 V grade, FRLS, XLPE insulated single / multi-core, heavy duty, stranded Aluminium/Copper conductor cables with following features.

All control wires shall be 650 V grade copper conductor Halogen free fire retardant or FRLS PVC insulated, conforming to IS 1554-Part I. The minimum size of the control wires shall be 1.5 sq. mm.

5.9.5.4. Conductor

All conductors shall be Tinned stranded copper conductor for low voltage cables and stranded aluminium conductor for medium voltage cables.

The conductor shall be clean, uniform in size, shape and quality, smooth and free from scale, splits, sharp edges and other harmful defects. The conductor shall be in accordance with IEC 60228. The conductor shall be filled with swelling powder to stop axial ingress of moisture.

Cable conductor construction and number of cable conductors for multi-core power cables shall be as per cable schedule.

Cables shall be manufactured with circular conductors; any deviation from this to shaped conductors is not acceptable without prior approval by authority.

- Multi-core LV cables shall be 3 Core, or 4 Core as applicable to the specific requirement

If required by the engineer's separate earth conductor shall be reduced half size where applicable to the specific requirement.

5.9.5.5. Insulation

The insulation shall be cross-linked polyethylene (XLPE) conforming to the requirements of IEC 60840. The insulation shall be applied by extrusion and cross-linked to form a compact and homogeneous layer. The colour of the insulation shall be such that it is easily distinguishable from the screening materials.

5.9.5.6. Metallic Sheath

Cables of the mineral-insulated, metal-insulated, metal-sheathed type shall not be used.

5.9.5.7. Over Sheath

There shall be an extruded over sheath of suitable material for intended service conditions.

The cable shall be embossed with the following information throughout the length of the over sheath.

The outer sheath of each cable shall be marked with the following minimum information along the cable length at 1 metre intervals:

- Manufacturer's name
- Voltage rating (Specified Voltage)
- Core / Pair numbering
- Cable type and size
- Year of manufacture
- Type of insulation

5.9.5.8. Outer Sheath Colour Coding

The outer sheath colour coding of cables shall generally be:

- Low Voltage Power cables – Grey
- Earth cables- Green / Yellow

5.9.5.9. Cable Core Colour Coding

The power cable core colour coding shall generally be:

- 3 core, Brown, Black and Grey
- 4 core, Brown, Black, Grey and Blue
- Earth core, Green / Yellow

5.9.5.10. 415V Multi-Core Power Cable

The following specification shall apply as a minimum requirement:

- Cable construction standard – IEC 60502-1
- Flame retardant cable as per IEC standard
- Voltage rating 1.1kV Low Voltage
- Number of cores – 3, 3.5 or 4
- Core- Uniquely identified by colour and/or number
- Conductors - Stranded high conductivity copper to IEC 60228
- Conductor Temperature 85° C.
- Insulation - cross-linked polyethylene (XLPE)
- Fillers - Non-hygroscopic polypropylene fillers
- Wrapping - Binder tape
- Armoured Cable
- XLPE Insulated Cable
- Resistant to water ingress in both radial and axial direction
- Resistant to sunlight
- Inner sheath: based on Polyolefin compound
- Overall outer sheath – PVC (Type 2)
- Screen: shall be tinned copper wire braiding (min. Density 90%)

5.9.5.11. End Terminations

The terminations for the cables shall be of an appropriate heat shrink design incorporating a suitable arrangement for stress control, and rain sheds for outdoor use.

Termination kits shall include suitable heat shrink tubing to effectively shroud, seal and insulate the exposed cable conductor and shall include a heat shrink glove to effectively seal the crutch of the cable to prevent ingress of moisture into the interstices of the cable. Suitable arrangements shall be provided to earth the cable screens and armour,

Terminations into cable boxes shall include brass double compression glands and back nuts of the correct size, which shall secure the cable outer sheath and ensure effective continuity between the cable armouring wires and the metal enclosures on which the cables are

terminated. At all rising terminations, the cable inner sheath shall pass through the gland to terminate not less than 6 mm above the gland.

5.9.5.12. Low Voltage Cable Glands

Cable glands shall provide minimum degree of ingress protection of IP 66 according to IEC 60529. Cable glands shall be certified for hazardous area classification and non-hazardous installations as applicable.

All glands shall have ISO threads to IEC 60423. The following materials shall be considered acceptable for glands:

Brass double compression glands shall be installed in all non-hazardous area and flame proof glands to be used in hazardous area; The exposed part of gland shall be nickel plated brass; Stainless steel glands shall be used in highly corrosive areas only.

Earth Tags to be supplied with all glands; Nylon sealing washers; Heavy duty locknuts are preferred.

Cable glands shall be selected based on the following wherever they are applicable:

- Cable glands for use with non-armoured cables in hazardous/ or safe areas shall have a cable retention seal and outer deluge seal.
- Universal Cable glands for use with armoured or wire braid cables in hazardous or safe areas, Glands shall have armour clamping, with an inner seal and outer deluge seal.
- Cable glands shall be tested in accordance with all relevant sections of IEC 60079.

5.9.5.13. Sealing And Drumming

The cable shall be wound on strong metallic drums arranged to take a round spindle of a section adequate to support the loaded cable drum during installation and handling. The drums shall be lagged with closely fitting battens that shall be securely fixed to prevent damage to the cable. Each drum shall be clearly marked including arrow indication of direction of rolling with following information.

- Drum number
- Requisition number and project name
- Rated voltage
- Cable type
- Number and cross section of cores / pairs
- Size of cable
- Length of cable on the drum (in metres)
- Overall weight of cable and drum (in kilograms)
- Manufacturer's name
- Company name
- Address and the contact number
- Reference IEC Standard number
- Year of manufacture

The actual length of cable shall not be less than the length indicated on the drum.

Drum lengths shall be continuous. Cable or conductor jointing in any form shall not be acceptable. The ends of the cables shall be suitable sealed to prevent ingress of moisture. The end of the cable left projecting from the drum shall be securely protected against damage by mishandling during transport and storage.

5.9.6. Cable Carrier System (Cable Tray)

The cable carrier system shall be designed considering the following:

- Facility for easy laying of cables
- Access to maintenance
- Neat and aesthetic appearance
- Safety of equipment & personnel
- Ground water seepage

Detailed cable routing diagram, cable tray layouts, cable schedules, interconnection schedules for all cables being supplied under this contract shall be prepared. It is anticipated that a few cables-supplied outside this contract would be required to be routed in the cable carrier system being provided under this contract and the details of the same would be made available during working designs to facilitate integrated cable layout/routing drawing considering the cable being installed by others.

The cable trays for energy block building shall be of GRP/FRP type only. For all other areas it shall be GI/GRP/FRP type as per requirement and approved drawings.

5.9.6.1. Applicable Codes & Standards

The cable carrier system shall comply in all respects with the requirements of the codes and standards listed given for reference purpose only. The list, in no way, shall be construed as full and confined. In case, Indian Standards are not issued in respect of the equipment, IEC and other equivalent international standards, CEA, shall be followed. The equipment shall also conform to the IE Rules and other statutory regulations in force, in the country.

IEC 61537	Cable management - Cable tray systems and cable ladder systems
IS 1852	Rolling and cutting tolerances for hot rolled steel products
IS 2629	Recommended practice for hot-dip galvanizing of iron and steel
IS 6746	Unsaturated polyester resin systems – specification (For GRP /FRP cable tray)
UL94V1 ASTM E-84, Class A BS476 PART 7&6 CLASS-II, IS-6746, ASTMD635	Fire Retardant Features (For GRP /FRP cable tray)
IS: 1239	GI Pipes

5.9.6.2. Cable Trays

Cable trays of prefabricated ladder and perforated types and the associated accessories such as coupler plates, tees, elbows, etc., shall be fabricated from 14 gauge (2.0 mm thick) mild steel sheets. Cable tray covers shall be fabricated from 16-gauge (1.70 mm thick) MS sheets.

Cable trays, accessories and covers shall be hot dip galvanized to a minimum thickness of 75 microns.

The spacing of rungs for ladder type of trays shall be not more than 250 mm. Vertical raceways shall be formed by either structural members or slotted angles or by running the prefabricated trays vertically.

Cable tray supports shall be fabricated from standard steel structures of different sizes. The sizes selected shall be adequate for the weight of cables/trays encountered.

All cable trays shall be hot dip galvanized. Galvanization thickness shall comply with IS 2629.

The tray shall be suitable of withstanding a load of 70 kg at the centre and UDL of 70 kg with a support span of 3000 mm without exceeding the deflection limit.

The cable trays shall be in standard widths of 600/450/150 mm.

Each section of tray shall be complete with necessary connector plate and hardware.

Cable trays and the associated accessories including tray covers shall be prefabricated hot dip galvanized sheet steel. In general, the cable trays and accessories shall comply with the requirements specified in installation details. Cable trays shall be Perforated type & Ladder Type. The cable tray accessories shall include Covers, Vertical Elbows, Horizontal Bends, Adjustable Bends, Crosses, Tees and Reducers, coupler plates, fixing hardware etc. Accessories shall have minimum bending radius of 600 mm.

5.9.6.3.Cable Tray Supports

Cable tray supports shall be fabricated from standard steel structures of same material as that of the main cable trays. The sizes selected shall be adequate for the weight of cables/trays encountered.

Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware's such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

All cable tray supports, steel components, accessories, fittings, and hardware shall be hot dip galvanized /zinc passivated to prevent corrosion.

The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated & galvanized at factory.

The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support

the cable trays. Welding of the components shall be avoided to the extend possible. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.

5.9.6.4. Installation of Cables

Cables shall be laid in ground, trenches, cable trays and on walls as specified. Installation shall include all supports and clamps as required. The complete work shall be in accordance with CPWD general specifications for Electrical amended up to date. As far as possible cables shall not be fixed on walls directly but laid on cable trays.

Testing of the complete cable installation shall be as per clause 2.8.2 and 2.8.3 of CPWD general specifications for Electrical Works (External) amended up to date.

5.9.6.5. Cable Marker

Cable markers with cable details (core, size, voltage grade and runs etc.) shall be installed at the beginning and end of the cable run on the surface all along the route, at all changes of direction, and above all joints, above cable duct entries and exits and at an interval not exceeding 50 meters along the cable route. This information as well as details about the joint (i.e., joint location) will be also recorded on a map.

5.9.7. Illumination System

5.9.7.1. Applicable Codes & Standards

All parts issued against a standard/code shall be referred to wherever specific Part No is or not given. Equipment covered by this specification shall conform to the latest editions andrevisions of all relevant applicable codes, and standards in addition to the ones listed below:

IS 6665	Code of practice for Industrial Lighting.
IS 2206	Specification for Flame proof, electrical light fittings.
IS 3646	Code of practice for Interior Illumination
IS 10322-Part-5	Specification for LEDs

All the luminaries shall be designed, manufactured, and tested in accordance with relevant IS. All types of light fittings shall be supplied with lamps.

5.9.7.2. General

Lux Level shall be followed as per NBC or Indian standards.
Lux Levels:

Security check area	200
Waiting room	300
Ticket counter	300

Office	300
Police	200
Security	200
First aid	300
Shops	200
Restaurants	300
Cloakroom	200
Janitors store	150
Gents' toilet/ Ladies Toilet/ Toilet	100
Staircase	100
Feeding area	150
HWC	100
Platform, ramps	50
Substation and Utility Building	200

5.9.7.3.Light Fixtures, Lamps & Accessories:

Individual light fittings shall be provided with suitable arrangements for GI threaded conduit entry of 20 mm dia unless otherwise specified. Terminals of all fittings shall be suitable for taking 2.5 sq. mm flexible, copper conductor PVC insulated, FRLS-PVC sheathed cable.

Fittings shall be supplied with all inter – connections made and fully wired up to the terminal block and shall be suitable for mounting on wall / column / ceiling / suspension (from the ceiling including suitable bracket).

All live parts shall be provided with suitable sleeves to prevent accidental contacts. The Earthing terminal in the fitting shall effectively earth the body of the entire luminaries.

The clearance between the live parts and the enclosure Earthing and other safety factors shall be governed by the latest revisions of the relevant IS specification and IE rules.

The fixing arrangement of various components and lamps shall be in such a way that the maintenance and replacement jobs can be easily carried out.

The luminaries shall be suitably designed to provide economically the required level of illumination on the working plane when mounted at normal standard height in accordance with the type of fixtures.

The luminaries shall be suitable for operating at normal supply voltage of 240 V, single phase, 50 Hz with voltage variation of +/- 6% or at voltages as specified.

The lamp holders of the fittings shall be suitable to take the lamp supplied. The light fittings/fans shall include the mounting accessories like chain, down rods for fittings mounted in false ceilings anchor bolt and all erection accessories required for complete installation.

Anchor bolts shall be used for supporting the mounting brackets from the ceiling and grouting on wall / column shall be provided for mounting the fitting on wall /column in consultation with the site engineer.

GI/MS/PVC conduits shall be complete with all accessories as required. Due to the highly corrosive atmosphere the fittings shall be provided with two coats anti corrosive epoxy painting over two coats of primer. the maintenance and replacement jobs can be easily carried out. Dust and vapour tight fittings shall have the enclosures suitably designed to withstand the heating effect. All fittings shall be supplied with all interconnections made and fully wired up to the terminal block.

LED fittings shall be selected to provide correct colour appearance and rendering to enable workers to see & judge quickly and accurately, details of their work such as colour, brightness, shape form etc.

Power factor of all the light fittings shall be improved so that it is not less than 0.95. Power factor shall be improved by providing capacitor banks with discharge resistor in the light distribution or by providing capacitors with individual fittings.

LED Light fixture shall have following features: -

- Energy saving
- Long system Life
- Rugged and Durable
- Smaller lighting Fixture
- Environment friendly – no mercury
- Instant starting
- Dimmable for automation

Following important parameters be kept in view while deciding the suitable light

- source for indoor lighting: -
- CRI of the source.
- Usable lumen per watt of fitting shall be minimum 80 lumens/watt.
- Glaring index of fixture shall not be more than 19.
- Life of the lamp shall be of 50000 Burning Hours as per L70 criteria.
- LED Drivers of all Luminaries shall be multistage isolated Constant voltage constant current driver with driver efficiency > 85%, Current THD < 10%, power factor > 0.95 and shall operate in a voltage range of 100V AC to 290V AC without making any illumination fluctuations.
- Luminaire efficacy shall be higher than 100 lm/W.

Driver shall satisfy IS Standards for safety Low Extra Voltage (SELV) less than 60V DC. Driver shall have internal surge protector of 4 kV or greater to bypass surges from the supply.

LED Colour temperature shall be in range of 3000K to 6000K. LM80 report shall be submitted stating life of greater than 50000 burning hours for LED chips.

The cost of all types of light fitting shall include the necessary accessories required for mounting of the fittings.

The Floodlight LED luminaries shall be suitable for proper light distribution with suitable integral control gear as per requirements. Optics of LED luminaire shall be considered based on height of installation of luminaire and required uniformity in lighting level. The Floodlight luminaire shall be integral type luminaire with SMD based LED, specially designed Pressure Die Cast Aluminum Housing for better heat dissipation, Aluminium reflector for better light distribution, better optics, Integral driver and IP65 rated or higher for better protection against ingress of dust and water.

Luminaire shall be with mounting cradle with suitable bolts arrangement.

5.9.7.4. Recess/Surface Mounted Luminaire

LED Recess/Surface mounted Square, linear and Downlighter type fixture shall be suitable and provided in-line with the requirements of false ceiling Plan for the buildings. Fixture shall come with non-yellowing PMMA diffuser with high efficiency for better light output making no glare Suitable edge provisions shall be made on the recess mounting fittings such that it merges well with any false ceiling system and covers the cutout for mounting effectively. The fittings shall have arrangement for mounting by down rod min 1 m, chain, or wire rope. Surface mounted fixture shall be provided with suitable accessories for mounting the luminaire on the ceiling based on ceiling type.

5.9.7.5. Bulkhead Luminaire

Bulkhead fixture with better luminaire efficacy with powder coated aluminium die cast having higher protection from oxidation shall be provided. Luminaire shall have powder coated wire guard for protection from impact. Dome of the product shall be with EPDM gasket for IP65 protection, complete with LED driver, and accessories pre- wired up to terminal block. And product shall conform to IS standards IS 10322.

All types of bulkhead type fittings shall be supplied with suitable mounting accessories for mounting on wall and ceiling.

5.9.7.6. Aviation Obstruction Luminaire

Aviation obstruction lights shall consist of cast corrosion resistant aluminium body housing a step-up transformer complete with thick dome glass which shall be hinged to the body, with high intensity/ medium intensity/ low intensity LED aviation lamp based on ENGINEER/end EMPLOYER approval.

The fittings shall be prewired up to a terminal block housed in a terminal box shall be suitable for mounting on 25 mm GI pipe stem. The terminal box shall be provided with two entries drilled and tapped for 20 mm ET. A suitable compression gland for one entry and suitable plug made of non-corrosive material to block the other entry may be supplied. There shall be one earthing (non-ferrous) screw on both sides of the fitting.

5.9.7.7. Accessories LED Light Fittings

5.9.7.7.1. General

All the fixtures shall be supplied along with all the necessary accessories required for its efficient working whether specifically asked for or not. All the accessories shall be manufactured and tested as per the latest revision of the relevant IS.

5.9.7.7.2. LED Chips

- LED Efficacy > 100 lm/W
- CCT >5000K
- CRI >70
- Life > 50000 burning hours as per L70 criteria
- LED binning < SDCM 5
- LM80 certificate shall be submitted for all type of luminaires.

5.9.7.7.3. LED Driver

LED Driver shall be compatible with Indian power condition, where it shall be able to operate in fluctuating power supplies (140-270V) and providing adequate immunity to line transients like spikes and surges. Driver shall come with Mufti stage isolated driver that avoids interference between input and output, thereby protecting LEDs. Precision CCCV operation of LED that improves reliability shall be ensured. Driver shall be designed to comply with safety standards for reliable operation and long service life.

5.9.7.7.4. Thermal Management

LED luminaire shall come with better heat management facilities like heat fins for better heat dissipation from LED chips. Thermal management shall be to ensure that working temperature in luminaire does not go beyond specified levels to ensure a consistent light output. Light fittings shall have pressure Die Cast housing.

5.9.7.7.5. Optics

Well-designed optics used in the LED luminaires not only control the glare but also act as a right channel for a better distribution of light resulting in high optical efficiency Highefficiency diffusers with good transmissivity ensure uniform and soft distribution of light thathelp create well-lit and pleasant ambiences.

5.9.8. Ceiling Fan

Ceiling fans shall be four Blades type. The suspension down rod shall be of sturdy mild steel rod of adequate diameter and of minimum length of 300 mm with shake less suspension arrangement as per IS. Min 1250 mm Sweep Ceiling fan for every 15 Square meter areas shall be provided wherever required.

Energy Efficient fans with BEE 5-star rating or complying with IS 374: 1979, shall be used. The minimum service value of fans shall be 3.5 m^3/min/W and air delivery 200 m^3/min. The values of service factor and air delivery for ceiling fans with 1200 mm sweep are given in the table below:

Energy Efficient fans with BEE 3–5-star rating or complying with IS 374: 1979, shall be used. The minimum service value of fans shall be 3.5 m^3/min/W and air delivery 200 m^3/min.

- Step Type modular electronic regulators should be used instead of resistance type regulators for controlling speed of fans.
- All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended from hooks or shackles, with insulators between hooks and suspension rods min 1 meter.
- A hook consisting of MS rod of size not less than 1.5 cm dia shall be inserted between the MS flat through oval holes on their sides. Alternatively, the flats may be bent inwards to hold tightly between them by means of a bolt and nut, a hook of 'S' form.
- In the case of 'l' beams, flats shall be shaped suitably to catch the flanges and shall be held together by means of a long bolt and nut. For concrete roofs, a 12 mm dia. MS rod in the shape of 'LJ' with their vertical legs bent horizontally at the top at least 19 cm on either side and bound to the top reinforcement of the roof shall be used, as shown in Fig. 5.
- In buildings with concrete roofs having a low ceiling height, where the fan clamp mentioned under sub-clause (v) above cannot be used, or wherever specified, recessed type fan clamp inside metallic box shall be used.
- Canopies on top of suspension rod shall effectively hide the suspension.
- The leading in wire shall be of nominal cross-sectional area not less than 1.5 sq. mm. and shall be protected from abrasion.
- Unless otherwise specified, all ceiling fans shall be hung 2.75 m above the floor existing conduit.

5.9.9. Sockets Outlets

Refer to Section 3.11 “General CPWD Specification Part-I Internal Electrical Works 2013**”.**

5.9.10. Telephone and Data Outlet

a. RJ-45 LAN Sockets will be provided for Main Rooms like Ticket counter, Terminal Office room, Security Room, Storerooms & Shops etc.
b. WIFI points will be provided in Main Areas and common spaces, WIFI Point consist of 1 No’s RJ-45 Socket and 2 No’s 6/16A twin Sockets.
c. For Data Cat-6 Cable will be used for connection from Ethernet Switch to RJ-45 Points

d. RJ-11 Telephone Sockets will be used for Telephonic connections for Main Rooms like Ticket counter, Office room, Security Room, Police room & Shops etc.
e. Telephone System consist of Krone distribution Box using multipair telephone cables.

5.9.11. UPS System

Online UPS with half hour battery backup, modular and compact, Single Phase, In-Built Batteries+ provides Uninterrupted Pure Power for Critical Applications such as Computer System. Even in environments with the worse power supply, this UPS can provide maximum protection to computer workstations applications.

5.9.11.1. UPS Type

5.9.11.2. Input Feature

Voltage	:240 V
Frequency	: 45 to 60 Hz
Phase	:1 Ph
Connection	: IEC 320 C14
Ratings	:1000 Watts
Product Certifications BIS	

5.9.11.3. Output Feature

Output Connections	: IEC 60320 C14/13
Voltage	: 240 V
Frequency	: 45 to 60 Hz
Phase	: 1 Ph
Output Wattage	: min 600 W
Efficiency	: 98 %
Transfer Time	: 2 mS
In built battery	: Yes
Battery backup	: 30 min
Recharge	: Time less than or equal to 6 hours
Display	: LED Indication
Audible Noise	: Less than 40 dBA
Alarm	: Yes, with all faults and on /off status.

- System have Constant Overload Capacity with higher efficiency.
- LCD/LED Display LED status display with online: on battery: replace battery and building wiring fault
- High Frequency and Double Conversion Online Technology.
- Overload Protection alerts user and protects UPS from damage, Microprocessor Controlled design.
- UPS can automatically monitor public power voltage under by-pass circuit mode,
- Can be suitable to operate in Temperature up to 50° C.
- Specially designed to suit Indian Power and Environment Conditions.
- Automatic Voltage Regulator (AVR) with Wide Input Voltage Range

- Compatible with low power loads.

- Cold start capability allows the load to power on just on battery; Stays quiet during a changeover from mains to generator
- Battery Cell Composition Lead Acid
- Includes Rechargeable Battery Yes
- Alarm when on battery distinctive low battery alarm - overload continuous tone alarm
- Energy efficient product
- Curve fit to measured runtime data. All measurements taken with new, fully charged batteries, at typical environmental conditions, with no electrical input and balanced resistive load (PF = 1.0) output.

5.9.12. System of Distribution and Wiring

Refer to Section 3.2 "General CPWD Specification Part-I Internal Electrical Works 2013**".**

5.9.12.1. Wiring

Refer to Section 3.3 "General CPWD Specification Part-I Internal Electrical Works 2013**".**

5.9.12.2. Point Wiring

Refer to Section 3.4 "General CPWD Specification Part-I Internal Electrical Works 2013**".**

5.9.12.3. Wiring System

Refer to Section 3.5 "General CPWD Specification Part-I Internal Electrical Works 2013**".**

5.9.12.4. Run of Wiring

Refer to Section 3.6 "General CPWD Specification Part-I Internal Electrical Works 2013**".**

5.9.12.5. Passing Through Walls or Floor

Refer to Section 3.7 "General CPWD Specification Part-I Internal Electrical Works 2013**".**
Refer to Section 3.8 "General CPWD Specification Part-I Internal Electrical Works 2013**".**

5.9.12.6. Rating of Outlets

Refer to Section 3.9 "General CPWD Specification Part-I Internal Electrical Works 2013".

5.9.12.7. Capacity of Circuits

Refer to Section 3.10 "General CPWD Specification Part-I Internal Electrical Works 2013".

5.9.12.8. Flexible Cable

Refer to Section 3.13 "General CPWD Specification Part-I Internal Electrical Works 2013".

5.9.12.9. Wiring Accessories

Refer to Section 3.14 “General CPWD Specification Part-I Internal Electrical Works 2013”.

5.9.12.10. Attachment of Fittings and Accessories

Refer to Section 3.15 “General CPWD Specification Part-I Internal Electrical Works 2013”.

5.9.12.11. Fans, Regulators and Clamps

Refer to Section 3.16 “General CPWD Specification Part-I Internal Electrical Works 2013”.

5.9.12.12. Marking of Switchboards

Refer to Section 3.17 “General CPWD Specification Part-I Internal Electrical Works 2013”.

5.9.12.13. Conduit Works

Refer to Section 4 and Section 5 “General CPWD Specification Part-I Internal Electrical Works 2013”.

5.9.13. CAT 6 Cable

4 pairs, 100 ohms, shielded/ unshielded twisted pair (UTP), each pair separated by a PE former (Star shaped) solid 23 AWG tinned copper conductor rated for temperature of 75° C, PVC insulated grey colour with following types

The high-performance category 6 UTP cable shall be of the traditional round design with Mylar bisector tape. The 4 pair UTP cable shall be UL Type CM (non-plenum) Performance shall be characterized to 550 MHz to support high bandwidth video applications.

5.9.14. IDF Box

Manufactured by reputed manufacturer of specified capacity, facility for wall mounting, with door & lock, aluminium frame for fixing of KRONE, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour. Junction box: Manufactured by reputed manufacturer of specified capacity, facility for + wall mounting, with door & lock, aluminium frame for fixing of Krone, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour.

Rosette box: PVC I Bakelite box with LED indicator, RJ 11 jack, facility for fixing on wall. Jumper wire: Twin twisted PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia.

KRONE Module: Disconnection type KRONE module having capacity to connect 10 pairs with silver-plated terminal contacts.

5.9.15. Telephone Wire

All material shall conform to relevant standard as per BIS and shall carry ISI mark.

Work shall be carried out as per the Method of Construction specified by BIS and as specified by DOT (Department of Telephone), Govt. of India. Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

PVC insulated Tinned copper solid conductor with minimum 0.5 mm dia. (Single & Multi pair) properly paired and colour coded, shall be terminated on KRONE module with suitable tool.

5.9.16. Earthing System

Refer to Section 8 "General CPWD Specification Part-I Internal Electrical Works 2013**".**

5.9.17. Lightning Arrestor System

Refer to Section 9 "General CPWD Specification Part-I Internal Electrical Works 2013".

5.9.18. Substation and Utility Building

Contractor shall undertake working design of substation and other utility buildings as per CPWD and NBC guidelines.

Incoming supply for the substation and other utility buildings include internal electrification, power & control cabling & wiring, distribution boards, internal Illumination associated with earthing and lightning protection system.

Contractor shall undertake following minimum requirement

- For illumination system lux level shall be refereed from Nation building Code.
- Provision of Industrial socket and utility power socket shall be provided as per CPWD and NBC guidelines.

5.9.19. CCTV

CCTV system shall consist of 8 Channel DVR, PC, 1 TB hard disk, Software, etc.

5.9.19.1. DVR

DVR shall be1080P high resolution support & AHD, CVI, TVI, CVBS supports H.265 / H.264 high profile compression. Playback 16 channels simultaneously & DHCP, DDNS, IE browser and CMS supported. Pentaplex operation: live view, record, playback, backup and remote access. Video Output: HDMI, VGA, power supply unit etc.

5.9.19.2. Fixed Camera

2MP AHD CAMERA- CMOS progressive scan, Minimum illumination: 0 Lux (IR ON), TDN (IR-cut), AWB, AGC, 3.6mm Fixed Lens, IR Distance: Upto 20 Meters, Power: 12VDC, True

day night capability. Ensures sharp, accurate and high-resolution video quality. Made In India, Plastic Housing-White. 25 frames per second.

5.9.19.3. Monitoring System

Monitoring System shall consist of Windows PC, 2 No's 21-inch LED Monitors, Web based CCTv Software. Mouse, Keyboard, 1 TB hard disk.

5.9.19.4. CCTV Cabling

CCTV cabling shall be decided by the Contractor to connect all Cameras to the DVR and monitoring System.

5.9.20. Access Control System

Access Control system consist of Card reader and latching for doors, working design and details for the same shall be proposed by the contractor.

5.10. Site Development

5.10.1. Landscaping

Landscaping involves beautification of Terminal site by cultivating plants and trees of environmental value and suitably modifying the appearance of Terminal site. It shall add scenic value to the Terminal site to obtain maximum visual impact. Plantation and implementation of landscape designs at site and maintaining green belt along the periphery of the Terminal. Contractor has to propose landscaping plan from professional landscape architect which must be approved by Employer/Engineer-in-charge. Interlocking pavers shall be provided at the Terminal building to accommodate cars and two wheelers. All provisions shall be followed. They shall maintain the landscape throughout the period of the Contract. The contractor shall also sustain and maintain condition of landscape establishment.

5.10.2. Boundary Wall and Gate

Construction of boundary wall all along the periphery of the facility. Boundary wall shall be of average height 2.5 meters above maximum of finished ground of inside and outside the campus with fabricated MS angles 'Y' shaped and concertina barbed fencing of 0.60 meters on the top. Boundary wall will be provided with gates, gate lights complete in all respect. The structural design and drawing to be developed by the contractor as per CPWD norms and IS Codes. Boundary wall shall be made in RCC framed structure with brickwork in CM 1:4 and shall be plastered in CM 1:4. The top of wall shall be provided with 75 mm thick RCC coping. 50 mm thick DPC shall be provided at plinth level before starting the masonry work. Necessary expansion joints shall be provided as per the construction drawings provided by the contractor and approved by Engineer-in-charge. Outer face (i.e., rough side) of all brick walls shall have 18 mm thick and inner face (i.e., smooth side) of all walls shall have 12 mm thick cement sand plaster 1:6. Exterior masonry paint shall be of two coats of waterproof cement paint of approved manufacture and of approved colour to the plaster surfaces including scaffolding including primer coat. The paint shall be applied on a coat of primer over dried, prepared plastered surface as per manufacturer's guidelines. The final, finished coating shall be fungus

resistant, UV resistant, water repellent, alkali resistant, and extremely durable with colour fastness. The structural design of the boundary wall is in the scope of the contractor's work.

The section of the boundary wall & design of gates shall be got approved from the Engineer. All gates shall be of structural steel of minimum 4.0 m clear width or as per layout drawing for access roads. The height of gate shall be same as that of the boundary wall. Each gate shall have provision for wicket gate of minimum width 1.0 m. The gate frame and post shall be fabricated from medium class MS pipe of nominal diameter not less than 50 mm. The panel plate shall be of minimum thickness 2.5 mm conforming to IS:513. The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminium ball bearing arrangement, castor wheel, etc. Guard room shall be of RCC framed structure of adequate size with proper ventilation. Drawings DI1530-RHD-ZZ-AH-DR-M-1062 and DI1530-RHD-ZZ-NI-DR-M-1562 can be used for reference.

5.10.3. Roads and Pavements

The design shall be carried out by the contractor as per the reference drawings. Road layout plan and profile has to be designed by the contactor with approval of Engineer-in-charge. The design shall be as per MoRTH, IRC and all other relevant specifications. Drawings DI1530-RHD-ZZ-AH-DR-M-1063 and DI1530-RHD-ZZ-NI-DR-M-1563 can be used for reference.

5.11. External Wet Utilities

5.11.1. Overview

The scope of work comprises supply, installation, commissioning and testing of the water supply, sewerage, drainage and firefighting systems including, water and fire pumping systems, and sewage treatment systems. The scope of work shall include the following.

a) Water supply System till OHT and Pontoon
b) External drainage Sewage disposal
c) External drainage Storm water disposal
d) Fire Protection System
e) Water supply pumps & Electrical control panels and related electrical works

All workmanship shall conform to Indian Standard Codes of Practice. The fixing and finishing shall be neat, true to level, plumb and fire-fighting. Manufacturer's instructions shall be followed closely regarding installation and commissioning. All fixtures and fittings shall be protected throughout the progress of the work from damage. Special care shall be taken to prevent damage and scratching of fittings. Tool marks on exposed fixtures shall not be accepted. Protective paper on fixtures shall be removed with hot water only at the final completion of work.

5.11.2. Basis and Guidelines

All the water supply and sanitary works shall be carried out strictly as per specifications, ISI codes and CPWD specifications 2019 with amendments up-to date. The Plumbing, Drainage & Fire Protection System for the project is designed keeping in view the following:

a) Domestic water supply through transfer pump to fill the overhead tank System for making water available at different locations
b) Sewage and Sullage collection system based on IS:1742 and applicable standards for domestic drainage and connected to outfall into municipal system after treatment in a biodigester tank. Two pipe drainage systems shall be adopted as per NBC (Part-IX) Provision of grease trap/oil separator shall be made for kitchen waste before connection to municipal line
c) Storm / Rainwater drainage system from various levels of the building and disposal to the municipal storm water disposal
d) Firefighting system for the external complex comprising of Hydrant and is based on NBC-2016

5.11.3. Water Storage & Distribution System

5.11.3.1. Water Requirement

The water requirement for the project is proposed to be based on the provisions of NBC 2016. The estimated requirement of water per day for the Terminal based on the number of users. The requirement for firefighting water for the complex is based on the area of the terminal.

5.11.3.2. Source of Water

It is expected that the daily domestic water requirement for the Terminal shall be through municipal mains supply. In a scenario where municipal supply is not in place, the water must be sourced from borewell pump within the premises, until the municipal supply has been arranged. Any clearances required for borewell pumping shall also be applied for by the contractor. All suitable tests required for determining design of borewell shall be carried out by the contractor.

5.11.3.3. Water Storage

The static storage for Fire Protection is at present sized for 100KL. The total water storage in raw & domestic water tanks is of 75 KL capacity for Neamati terminal and 30 KL for Aphalamukh Terminal.

5.11.3.4. Appurtenant

Following components shall be included in the water supply system for efficient functioning:

a) Automatic air vent at each of the high point.
b) Drain valve at each of the low point.
c) Water Hammer Arrestors (as required).
d) Flow meter.
e) Pressure Gauge.
f) Anchor block / thrust block

5.11.3.5. Water Quality

The water is expected to be supplied by municipal mains. In a scenario where municipal main supply is not present, water will be sourced from borewell pump. The quality of the borewell water must be tested for potable water standards by the contractor, and suitable treatment must be provided before filling of overhead tanks.

5.11.3.6. Water Distribution

The water supply distribution will be through transfer pump for filling the overhead tanks. From overhead/ terrace tank the entire water distribution networking will be through gravity system.

5.11.3.7. Workmanship

The workmanship shall be best of its kind and shall conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the client Site Representative. All materials and/or Workmanship which in the opinion of the Employer/Engineer is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

5.11.3.8. Materials

All materials shall be best of their kind and shall conform to the latest Indian Standards. All materials shall be of approved quality as per samples and origins approved by the Employer/Engineer.

As and when required by the Employer/Engineer, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or unsound by the Employer/Engineer, the contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Employer/Engineer. To prove that the materials used are as specified the contractor shall furnish the Employer/Engineer with original vouchers on demand.

5.11.4. Water Supply System

Modifications to the Standard Specifications are as follows.

Item no.	**Particulars**
Item 18.3.9 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Item **18.3.9** to be read as Pipes and specials may be Galvanised steel – IS 1239 & IS 4736.

<table>
<tr><td></td><td>In choosing the material for piping and fittings, account shall be taken of the character of the water to be conveyed through it, the nature of the ground in which the pipes are to be laid and the relative economics.

Subsequently, Items 18.3.11, 18.6, 18.11 to be taken care of, in addition to all other relevant codes and standards. The nominal diameter shall be 50mm for external works/ as per drawing.</td></tr>
<tr><td>Item 18.3.11.7 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)</td><td>In addition to item 18.9.11, add item 18.9.12 to 18.9.13 as follows:

18.9.12 Pipe Hangers and Brackets for suspended pipes

Sturdy hangers, brackets and caddies shall be installed to support all pipe lengths which are not embedded over their entire runs. The hangers and brackets shall be fabricated from suitable MS rolled sections. The hangers and brackets shall be of adjustable I heights and painted with red oxide primer and one coat of oil paint of approved colour. Clamps, coils and saddles to hold pipes shall be provided with suitable gaskets. The brackets and hangers shall be of design as approved by the Engineer.

18.9.13 Trenches

The pipes and fittings where specified shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes shall be as in Table below: -

<table>
<tr><th>DIA OF PIPE</th><th>WIDTH OF TRENCH</th><th>DEPTH OF TRENCH</th></tr>
<tr><td>15mm to 50mm</td><td>30cm</td><td>60cm</td></tr>
<tr><td>65mm to 100mm</td><td>45cm</td><td>75cm</td></tr>
</table>

At joints the trench width shall be widened where necessary. The work of excavation refilling shall be done true to line and gradient in accordance with general specifications earth work in trenches.

When excavation is done in rock the bottom shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.</td></tr>
</table>

	18.9.13.1 Trench Filling The pipes shall be laid on a layer of 7.5cm sand and filled up to 15cm above the pipes. The remaining portion of the trench shall then be filled with excavated earth as specified and directed and the surplus earth shall be disposed of as directed.
Items 18.2.16, 18.2.23 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Storage tanks for water supply shall be in Reinforced Cement Concrete (RCC) built by the building contractor. Each tank shall be provided with a manhole frame and cover. The covers and frames shall conform to IS 1726 for cast Iron and IS 12592 for pre-cast concrete covers. All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or asper design by the contractor ad duly verified by the Engineer, further connections with all the accessories shall be provided under this contract. **14.41.1.4 Disinfection** Before commissioning the water supply system, the contractor shall arrange to disinfect the entire system as described in the succeeding paragraph. The water storage tanks shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water. If ordinary bleaching powder is used, the proportions will be 150 gm of power to 1000 liters of water. The power shall be mixed with water in the storage tank. If a proprietary brand of chemical is used, the proportions shall be specified by the manufacturer. When the storage tanks is full, the supply shall be stopped and all the taps on the distributing pipes are opened successively working progressively away from the storage tank. Each tap shall be closed when the water discharged begins to smell of chlorine. The storage tank shall then be filled up with water from supply pipe and added with more disinfecting chemical in the recommended proportions. The storage tank shall then remain charged at least for

	three hours. Finally, the tank shall be thoroughly flushed out before any water is used for domestic purpose. The pipe work shall be thoroughly flushed before supply is restored. **14.41.1.5 Connections to RCC water tanks** The contractor shall provide all inlets, outlets, washouts, vents, ball cocks, overflows control valves and all such other piping connections including level indicator to water storage tanks as called for. All pipes crossing through RCC work shall have puddle flanges fabricated from MS/GI pipes of required size and length and welded to 6/8 mm thick MS plate. All puddle flanges must be fixed in true alignment and level to ensure further connection in proper order. Full way gate valves of a approved make shall be provided as near the tank as practicable on every outlet pipe from the storage tank except the overflow pipe. Overflow and vent pipes shall terminate with mosquito proof grating. The overflow from the first compartment of the fire tank shall flow in to the other compartment and then into the potable water tank for circulation of stagnant water. The overflow pipe shall be so placed to allow the discharge of water being readily seen. The overflow pipe shall be of size as indicated. A stop valve shall also be provided in the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be emptied for cleaning.

5.11.5. External Drainage/Sewage Disposal

A surface water drainage by gravity using nature-based solution is to be provided for all open and paved surfaces.

Drain shall be designed in such a way that there shall be no intermixing of sewage/pollutants and storm water. The structural design of the storm water drainage shall be in scope of the contractor.

Item no.	**Particulars**
Item 19.1.5 of CPWD Specifications 2019 Volume I and	Item **19.1.5** to be read as:

<table>
<tr>
<td>II (For Civil, Architecture and Structural)</td>
<td>The contractor must employ gradients giving velocity of flow lesser than 2.0 metres per second. The approximate gradients which give a velocity of 2.0 metres per second for the pipe size of 150 mm and the corresponding discharge are given in Table 19.1.

TABLE 19.1
Gradients for Sewers
<table><tr><th>DIAMETER MM</th><th>GRADIENTS</th><th>VELOCITY M/SEC</th></tr><tr><td>150</td><td>1 in 250</td><td>0.6 – 2.0</td></tr></table></td>
</tr>
<tr>
<td>Item 19.2.5 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)</td>
<td>In place of items no. 19.2.1 to 19.2.3 the following shall be used.

Add new item no. 19.2.5 as follows:

19.2.5 Double Wall Corrugated pipes

Item Description

Supplying of Class SN 8 Double wall corrugated (external annual corrugated & smooth internal wall) (DWC, Double Wall Corrugated) piping system in accordance with IS:16098 (part 2) and conveying to worksite, rolling and lowering into trenches, laying true to line and level and perfect linking at joints, testing and commissioning, including loading and unloading at both destinations and cuts of pipes wherever necessary including jointing with all labour, all lead & lift including encasing the pipe around to a depth of not less than 15cms with soft gravel or selected earth available from the excavation etc. complete and giving necessary hydraulic test to the required pressure as per IS Codes. (Contractor will make his own arrangements for procuring water for testing).

19.2.5.1 Pipe Stiffness Class

SN 8 based on approved design as per IS:16098 (part 2)

19.2.5.2 Transportation: (as per IS16098 (Part 2))

The arrangement of loading the pipes in a telescopic manner is advised, i.e. smaller diameters inserted into</td>
</tr>
</table>

	the next higher sizes of pipes. While loading the pipes onto the truck, care should be taken that the coupler- end should be arranged alternatively in the corresponding layers so as to avoid the damage to the coupling/ socket ends **19.2.5.3 Handling Recommendation: (as per IS16098 Part 2)** i. Adherence to National Safety requirements ii. Pipes to be smoothly lowered to the ground iii. Pipes should not be dragged against the ground to avoid the damages to the Coupler/pipes. iv. 0mm and larger diameter pipes are carried with Slings at two points spaced approximately at 3 Meters apart v. For smaller diameters (400mm - 800mm) one lift point shall be sufficient & can be handled either manually or mechanically vi. Loading Boom or Fork Lift should not be used directly on or inside pipe. **19.2.5.4 Pipe Storage at Site: (as per IS16098 Part 2)** Stockpiling shall be done temporarily on a flat clear area. For avoiding collapse of stacks use wooden posts or blocks. Stacking shall not be higher than 2.5 m. While stacking, alternate the socket/coupler ends at each row of stacked pipes. **19.2.5.5 Lowering into Trenches, Laying True to Line and Level:** i. The Contractor shall refer to the Clause 19.2.2.1 of IS16098 (part 2) for Laying and Jointing of the DWC pipes in addition to the following descriptions. ii. The width of a Sewer Trench depends on the soil condition, type of side protection needed; and the working space required at the bottom of Trench for smooth installations. Increase in width over required minimum would unduly increase the load on pipe and cost of road restoration. Considering all above factors, the Minimum Trench Width shall conform to Table 21 of Clause A-4.1.1 in IS 16098 (Part 2): 2003. iii. Excavation of trenches shall be carried out in accordance with the drawing & specifications and as

directed by the Engineer as well.

iv. The piping system shall be laid and jointed true to gradient with the help of sight rails and boning rods as detailed in CPHEEO, MoUD, GoI Manual on Sewerage and sewerage treatment. The levels need be checked with calibrated modern Levelling Instrument. Specific care shall be taken to prevent entry of sand / mud / slush/ any other foreign material etc into the system during the installation operation.

v. In case of high ground water table, the Contractor will use underdrains or sumps on the trench floor. De-watering should continue throughout the pipe laying operation until sufficient cover is placed over the pipe so that it will not float.

vi. The Excavation of Trenches, Shoring/mild steel sheet piling, protection to other existing utilities (if any), Dewatering shall conform to IS 16098 (Part 2): 2003.

19.2.5.6 Shoring/Mild Steel Sheet Piling:

The protective shoring works shall be strong enough to prevent caving in of trench walls or subsidence of contagious areas adjacent to trench. For wider and deeper trenches, a system of wall plates (wales) and struts of heavy timber section is commonly used as per the requisite structural design. In non-cohesive soils with high ground water table, continuous interlocking mild steel sheet piling may be necessary to prevent excessive soil movements due to ground water percolation. Such sheet piling shall extend 1.5 m below the trench bottom unless the lower soil strata are adequately cohesive.

19.2.5.7 Underground Services:

The underground public and private utility services exposed due to the excavation shall be effectively supported under the guidance of the owners of such services.

19.2.5.8 Dewatering:

Sewer installation trenches shall be adequately dewatered for the placement of pipe at proper gradient till the pipe is integrated through socket and spigot

	joint/coupler assembly with the already laid segment. Precautions are to be taken to arrest floating of installed sewer segments against buoyant forces in case of sudden accumulation of water in the trench. The diameter wise minimum cover necessary to counteract the buoyant forces is given in Table 22 of IS 16098(Part 2). For exceptional cases of higher level of ground water, additional anchoring at equal intervals would be necessary. **19.2.5.9 Jointing:** The Contractor shall ensure the following steps to maintain the performance aspects: i. The non-coupler end needs to be thoroughly cleared and shall be free from any foreign material. ii. Use a clean rag or brush to lubricate the non-coupler end with lubricant. iii. Clean and lubricate the coupler end of the pipe to be laid in similar manner. iv. Lubricate the exposed gasket in the same manner with pipe lubricant. Keep the lubricated non-coupler end free from dirt, backfill material, and foreign matter so that the joint integrity is not compromised. v. Push the coupler into non-coupler and align properly. Always push coupler end into non-coupler end. vi. For smaller diameter pipes simple manual insertion shall be sufficient. It should be ensured that the coupler end is adequately 'homed' within non-coupler end to ensure installation and tight joining seal. Therefore, prior to insertion always place a homing mark on appropriate corrugation of the non-coupler end. vii. All the jointing functions, test for water tightness at joints shall conform to IS 16098 (Part 2). **19.2.5.10 Construction of Backfill Envelope and Final Backfilling of Trenches:** i. DWC PE Piping System with well compacted Backfill Envelope along with the bottom and sides of trench (native soil) work together to support soil overburden and superimposed (traffic) loads. The carefully constructed Backfill Envelop has three distinct but non-isolated stages. The construction needs to be done stage by stage as per the sequence stated below: a) Bedding portion

	b) Up to Haunch level c) Remaining portion ii. The material for backfill envelop shall be in accordance with the structural design of flexible buried conduit as per relevant Indian/international codes mentioned in the list of Standards. It can be the same material that were removed in the curse of excavation or it can be fine sand/course sand/gravel / moorum / other form of course / fine aggregates depending on the effected Design Load [Overburden + Superimposed (Live) load]. However, in no circumstances, the flexible pipe should not be embedded in cement concrete (un- reinforced or reinforced) which invariably induces undesired rigidity in the system. iii. The remaining portion of backfilling which do not contribute to the structural integrity of the system may be the materials that were removed in the course of excavation or any other foreign material as may be required to suit the particular site condition. These materials shall consist of at least clean earth and shall be free from large clod or stone above 75 mm, ashes, refuse and other injurious materials. iv. After completion of laying of pipes, etc, first the Backfill Envelope shall be constructed as per design around the pipe. Voids must be eliminated by knifing under and around pipe or by some other indigenous tools. v. The compaction, by hand rammers or compactors with necessary watering to a possible maximumlevel of proctor density shall be ensured. vi. Backfilling shall start only after ensuring the water tightness test of joints for the concerned sewer segments. However, partial filling may be done keeping the joints open. vii. Precautions shall be taken against floatation (if at all necessary) as per the specified methodology and the minimum required cover. **19.2.5.11 Bedding:** i. The bedding and backfill shall comply to IS:16098 (Part 2): 2013 for DWC sewers as mentioned below. ii. Precautions are to be taken to arrest floating of installed sewer segments against buoyant forces in case of sudden accumulation of water in the trench. The diameter wise minimum cover necessary to

	counteract the buoyant forces is governed by Table 22 in IS:16098 (Part 2): 2013. iii. Normally, even for the maximum combined loading (wheel load + backfill), any form of cement concrete structural bedding would not be necessary. iv. For maintenance of sewer slopes the initial backfill envelop with sand or gravel (as computed through structural design of buried flexible conduit) over a single BFS would be sufficient. v. In the event, anchorage becomes imperative the transverse concrete anchorage blocks spaced at suitable interval shall also act as chairs for defining and maintaining the sewer slopes. **19.2.5.12 Continuity Test /Hydraulic Testing** Continuity of the pipe segments in between two manholes is required to be ensured in the same modality as practiced for non-pressure DWC pipeline. Hydraulic testing of pipes shall be done, if specifically asked for by the client for any specific stretch. The procedure for testing shall be similar to that for non-pressure plastic pipes mentioned in the IS16098(Part 2): 2013.
Item 19.3.3 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	In addition to item 19.3.2, add item 19.3.3 as follows: 19.3.3 **Covers for storm water drains** Covers for storm water drains shall be Hot Dip Galvanized drain grating with frame 1000x500 mm horizontal grating as per approved design. The grating shall be well coated as per approved brand and manufacturer of required shade and shall be approved by the Engineer.
Item 19.3.1.1, (vi) of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	Item **19.3.1.1, (vi)** to be read as: Size and shape and performance requirement of manhole covers and frames shall conform to IS 1726 and following sizes to be added: 300 mm X 300 mm 600 mm X 600 mm 900mm X 800 mm
Item 19.20 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)	In addition to item no. 19.9 the following shall be added. Add new item no. 19.20 as follows:

	19.20 Bio Digester **19.20.1 Item Description** Supply and installation as per DRDO norms of brand new FRP Bio Digester Tank of approved make having facility and jointing materials complete as per detailed specifications and as directed by the Engineer. Defence Research Development Organisation developed and deployed the Anaerobic Bio- Digestion Technology for sewage treatment in toilets at extreme climate condition (-50°C to 50°C). After successful run the Bio Digester technology is now being used in various places across the country. Bio Digester does not need sewer collection system and sewage treatment plants. It is an on-site independent system and does not require any major infrastructure. The functions of the Bio digester are as follows: i. Bio digester is a specially designed fermentationtank with provision of inlet for human waste / grey water and outlets for treated effluent and biogas. ii. Night soil degradation occurs through microbial reaction which converts it into biogas. iii. The effluent is free from off odour, suspended particle matter, pathogens and is environmentally acceptable iv. Bio-digester is a specially designed fermentationtank for accelerated microbial degradation of organic waste. It shall be made of FRP (Fibre Reinforced Plastic) with provision of inlet for human waste and outlets for treated effluent and biogas. The tank has several chambers to provide more surface area to expedite biodegradation. The chambers increase retention time of the waste in places where water table is high and where people flush frequently. v. These tanks shall be rectangular in shape and involve fabrication in shops and transportation to the site of installation. These tanks are available in the market through DRDO approved vendors. The Contractor shall purchase these tanks from such approved vendors for superior quality and installation is done as per DRDO approved methodology. vi. Depending upon number of users, the volume of FRP is calculated. Proposed BIO-digester system location in site as per the size, the area required is demarcated

in the layout or as per Bill of Quantities.

vii. The outlet parameters of the bio-digester system should be as follows:

DETAILS	RANGE
pH	7.0-7.5
Turbidity (NTU)	70-90
TSS (mg/L)	90-120
TDS (mg/L)	350-450
VS (mg/100ml)	20-30
COD (mg/L)	250-300
BOD (mg/L)	70-120
Coliforms (MPN/ml)	300-350

19.20.2 Dimensions of Typical Biodigester Tank

BIO-DIGESTER TANK CAPACITY (KL)	LENGTH(M)	WIDTH (M)	HEIGHT (M)
4	2	2	1
5	2.5	2	1
12	4	2	1.5

Drawings DI1530-RHD-ZZ-AH-DR-M-1059 and DI1530-RHD-ZZ-NI-DR-M-1559 can be used for reference.

Item 19.21 of CPWD Specifications 2019 Volume I and II (For Civil, Architecture and Structural)

In addition to item no. 19.20 the following shall be added.

Add new item no. 19.21 as follows:

19.21 Oil/Grease Separator

Businesses with commercial kitchens that produce fats, oils and grease (FOG) must have an interceptor (or separator) for pre-treatment to keep contaminates out of the city's sewer system. The separator is a holding tank that separates grease and oils from the wastewater produced from sinks, floor drains and dishwashers. Water from these sources enters a grease separator where it is separated using gravity – grease floats to the top of the separator (as FOG have lower specific gravity than water) and is removed while the wastewater exits through an outlet pipe into the city's sewer system. There

	are different methods on how the separator is cleaned. Depending on the grease separator system, the separated substances must be disposed of either separately (partial disposal) or together with the total contents of the grease separator (complete disposal). The grease interceptor plants can be made of polyethylene, both for free-standing (indoor) or below-ground (outdoor) installation, tailored to the project's needs. Oil & Grease Trap *Size – 1000x 1000x1500mm *Make- S.S 304 *S.S Make Big Size Basket *Ball Valve for releasing Oil make – Brass Complete stainless steel 304, Grease, oil and sludge storage capacity will be 300 kgs. (Approx) Drawings DI1530-RHD-ZZ-AH-DR-M-1060 and DI1530-RHD-ZZ-NI-DR-M-1560 can be used for reference.

5.11.6. External Fire Protection System

The Contractor shall design, supply, install test and commission fire detection and suppression system. The fire detection systems shall be designed in accordance with NBC/ NFPA and all local requirements. It will be the responsibility of the contractor to get all approval and completion certificate from the Local Fire Authorities without which the work will not be considered complete and will not be taken over. The contractor shall bear all the expenses required to obtain these certificates. The contractor must prepare the necessary drawings and documents for the submission to fire authorities. Nothing extra will be paid for the work done and follow up by the contractor in this regard. However, any statutory fees paid by the contractor shall be reimbursed by the Employer on depositing the proper receipt.

This section for external fire protection provides the modifications (additions, deletions, changes) to the CPWD Specifications (General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020 applicable to this Contract.

Item no.	**Particulars**
Item 2.4.1.8 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	In addition to item 2.4.1.8, add requirement 2.4.1.8.8 as below: All external hydrants shall have an associated Fire Hose Box that shall house two numbers of 63 mm dia x 15 m long Fire Hose with a short branch pipe. All hydrants

	shall be readily accessible to the fire appliances and for firefighting operations.
Item 8.6 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	In addition to item 8.6, add item 8.7 as below: **8.7 Hose Box** Hose box made of 18-gauge MS Sheet 800mm X 600mm X 250mm with double door with 4 mm thick glasses and door frame made of 16 gauge MS sheet painted. These are provided for connection of fire service hose pipes for either directly pressurizing the system with their pumps or filling water in the tank from a distance. In the first case non return valve with butterfly valve shall be provided for holding water pressure. Fire service inlet shall be provided with each wet riser/down comer and the ring main. These are fixed to 150mm dia. pipe and located in MS box made of 2 mm thick mild steel with openable glass cover. These shall be as per IS: 904. Material of Construction – M S Sheet Box should be painted with red color shade No. 536 of IS:5. Drawings DI1530-RHD-ZZ-AH-DR-M-1058 and DI1530-RHD-ZZ-NI-DR-M-1559 can be used for reference.
Item 11.6 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	In addition to the item no. 11.6, the following shall be added. Furthermore, following items also must be added: **11.7 Anchor / Thrust Block** Contractor shall provide suitably designed anchor blocks in cement concrete/steel support to cater to the excess thrust due to work hammer and high pressure Thrust blocks shall be provided at all bends, tees and such other location as determined by the Engineer and vetted by the Engineer. Exact location, design, size and mix of the concrete blocks/steel support shall be as shown on the drawings or as directed by the Engineer prior to execution of work.

	11.8 Pipe Fittings Pipe fittings mean tees, elbows, couplings, unions, flanges, reducers etc and all such connecting devices that are needed to complete the piping work in its totality. Forged steel screwed type fitting shall be used for pipes of 50 mm dia & below. Fabricated fittings shall not be permitted for pipes diameters 50mm and below. Fabricated fittings used on pipe size 65 mm & above shall be fabricated, welded in workshops. They shall be inspected by Project Manager before dispatch from the workshop. The welding procedures of the workshop should have been approved by the rules for sprinkler system and applicable to hydrant and sprinkler system. For "T" connection, pipes shall be drilled and reamed. Cutting by gas or electrical welding shall not be permitted.

5.11.7. Mechanical Works Specifications for Pumps and Allied Equipment

This section provides the modifications (additions, deletions, changes) to the CPWD Specifications (including General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020 applicable to this Contract.

Item no.	**Particulars**
Item 5.6 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	To item 5.6, add additional item 5.7 **5.7 Potable Water Pump** **General** The potable water pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz. A.C. system. Both the motor and the pump shall be assembled on a common base plate, fabricated M.S. channel type or cast-iron type.

	Drive The pump shall be direct driven by means of a flexible coupling. Coupling guard shall also be provided. The pump shall be horizontal mounted centrifugal type.
Item 7.18 of CPWD General Specifications for Electrical Works Part-V (Wet Riser & Sprinkler Systems)) 2020	To item 7.17, add following additional items 7.18 to 7.19 **7.18 Expansion Bellows** The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or other major items of equipment's. Stainless steel AISI 304 expansion bellows which can take radial and axial misalignment of minimum 1 percent of valve nominal size with tie rods shall be included in the suction and delivery pipe work of all pumps for easy dismantling. All loose flanges shall be secured to fixed flanges by suitable tie-bolts. All pipe work shall be adequately supported with purpose-made fittings. When passing through walls, pipe work shall incorporate a puddle flange or other suitable sealing device. **7.19 Hand operated Hoist and Trolleys** Manual hoist shall be complete with hand chain, trolley, pulley block, hook, hand and load chains, brake and other accessories. They shall comply with the latest applicable standards, regulations and safety codes in the locality where equipment will be installed. Each hoist shall be operated on a monorail (I-beam). The factor of safety shall not be less than 5. The load chain may be heat-treated to give ductility, toughness and as per IS 3109/BS 1663/BS 3114. The load wheel is to be made heavy duty malleable castings. the hand chain should be as per BS 6405 and hand chain wheel may be made from pressed sheet steel with roller type guarding. Gears shall be cut from solid cast or forged steel blanks or shall be stress - relieved welded steel construction. Pinions shall be of forged carbon steel of heat treated alloy steel. strength, Quality of steel, heat treatment, face, pith of teeth and design shall be as per BS-436, BS-545 and BS 721. Spur and helical

	gear must comply with BS 436 and worm with BS 721. Bearing must be ball and roller type as per IS 2513 / BS 2525-32. Proper lubricating arrangements are to be provided for bearing and pinion. The brakes for the lifting gear shall be automatic and always in action. The proof testing of each chain pulley block is to be carried out as per latest applicable standards. the safe working load is to be marked in such a way that is clearly visible from the operating level.

5.12. External Power Supply

5.12.1. Overview

These general specifications cover the details of Substation Equipment(Transformers, Diesel Generator Sets, HV Switchgear, LV Switchgear, Distribution Boards, Battery and Battery Charger System, UPS, APFC Panel etc.), Power & Control Cables, External Illumination, Earthing & Lightening Protection System, CCTV System, Communication System, Rooftop Solar Panels, Vessel Information Display system to be supplied, Factory Acceptance Test (FAT), the inspection as may be necessary before dispatch, delivery at site, Installations, providing Quality Assurance Plan (QAP), testing, commissioning, putting into operation and handing over in working condition, training of the personnel, providing operation manuals for the equipment and system mentioned above. Detailing and shop drawings shall be prepared by the contractor for all electrical utility drawings.

5.12.2. Conflicts and Deviations

Any inconsistency, conflict or disagreement between the requirements specified in this Technical Specification or defined elsewhere in Contract, shall be brought to the attention of the Engineer in writing by the Contractor.

Contractor shall be responsible to assist the Engineer in resolving the conflict such that work shall be completed in timely manner as per schedule minimising interfaces and impact on cost and schedule.

5.12.3. General

- Guidelines laid down by APDCL (Assam Power Distribution Company Ltd.)
- Regulations laid by AERC (Assam Electricity Regulatory Commission)
- Safety Guidelines- CEA (Central Electricity Authority) & AERC
- Metering-AERC guidelines & regulations
- Any other regulations laid down by the local government authorities.

5.12.4. International Codes and Standards

International codes latest amendments and standards as specified for equipment in the relevant equipment specifications shall be complied with. List of major International standard which are essential for the project are listed below:-

IEC: International Electrotechnical Commission
IEEE: Institute of Electrical and Electronics Engineers
ISO: International Organization for Standardization

.

5.12.5. Source of Power Supply

In order to meet the total power demand for river Terminal, power supply shall be provided by ASEB at 11kV level. The power tap-off location shall be in vicinity of Terminal building with a suitable breaker. The main electrical substation location shall be near the Terminal Building only. Cabling from power tap-off point to the substation shall be considered in present scope of work. Further onward power transmission to the Terminal building area (Through 415V LT Power cable) and all downstream distribution to Pontoons, pathways and associated facilities shall also be considered in present scope of work and shall be through 415V Switchgear. Upon receiving the power at 11kV level from ASEB tap-off point, power shall be taken up to main sub-station area through 11 kV cable and it will be stepped down to 415V level by means of 11/.415kV step down transformer. It shall be connected with 415V Switchgear for downstream LV power supply.

5.12.6. External Electrical Specifications

Item no.	**Particulars**
Item no. 3.2. xvi of CPWD Specifications for Electrical works 2013 Part I, Internal.	In addition to item 3.2.xvi, add item 3.2. xvii as follows: Surveillance System: Surveillance CCTV system is required to ensure surveillance of required locations as well as create secured record for post event analysis. The system shall provide an online display of video images on LED monitors located on each Slat System shall facilitate viewing of live and recorded images and controlling of all IP cameras by the authenticated/authorized personnel. The core of the surveillance system shall be NVR servers. System shall also have operating systems, appropriate software, networking equipment and other essential components. System shall have expansion possibility with the available hardware (system shall have the facility of additional camera installations beyond the originally planned capacity). It shall be an open standard based integrated system with IP network aimed at providing

	high-speed automatic operation for best performance. It shall use video signals from various types of indoor/outdoor cameras installed at different locations. Joystick and mouse-keyboard controller shall be used for Pan, Tilt, Zoom, and other functions. System shall have a combination of Digital colour video cameras with individual IP address. It shall also have raid backup device of recording, application software, colour video monitors and keyboards. Camera server shall be NVR server based with appropriate Audio and Video Management System backup system and software. Each camera server shall handle 60 or more cameras. CCTV system shall ensure that once recorded, the video cannot be altered; ensuring the audit trail is intact for evidential purposes. System shall provide sufficient storage of all the camera recordings for a sufficient period. The recording resolution and frame rate for each camera shall be user programmable. Surveillance system shall comprise of control console, monitor, switching unit, line unit, coupling unit, TV cameras with remote control of pan and tilt video recorder. The CCTV is intended for remote monitoring of different operations. The TV image can also be recorded on the video recorder. The visual surveillance facility with control console and video recorder will be located in the Electrical room. TV cameras shall be located as per the layout drawings. Suitable nos, of dome cameras and PTZ outdoor cameras with bracket shall be installed. The CCTV shall be able: a) To monitor and supervise in colour the objects, outdoor and indoor areas, b) To control TV cameras and pan and tilt units remotely from Electrical Room, c) To overview simultaneously images on one monitor from several TV cameras (up to 4), d) To operate in the automatic mode according to the programme specified by the operator, e) To transmit video signal and supply power to TV camera over a signal cable, f) To operate jointly with PC, g) To tag current time, date, TV cameras for recording on video recorder, The CCTV system shall comprise control console, monitor, switching unit, line unit, coupling unit and TV cameras.

	Control Console: The Control Console is intended for control of multi camera installation using the 2 wire communication line. The control console shall ensure: Remote switching on and switching off TV cameras, Control of TV camera switching and Control of pan and tilt units. Monitor: The monitor will ensure: Display of any four input images at the operator's command, Automatic overview of input images. Switching unit: The switching unit shall perform the following functions: Processing of control signals for pan and tilt units, Switching of video signal for output, Switching of video signal and its transmission over coaxial cable. Line Unit: The Line Unit shall provide: Power supply to control console, Conversion of input and output control signal levels, Correction of video signal distortion transmitted by coaxial cable. Coupling Devices: The coupling device is intended for multi camera TV installation. The coupling unit shall perform the following functions: Power Supply to TV cameras, Transmission and receiving of control signals over two wire communication line, Transmission of video signal over coaxial cable. TV Cameras: Colour TV cameras integrated with pan and tilt units for indoor use, Colour TV cameras integrated with pan and tilt units housed in protective enclosure and intended for outdoor use. Video Recorder: The video recorder shall have 24-hour time laps in different modes of slow down and online recording with sound and different modes of playback.
Item no. 2.3.6.(a) of CPWD Specifications for Electrical works 2013 Part I, Internal.	In addition to item 2.3.6 (a) , add item 2.3.6 (b) as follows: Communication System: The Communication system shall comprise of the following: a) General Telephone System b) Intercommunication System c) Loud speaking and staff locating system. Automatic Telephone Communication shall have Digital automatic exchange, telephone sets of desk and wall type. It shall have following devices/components: a) Intercommunication system: Operator's switchboard (master control multifunctional station), recording and playback facility (recorder)

	b) Staff location (paging) and public address system: The amplifier stations, speakers of 2 W, speakers of 6 W, cone speakers of at least 10 W and subscribers' speakers c) Cable Work: Telephone box, junction boxes, multi pair telephone cables, single pair telephone drop wires. The automatic telephone services as per above features shall be provided by digital programmable automatic) exchange of EPABX type of 6 P&T ports, 30 extension ports (Upgradeable up to 140 extensions) to be installed in Electrical Room with facilities for: a) Connection of subscribers' lines, b) Connection of digital subscribers' lines, c) The lines with automatic exchange of phase 2. d) The subscribers' telephone terminals shall include: i) Analog push button telephone sets permitting operation in the tone and pulse mode, ii) Digital multifunctional telephone set to be installed in different areas. The communication system shall include the facility (recorders) for automatic recording of the conversation and its playback which are to be connected to the multifunctional telephone sets. The recorder can be coupled to the line both automatically and by hand. The automatic telephone exchange shall provide the following services: a) Subscriber shall have facility using one telephone set to organize several independent talks with possibility of mutual inter connection, joint conversations and listen in functions, b) a new call while holding up the conversation in progress, c) Diversion of calls, d) Conference coupling, e) Circulating conference. The system shall include the PA and staff locating (paging) system. For this purpose provision shall be made for amplifier station of 500W to be installed in the communication centre located in Electrical Room. The amplifier station shall permit paging of the personnel and passing of important messages to all areas over different feeders as well as to distribute music or speech programs. The feeders shall be programme controlled remotely from the operator's switchboard. The programme shall provide both selective and collective

	control of the feeders and distribute music or speech programs. Wired Broadcasting station: the wired broadcasting equipment shall comprise: a) Audio power amplifier of 500W output power b) Switching equipment for radio feeders c) Equipment monitoring system d) Receiver e) Professional audio recorder. Audio Power Amplifier: The audio power amplifier is intended to page personnel, pass important messages and distribute music or speech programmers. The amplifier shall be designed for continuous operation and protected against overload and short circuit. The amplifier shall have priority in one of the microphone outlet. Mixer unit: The mixer unit is intended to compensate for noise and suppress feedback. Control Unit: The control unit permits transmission of information both over separate radio feeders and through all radio feeders and through all radio feeders simultaneously. Telephone set: The offices and other areas shall be furnished with push button telephone sets of desk/wall mounting type and modern design. The telephone set shall have syllable intelligibility of at least 80% at noise level of 60db. The calling signal volume shall be adjustable and shall be at least 70 db. There are 9 no desktop telephone sets and 10 no wall mounted telephone sets. Out of 9 no desk top handsets 4 no are considered digital phones whereas the remaining are analog handsets. The wall mounted telephone sets are all analog type only. Master control station multifunctional telephone: The intercom master station to be connected to the digital automatic exchange which shall provide high quality control due to combination of the intercom analog master control station functions and capabilities of the digital automatic exchange. The intercom mastercontrol station shall have a wide range of differentfunctions and convenient user's interface. The master control station shall have a keyboard with assigned keys for programmable access to any subscribers', external or connection lines. Multi pair telephone cables: The multi pair telephone cables shall be suitable for communication lines to be laid inside wall of buildings and outdoor areas. Telephone communication system shall be carried with

	cables to be laid on the racks, trays along the walls or underground. Power and telecommunication cables shall not be laid down together on the cable racks and trays. In case of joint running of telephone and power cables, the minimum distance between them shall be in the manner specified by the Codes of practice. When the cables are laid down on the wall surface, they shall be run through PVC conduits. When cables are laid underground a sand cushion shall be arranged on the trench bottom and covered by bricks. All cables shall carry a tag with indication of its type, no as shown in the cable logbook.
Item no. Appendix 2.(5) of CPWD Specifications for Electrical works 2013 Part IV, Sub stations.	In addition to item Appendix 2.(5), add item 2.(6). as follows Vessel Information Display: The large screen for Vessel Information Dis[lay shall be connected to both network switches through CPU and capable to display the same graphics as displayed by the screen on any location. On screen commands shall be possible with the click of the mouse located on respective system. It shall have following features: Diagonal size: Minimum 50'' Resolution: Full HD (1920x1080) Screen Brightness: 450 Contrast Ratio: 1600:1 Pixel Shape: Square Lifetime: 60000 hours Screen Type: Ag screen, 3 layer Screen to screen gap: <0.7Mm Brightness uniformity: >95% Colours: 16.7 Million Operating Temperature: 0-50 degree C Serviceability: Full Rear Access Power Supply: 2240V AC 50 Hz Noise: 40-50 db Control: IR Remote, RS-232/Rj45 Ethernet TCP/IP Screen Dimension: Minimum 43.6''(W) x 31.3''(H) The above screen shall be suitable for continuous operation for display of arrival/departure. It shall operate jointly with PC or connected to server to receive information of each arrival /departure for display on the screen.

Item no. 5.3 of CPWD Specifications for Electrical works 2013 Part IV, Sub stations.	In addition to item 5.3, add item 5.3.1 as follows: Cable Trays: FRP Cable trays shall be cleated individually or in a group using GI saddles. The interval for cleating shall not exceed 1,500 mm. Power and control cables shall be laid in separate cable trays or racks. The order of laying of various cables shall be as given below: HV cables on top tiers with specifications as listed below: The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed. The design, material, construction, manufacture, inspection, testing and performance of FRP Cable Trays & Accessories shall conform to the latest revision of relevant standards and codes of practices as per Data sheet. In case of conflict between the applicable reference standard and this specification, this specification shall govern. FRP type Cable trays as per NEMA FG-1 1993 standard shall be considered.

5.12.7. Inspection & Testing

Major electrical equipment's, as indicated below shall be tested and inspected at vendor/ manufacturer works before dispatch to ensure compliance with the specifications/requirements and applicable codes and standards and agreed quality assurance/testing plan.

Inspection at Manufacturers Premises: Tests of major items like HT panel, LT panels, Transformers, HT Cables & LT cables shall be conducted at manufacturer's work in presence of Consultant/third party inspection agency (TPIA) and client' representative appointed by purchaser's representative. All the expenses like transportation, lodging & boarding shall be borne by contractor.

Rest items shall be cleared for dispatch based on review of manufacturer's Test Certificates/ manufacturer's Test Report by TPIA/ Client's Engineer.

The owner/Client or his authorized representative may visit the works during manufacture of various e equipment/materials to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given full assistance to carry out inspection. Owner/ client's representative shall be given minimum two weeks advance notice for witnessing of final testing.

All the cost pertaining to inspection including to & from travel, local conveyance, lodging and boarding expenses shall be borne by contractor for minimum 2 representatives of client/ client's consultants/Third Party Inspection Agency.

5.12.8. Drawings/Documents

Following working design drawings/documents to be prepared in line with recommended specifications/details and submitted to engineer in-charge in a timely manner to allow for review and approval as a minimum:

- List of Drives/Loads with Qty./Rating/Specifications along with power load statement
- Transformer, D.G. Set and Capacitor Sizing Calculations
- SLD of complete electrical system
- Wiring/Schematic Drawings for complete electrical system (HT Panels, LT Panels, Lighting Panels, PDBs, etc.)
- Overall Cable Layout & Unit Wise Cable Tray layout
- Earthing Layout with Earthing Calculations
- External Lighting Layout with calculations
- Cable Schedule with voltage drop calculation / sizing calculations/ cable tags
- Interconnection Schedule
- G.A. Drawings for all equipment including sectional drawing wherever necessary, and specifying recommended installation, weight, clearance requirements, etc.
- Filled in Data Sheets
- Schedule of quantities along with brief specifications
- Design / sizing calculations for equipment as applicable
- O&M manual for all equipment

5.12.9. As Built Drawings/Documents

All above final documents and drawings incorporating modifications, if any, done during erection/commissioning shall be furnished in at least 3 number of sets for submission to the Engineer.

5.12.10. List of Recommended Makes

S No.	Equipment/Component	Preferred Makes
1.	HT Switchgear	Adlec (Schneider)/SPC Electrotech (L&T)/RISHA (L&T)/NITYA (Siemens)/Schneider/Siemens/L&T
2.	LT Switchgear	Adlec (Schneider)/RISHA(L&T, ABB)/SPC Electrotech(L&T)/Vidhyut Control (L&T)/NITYA (Siemens)/Schneider/Siemens/L&T

3.	Distribution Boards	SPC Electrotech (L&T)/NITYA (Siemens)/RISHA (L&T, ABB)/Adlec (Schneider)
4.	Distribution Transformer	Areva/Emco/Crompton/BHEL/Voltamp/Essenar/ Transformers & Rectifiers India Limited/Bharat Bijlee /PETE Hammond
5.	HT cables	Havells/Ravin/Gemscab/Gloster/Paramount/Polycab/KEI/Universal Cables
6.	LT Power cables	Havells/Ravin/Gemscab/Gloster/Grandlay/Polycab/KEI Paramount/Universal Cables
7.	Control Cables, Wires & Flexible Cables	Havells/Gemscab/Ravin/Gloster/Grandlay/KEI Paramount
8.	Copper Wires PVC FRLS	Skytone/Echo Cables/National/Finolex/Polycab
9.	Cable Glands/Lugs	Jainsons/Dowells/Gripwell/SMF
10.	Cable Trays (FRP)	Ercon/Indiana/ Sumip Composites/Sintex/EPP Composites
11.	Capacitor Panel with Banks and other related accessories	L&T/Epcos/Schneider/ABB/Asian/Madhav/Havells
12.	Battery	Exide/Amco/Amara Raja/Chloride/HBL
13.	Battery Charger with DCDB	Chhabi Electricals/Caldyne/Mastek/DB Electronics/HBL
14.	Diesel Generator Set	Powerica/Jakson/Sudhir/Greaves
15.	Alternator	Crompton Greaves/Kirloskar/Stanford
16	Lighting fixture with street light poles	Bajaj/Philips/GE Lighting/Havells/Pharox/Wipro/Orient Electric/Surya
17.	High Mast	Bajaj/CGL/Philips/Surya

18.	Plate-Switches & Sockets, Boxes	MK/Crabtree (Havells)/Anchor
19.	GI Conduit with accessories	BEC/AKG/SENCO/Jindal
20.	VCB	Siemens/L&T/ABB/Schneider
21.	ACB	Siemens/L&T/ABB/Schneider
22.	MCCB	Siemens/L&T/ABB/Schneider
23.	MCB/ELCB/RCB/ MPCB	Siemens/L&T/MDS/Schneider/Havells
24.	Fuse/Link	Siemens/L&T/Alstom/Schneider/C&S/Areva
25.	Switch Fuse Units	Siemens/L&T
26.	Contactors	Siemens/L&T/ABB/Schneider
27.	Indicating Lamps/Push buttons	Siemens/Schneider/Teknic/Kaycee/L&T/Essen/Vaishnav/ BCH/C&S
28.	Push button stations	Siemens/Schneider/Teknic/Rishabh/L&T/BCH/Control Group
29.	Meters (digital) MFM	Schneider (Conzerv)/L&T/Secure
30.	Voltmeter/Ammeter/ PF Meter/Frequency Meter/KWH Meter	AEI/IMP/MECO/INDCOIL/Enercon/L&T/Rishab/Siemens/Industrial Meters
31.	Selector Switch	L&T/Siemens/Schneider/Kaycee/Salzer/C&S/Vaishnav
32.	Auxiliary Contactors/Relays	L&T/Siemens/BCH
33.	Overload Relays (Hand Reset Type)	L&T/Siemens/BCH/Telemachanique

34.	Protective/Auxiliary Relays	Areva/Schneider/Siemens/EasunReyroll/ABB/ Telemechanique/L&T
35.	Time Delay Relays	BCH/Siemens/L&T/English Electric
36.	Power Contactor	L&T/ Siemens/Telemechanique
37.	Timer	Siemens/L&T/BCH/Schneider
38.	Terminal Blocks	Elmex/Connect Well
39.	Current Transformer/ Potential Transformer	AE/Kappa/L&T/Siemens/Pragati
40.	Switches & Sockets	Havells/LegrandAnchor/Roma
41.	Power & Welding Sockets	Hensel/Mennekes/Walther
42.	PVC Conduit and accessories	BEC/Polypack/Precision/AKG
43.	Cable Termination Kits & Straight Through Joints	Raychem/M-Seal(3M)
44.	Motors	BHEL/Kirloskar/Crompton/Siemens/Havells
45.	Soft Starter	ABB/CG Power(Emotron)/Danfoss/ L&T/Rockwell/Schnieder/Siemens
46.	Chemical Earthing	Ampere Protection/JKEarthing/JMV/OBO/Uniearth
47.	EPABX	Panasonic/Coral
48.	CCTV	Hikvision/Dahua/Axis/Godrej/Honeywell/Panasonic/Sony

Note-1: In order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service, like items of equipment provided hereunder shall be the end products of one (1) manufacturer.

Note-2:All products shall be completely manufactured in the country of Origin as indicated. Assembled products shall not be accepted.

Note-3: In the event that the contractor wishes to propose alternate makes for the equipment mentioned above, he shall submit the following:

- Demonstrate that the proposed makes are “Superior/Equivalent” to the approved makes.
- Submit ISO certificates for the OEM.
- Submit quality certificates that the equipment adheres to.
- Submit product brochures for the proposed equipment.
- Manufacturer involved in manufacture of specified equipment for at least 10 years before bid date.
- At least 10 successful individual installations of similar size as per this contract with the proposed equipment and model no, commissioned in last 5 years before bid date and satisfactorily operating for at least five years before bid date.
- Valid Justification of proposing the alternative makes.
- The contractor shall distinctly understand that it will not be their prerogative to insist on a particular brand from the list, and final selection will be done with the approval of the Engineer.