VOLUME – II

PART – 2

SCOPE OF WORK & TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

SCHDULE – III EPC TECHNICAL SPECIFICATION

D - CIVIL AND STRUCTURAL WORKS

D1 – SCOPE

1.0 This specification covers the general requirements for the Civil & Structural design engineering, construction, fabrication, procurement, supply, transportation to site, storing at site, erection, installation, testing, commissioning, performance testing of all the facilities as listed below on Engineering Procurement and Construction (EPC) basis as per the specification mentioned in this document. Bidder to carry out Geotechnical Investigations, Topographical Survey & Hydrology study of each site. Risk/ambiguity pertaining to above study (land, soil and water) shall not be responsibility of OWNER.

1.1 The scope of work covered in this specification consists of collection of all site related data, labours, fuel, oils, equipment/machinery, setting up of batching plant (Minimum 15 m3/hr- in case the single location plant size is 70MW and above / mandatory for the high corrosive site), AJEX transit mixers machine (only for transportation), vibrator, Needle, JCB machine, truck/tractor mounted piling machine, total station for pile marking, dumpy level machine, shuttering & MS pipe stagging materials, welding machines, gas cutting sets, drill machine, concrete breaker, water tankers, trucks, required nos. of MS templates (for MMS foundations), cube testing machine, all any other required machinery, all type of consumables, design and construction etc. as per detailed technical Specification for completion of civil work. The scope of work also includes, supply, fabrication, erection of structural materials like insert plate, pipe sleeves, anchor bolt, edge angle, nuts & bolts, hand rails, staircase, ladders, platforms, erection, testing etc. as per details given in the tender document. The scope works shall cover for all services required for completion of civil works in all respect for Solar Power Plant. Any civil works which are not mentioned in the tender document but required to complete the solar plant evacuation up to STU (GETCO) Substation, in complete manner deemed to be included in the scope of Bidder.

1.2 For Solar PV Project, all the material, installations, fixtures, accessories etc. to be provided shall be as per the relevant I.S. specifications. These shall be of best quality and of standard manufacturer as approved by the OWNER, when there are no standard specifications. The agency has to keep the full proof records of purchase and consumption along with original purchase bills of Cement and Steel and other brought out material as per the OWNER procedures and rules. The agency has to provide best workmanship with skilled manpower for all the civil items as per the standard specifications/ best practice as approved by the OWNER. The booklet Standard Specifications for Civil Works will be applicable wherever there is dispute in the items of civil works. OWNER will not supply any material for this work.

1.3 Industrial Sign Boards (Safety Board, Hazard Board, Electrical SLD, earthing layout, artificial respiratory sign board for each inverter station and for each sub pooling station) and Safety Signs, Bidder shall install and fix industrial sign boards and safety signs as per relevant safety regulations. Safety signs and boards shall be in fluorescent Acrylic Night glow standing sign board, stick on the door, framed on walls, and hang on false ceiling with Solid 8 mm GI rod and Clamps including foundation. Bidder shall submit relevant drawings to owner for approval. For Signage Boards, Bidder shall provide to the

owner, detailed specification of sign boards. For transformer yard, the sign board shall be made of Aluminium composite sheet. Letters on the board shall be proper illumination arrangement. All sign boards at open area and on road shall be placed on 400 X 400 mm and 600mm deep RCC foundations. Vertical posts shall be 65NB circular GI pipe, painting with epoxy paint with black and white Strip of 300mm with required Dry film thickness. Post shall be in two pieces. Short arm embedded in concrete pedestals and long armed above the ground shall be connected with short arm by bolt and nut connection Each room shall be provided identification name plate of 2 mm thick stainless steel with black letter engraving on it. Shock treatment chart shall be printed in at least three languages i.e. Hindi, English and local language. The chart shall be fitted in wooden frame with glass on front side and hard board at back side. The chart shall be displayed in all electrical equipment room. Big size SLD of Plant, auxiliary system and earthing layout shall be printed in English and shall be framed and displayed at strategic locations as suggested / asked by Owner.

1.4 BIDDER is responsible for all the engineering, procurement, supply of all materials, fabrication and construction of civil and structural works pertaining to PV solar plant.

1.5 The IS codes referred in this specification shall be considered to be latest as on the date of contract.

1.6 Civil & Structural scope for each Solar Plant shall include but not limited to the following items of work.

(a) Conducting contour survey of the total area, Hydrology study (if required) & soil investigation with field and laboratory tests, submitting draft and final report to OWNER / ENGINEER including all field data in soft copies for approval for each Solar PV Project site/location.

(b) Earthwork for site grading, cutting, filling & levelling of land including cutting and removal trees and vegetation along with necessary statutory permissions, NOCs.

(c) Office setup at Project site for GIPCL employees/representatives, Bidder to provide container (01 Nos for single project capacity up to and 30MW and 02 Nos. for single project capacity above 30 MW) with all facilities like Air conditioning, freeze, drinking water facilities, chair, conference table, electrical facilities, water facilities with pantry facilities in good working condition with no cost to OWNER. The Portable container shall be 20 ft. in length (7 Nos.- Seating Capacity). These shall be considered till project execution stage and the same shall be taken back by Bidder after completion of the project on as is where is basis.

(d) Design, construction, and erection of Module mounting structures / Single Axis Tracker (if applicable) & its foundations.

(e) Design and construction of Inverter room including foundation for Inverter Platform with Structural steel Shed over Inverter area & PEB structure / Containerized solution for rest of the equipment's. In case of string inverter, the foundation & structure design shall be decided during detail engineering.

(f) The Sub Pooling Station/ Control room Building for operation of Solar PV Plant shall be made up of RCC/PEB structures and it shall be Designed and Constructed as per relevant Codes and site conditions. The Sub Pooling Station/ Control room Building shall include (but not limited to) following rooms:

I. PV Plant SCADA & monitoring room
II. 33/11 kV Switchgear room
III. Conference room
IV. O&M office room
V. Mandatory spare room
VI. Store room
VII. Pantry & dining Room
VIII. Battery room
IX. UPS, Battery Charger, LT DB, UPS DB, DC DB etc.
X. Toilet rooms

The Control room building shall have internal and external illumination, requisite furniture's and workstations, Air Conditioning and Ventilation system (where ever applicable) and other equipments as per specifications

(g) Deleted
(h) Deleted
(i) Design & Construction of foundations of transformers, Burnt oil pit, switchgears, combiner boxes, earth pits, ESE Lightening Arrestor, Weather monitoring system, Fencing, main gate, security cabin etc.

(j) Design & Construction and erection of Transformer yard Fence, Switchyard fence, periphery wall (Pre-Cast wall), main/ security gate(s) etc.

(k) Design & Construction of approach road from main Road for easy access to site, internal roads up to inverter stations, with well compacted shoulders on each side for safe and easy transportation of equipment and material at the site during and after construction for O&M of the plant.

(l) Design & Construction of Security cabin one for each Solar Project location placed at main entrance gate with minimum dimension of 3 m x 3m and toilet facility. Toilet shall be provided with clear space of security cabin of 3mx3m. Bidder shall provide Duty guard closed cabin ((i) 4 Nos. for 40 MW (AC) capacity and above (ii) 02 Nos for 10 MW (AC) to 39 MW (AC) (iii) 01 No for up to 9 MW (AC)) for Solar project at single location placed at strategic location as per the directive of Owner for each of Solar Project. . It shall be inclusive of all furniture as per requirement of security cabin.

(m) Carrying out area drainage study to understand the effects of the proposed plant on the storm water drainage of surrounding upstream areas, providing suitable alternate drainage paths to divert upstream storm water away from proposed plant and to nearby nallah (wherever required), or routing the upstream storm water into nallah that runs through the proposed site and carrying out required diversion, widening/ deepening of the nallah. Design & Construction of Storm water drainage & sewerage system if required based on outcome of the study.

(n) Design & Construction of Structures for carrying cables, vehicular movement from one plot to another plot. Bidder to visit the site and obtain all necessary information

pertaining to site condition and project related activities before quoting for the project.

(o) Design & Construction of foundation of water storage tank to cater the day-to-day requirement of drinking water and permanent water supply for module cleaning and other needs of SPV power Plant & during entire O&M period.

(p) Design life of all above structures shall be minimum 25 years.

(q) Providing, supplying, and laying Hume pipes for road crossings while laying power cables, control cables, pipelines etc. These pipes shall withstand the necessary vehicular loads, during the entire life cycle.

(r) Any other approval, as necessary for setting up of a solar power plant as per the statutory guidelines

(s) Structural Stability Certificates for the structures / buildings specified in, for the intended Design Life.

(t) All other statutory approvals and permissions not mentioned specifically but are required to carry out hassle free construction and operation of the plant is in the scope of Bidder.

(u) Construction Power & construction Water as required for construction and completion of this contract are to be arranged by the BIDDER at his own cost.

(v) Designing, submission, to GIPCL and construction of all architectural finishing works necessary for occupation of buildings.

(w) All other temporary facilities like worker accommodation, sanitary facilities, first aid facilities, site office, Storage sheds etc. shall be provided by the BIDDER.

(x) All approvals, equipment, item and works which are not specifically mentioned in this document but are required for successful completion of work including design, construction, commissioning, operation & maintenance of Solar Photovoltaic Power Plant in every respect and for safe and efficient construction & erection, operation and guaranteed performance are included in the scope of the Bidder.

(y) Submission of following documents and drawings, data to OWNER/CONSULTANT/ENGINEER for review and approval in hard copy and softcopy/AutoCAD copy/ STAAD file from time to time as per project schedule.

(i) General Arrangement (GA) layout or Plot Plan or PV Array layout of the entire project shall include roads, drains, storm water drainage, Sanitary and Sewerage system, buildings, sheds, security gate, fire protection system, etc.

(ii) Bidder shall consider applicable Design basis criteria for buildings, foundations, supporting structure, roads, drains, any other foundations etc.

(iii) Bidder shall submit drawings/documents including but not limited to Design calculations for all structures including peripheral fence (wherever required), buildings, foundations, roads, storm water drains etc.

(iv) Bidder shall submit Architectural, Structural & services GA drawings and Good for Construction (GFC) drawings for all types of structures and buildings.

(v) Bidder shall submit all the drawings/documents related to Structural Fabrication.

(vi) Bidder shall restore the site facilities/landscape etc., after the construction phase over to its original condition.

(i) Bidder shall submit As-built drawings / documents and deviation list from good for construction (GFC) drawings. All drawings shall be fully corrected to comply with the actual "as built" site conditions and submitted to OWNER after commissioning of the project for record purpose.

D2 - DETAILED TOPOGRAPHY SURVEY & GEOTECHNICAL INVESTIGATION OF THE PROPOSED SITE

The BIDDER shall be responsible for detailed soil investigation and contour survey at required locations for the purposes of foundation design and other design/ planning required for the successful completion of the project. The BIDDER shall submit the detailed soil investigation report and topography survey report to OWNER/ENGINEER for approval.

1.0 **Topographical survey**

1.1 The scope of work shall include mobilisation of all necessary equipment, providing necessary experienced and qualified land surveyors, supervisors and technical personnel, skilled, unskilled labour and such other services as required to carry out all field work, analysis and interpretation of all the collected data, preparation & submission of survey drawings and detailed report on the work done.

1.2 Only SI System shall be followed.

1.3 The BIDDER shall conduct topography survey to –

(a) To demarcate the acquired property and fix Boundary Pillars at site in co-ordination with the OWNER / ENGINEER as well as representatives of other agencies as applicable. Lengths and bearings with respect to the Magnetic North of each Boundary line shall be determined.
To establish a baseline within the area being surveyed at location indicated by the Engineer and determination of its bearings with respect to the True North as well as the Magnetic North.

(b) To establish and Construct permanent Benchmarks (6 Nos.) on site at locations to be indicated by OWNER/ENGINEER. These shall be tied to nearest authenticated GTS / Survey of India Benchmark established at site and can be used for verification.

(c) To establish horizontal ground control points including those defining the baseline and demarcate them by permanent pillars within the area by triangulation or close traverse or both, based on the nearest GTS / Survey

of India station. These control points shall form the basis of the site Triangulation Network.

(d) To determine Latitude and Longitude of one of the horizontal ground control points, decided in coordination with OWNER / ENGINEER.

(e) To establish a site coordinate grids at 50m interval incorporating established baseline. Each intersection shall be demarcated by a permanent grid pillar with coordinates engraved on the plate.

(f) To survey and determine the ground levels and map (incorporating contour and topographic details) the entire site including land 50m beyond the boundaries or to the opposite edge of adjoining roads or as directed by the OWNER / ENGINEER.

(g) To measure depths and temperature of water in wells, Monsoon stream, rivers, ponds, lakes etc. within the plot, simultaneously recording the ambient temperature and the time of the day and the date. Levels of the ground at the well locations shall be specifically taken and recorded. The survey shall also record bed levels of the Monsoon streams.

(h) To obtain Highest High Flood Levels and Lowest Low Water Levels of normal streams and Monsoon streams; overflow levels and lowest levels of ponds and lakes; tidal levels etc. if applicable.

(i) To identify and mark on the Survey Drawings places of worship, tombs, relics of archaeological importance, trees with girth more than 300mm at 1m above ground level, transmission lines and towers, telephone /telegraph lines and poles, power and lighting poles, trenches, identified underground services and any other structure, etc.

(j) To suitably collate all the Survey details and represent the same on drawings drawn to scales as specified.

1.4 The BIDDER shall mobilize and use appropriate and adequate number of precision instruments and equipment required for the successful execution of the work. These shall include but not be limited to Differential Global Positioning System (DGPS), "Total Stations", theodolites of one second accuracy, levels, ranging rods with least count of at least 5mm, level staves, calibrated tapes, survey umbrellas, etc.

1.5 Boundary Lines of the plot shall be physically established at site by closed traverse with "Total Station" or Theodolite and by constructing Boundary Pillars or embedding pegs at all bends, turning points and at intermediate points of the boundaries located not more than 100m as shown on the Drawing or as directed by the ENGINEER. The BIDDER shall establish co-ordinates of each of these Boundary Pillars with respect to the Site Co-ordinate Grid. Bearings of all Boundary Lines shall be established with respect to the Magnetic North. The general directions of the next Boundary Pillar on either side shall also be etched on the plate. For straight stretches of lengths exceeding 100m, Boundary Pillars shall be established at every 100m interval.

1.6 All necessary Reduced Levels (RL) as entered in the field book have to be submitted along with pre-contour layout of the total site.

1.7 The reference pillars shall be labelled permanently with their respective coordinates and reduced levels for future use. The Benchmarks and reference pillars shall be shown on the survey drawings.

1.8 Pillars shall be 300 x 300mm size founded below 500mm below NGL on100 thick, M 35 grade RCC Pillars shall use, marking RL on top and shall project minimum 300mm above FGL. The top of pillars shall have MS plate with galvanized embedded in concrete for engraving necessary details as specified.

1.9 Positions, both in plan and elevation, of all natural and artificial features of the area like waterways, railway tracks, trees, cultivation, houses, fences, any other permanent and temporary structure, permanent (pucca) and temporary (kutcha) roads including culverts and crossings, foot tracks, other permanent objects like telephone posts and transmission towers etc. are to be established and subsequently shown on survey maps by means of conventional symbols (preferably, symbols of survey of India Maps). All hills and valleys within the site are to be surveyed and plotted on maps by contours. Necessary levelling work of the entire area/areas are to be surveyed and plotted on maps by establishing horizontal location so that location and sketching of contours for the site can be done at specified intervals and in specified scales on maps. Method of survey, contour intervals etc. shall be decided by OWNER /ENGINEER on site in case of steep slopes etc. where grading is not possible. Any unusual condition or formations on the ground, locations of rock outcrops (if visible on the surface) and spring/falls, sand heap/dune, possible aggregate deposits etc. shall also be noted and plotted on the maps. The grids for the survey work shall be established in N-S & E-W direction (Corresponding to Magnetic North) or the Plant North as directed by the/ENGINEER.

1.10 The spot levels shall be taken at nodes of grid 10 m side. The grid shall essentially be perpendicular and parallel to established baseline. Finer grids may be adopted for representing local features. The Contour Maps shall show contours at 0.5m interval. Smaller contour intervals shall be adopted to indicate local mounds, field bunds, dykes, Monsoon stream, rivers, lakes, ponds, wells etc. Presence of any well and/ or tube well in the site or adjoining areas and water level in them shall be in the documents. Details of earlier uses of the site i.e. mining, quarrying, agriculture etc., existing drainage pattern of the site, possibility of water logging and high flood level of the area shall also be captured in the documents.

1.11 Levels shall also be taken on all traverse stations and on salient points located at random over the area (ground points). Contours are to be interpolated at 0.5 M intervals after the above points are plotted.

1.12 The contours shall not be just interpolated but properly surveyed on the ground so that features falling between the two successive levels are also picked up. Sufficient points shall be properly distributed over the entire area and levels shall be taken so that accurate contouring can be done at places of sharp curvature or abrupt change in direction and elevation, points selected shall be close to each other.

1.13 Salient points on ridge lines and valley lines shall also be measured. Transfer of levels shall always start from Main/Subsidiary stations whose levels are based on bench mark established in the survey area.

1.14 The BIDDER shall initially produce check prints of all Drawings for review and comments of the OWNER / ENGINEER prior to proceeding with the final copies at no extra cost to the OWNER. All comments of the OWNER/ ENGINEER shall be incorporated onto the final Drawings.

1.15 The BIDDER shall submit the following drawings:

a) Site location plan drawn to a scale of 1:20000.

b) One drawing, showing the complete plot and prominent features in and around it, drawn to a scale of 1:1000.

c) Detailed Survey Drawing drawn to a scale of 1:500.

d) Contour Map drawn to a scale of 1:500 with Contour Interval of 500mm. The contours shall be drawn in 3-Dimensions such that all the spot levels indicated on the drawings bear all the three co-ordinates viz. X, Y and Z - co-ordinates.

e) Longitudinal profile of the railway lines, pipelines etc. as specified, drawn to a horizontal scale of 1:2000 and a vertical scale of 1:10. Plan shall be drawn along the profile, with scale normal to the alignment at 1:1000.

1.16 Boundary lines shall be shown on all the drawings. Bearings of each boundary line with respect to the Magnetic North and that of the baseline with respect to both the True North as well as the Magnetic North shall be indicated on the detailed survey drawing the contour map as well. Magnetic and true north shall be indicated on each of the sheets. All Pillars shall be shown on the detailed survey drawing as well as the contour maps. The unique nomenclature for each pillar shall be indicated on these drawings.

1.17 The Detailed Survey Drawing shall identify and depict all prominent features and details with their sizes, elevations / depths, bearings and co-ordinates.

1.18 It shall be noted that all Drawings, Maps, Records etc. produced by the BIDDER shall be the sole property of the OWNER and the BIDDER shall not use any of the details for any other work without the written approval of the OWNER.

1.19 All the maps should be prepared in digitized forms using computer software like AutoCAD or as directed by OWNER / ENGINEER. The block of name plate of all the drawings should be as per standard defined by OWNER.

1.20 BIDDER shall submit all data pertaining to the survey in original to the OWNER / ENGINEER including all levels & co-ordinates in X-Y-Z format for the area on Pen drive

1.21 At least 50-meter width of the adjoining solar plots and area shall also be covered in the survey for correlation with adjoining plots. Presence of any well and/or tube well in the site or adjoining areas and water level in them shall be marked in the documents / Drawings.

1.22 The survey shall be conducted through DGPS only.

2.0 **Geotechnical Investigations and Laboratory Tests**

2.1 The BIDDER is advised to and is solely responsible to carry out detailed soil investigation to ascertain soil parameters of the proposed site for the use of planning /designing / construction / providing guarantee / warranty of all civil work including but not limited to foundations / piling for module mounting structures, HT lines, etc. The BIDDER shall carry out soil investigation through either KCT (Ahmedabad), M.K. Soil (Ahmedabad), Unique Lab (Surat), GEO DESIGN (Baroda) and NABL accredited labs or agency suggested and approved by GIPCL. These reports shall be furnished to the Owner for approval prior to commencing work.

2.2 The BIDDER shall carry out geotechnical investigation for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The BIDDER shall obtain the approval for the field and laboratory testing scheme proposed by him from the OWNER / ENGINEER before undertaking the geotechnical investigation work.

2.3 The scope of soil investigation covers execution of complete soil exploration including boring, drilling, collection of undisturbed soil sample where possible, otherwise disturbed soil samples, conducting laboratory test of samples to find out the various parameters mainly related to load bearing capacity, ground water level, settlement, and soil condition and submission of detail reports along with recommendation regarding suitable type of foundations for each bore hole along with recommendation for soil improvement where necessary.

2.4 Field test shall include but not be limited to Boreholes, Standard Penetration Test (SPT), Cone Penetration Test (CPT), Plate load tests (PLT), collection of disturbed and undisturbed soil samples (UDS), Trial Pits (TP), collection of water samples, Electrical Resistivity Test (ERT), etc.

2.5 Bidder shall submit a soil investigation plan for review and approval before executing field work. The minimum requirement for field work is indicated in ensuing paragraphs.

2.6 Minimum 1 No. of borehole of minimum 10 m depth shall be carried out in every 12.5 acres of land for MMS foundations. For Inverter yard and building location the minimum depth of bore hole shall be 30 m in seismic zone iv and v, for other location it shall be minimum 15 meter. Please note that if soil data reveals significant variations, bidder shall carry out additional boreholes after intimating client/GIPCL. On completion of every borehole, field record shall be continuously mailed to client/GIPCL.

2.7 The minimum depth of borehole shall be not less than 30m /refusal strata (3 consecutive SPT N>100) or 5m inside hard clay (SPT N>30 consistently) or 10m inside dense sandy strata (SPT N>30 consistently). Locations shall be as per approved geotechnical investigation scheme.

2.8 Standard Penetration Test (SPT) shall be carried out in all types of soils up to three consecutive refusals (SPT N>100) within a borehole. In refusal strata, the number of blows and corresponding penetration of sampler shall be recorded.

2.9 SPT shall be conducted at every 0.5 m interval or at change of strata. Up to 5m. Further beyond, SPT shall be conducted at intervals of 1.5m /change of strata up to refusal.

2.10 Undisturbed samples (UDS) shall be collected at every 1.0 m interval or at change of strata in clay /semi cohesive soil layer only. In sands/silty sands/sandy silts , SPT shall be performed. In clays /semi cohesive soils, if SPT N exceeds 20, UDS shall be replaced with SPT

2.11 In weathered rock /refusal strata (having nil CR), Once refusal is reached (N>100), same shall be reconfirmed by conducting two more SPT at 3m intervals. SPT in refusal strata shall be conducted using new SPT shoes. Damaged shoes shall not be used Wash samples recovered from drilling shall be collected

2.12 For rock having CR <50% drilling shall be carried out for a depth of 5m. Drilling shall be done in runs of 1.5m.

2.13 For rock having CR>50% and RQD>25%. depth of drilling shall be 3m. Drilling shall be done in runs of 1.5m.

2.14 For poor quality rock, individual drill run shall be suitably reduced to 0.5 /1m

2.15 During drilling, Site Engineer shall record details such as time taken for drilling each drill run, individual core piece length, depth at which drilling bits changed from MS Cutter to TC /Diamond bits, water losses, borehole collapses etc

2.16 Rock cores obtained shall be placed with sequential numbering in core boxes and photographed. In field borelog, individual core piece length shall be mentioned and CR as well as RQD computed.

2.17 Minimum 1 number of ERT, 1 no. Trial pit (with TRT) shall be carried out for every 100 acres/mandatory at location of Inverter Yard or less area, as per layout.

2.18 All four walls of trial pits shall be photographed. Bulk samples shall be collected at 0.5m and between 0.5m to termination depth. If strata is same as revealed visually, one sample is sufficient

2.19 During field investigations, presence of localized /surface rock outcrops, laterite outcrops, localized slushy soil areas /channels or tank beds if found either within the site or in vicinity of Boreholes /Trial pits, same to be noted down by site Engineer along with GPS coordinates (UTM) and details to be enclosed in the report along with photographs.

2.20 Thermal resistivity tests, where specified by Engineer -in-charge shall be conducted on site in all the trial pits as per ASTM standards. Soil sample from the same location shall be collected and tested in laboratory for laboratory thermal resistivity

2.21 The laboratory tests shall be conducted on soil, rock & water samples collected during field investigations in sufficient numbers as approved by OWNER or ENGINEER. Laboratory tests shall be carried out on disturbed and undisturbed soil samples for –

(a) Grain Size Analysis,
(b) Hydrometer Analysis,
(c) Atterberg Limits,
(d) Triaxial Shear Tests (UU),
(e) Natural Moisture Content for UDS samples
(f) Specific Gravity, Total and dry unit Weight for UDS samples
(g) Specific Gravity and Bulk Unit Weight,
(h) Consolidation Tests,
(i) Unconfined Compression Test,
(j) Free Swell Index, Shrinkage Limit, Swell Pressure Test,
(k) Swell Pressure Test on soils having DFS>50%,
(l) Liquefaction analysis and its outcome
(m) Modulus of subgrade reaction shall be derived as per IS-2950 (Part-1)
(n) Thermal Resistivity Test
(o) Compaction tests (both Standard and Modified) for bulk soil samples collected in trial pits. Sample collected at 0.5m shall be tested in Modified Proctor condition and sample collected between 0.5m to termination shall be tested in Standard Proctor condition
(p) CBR tests in 97% Modified Proctor condition (Both Unsoaked and 4 day Soaked)
(q) Chemical Analysis test on soil and water samples to determine pH, chlorides , sulphates 2: 1 Water :Soil extract and accordingly provide recommendation of type of cement to be used for concrete.
(r) Chemical analysis of water samples from boreholes as per relevant IS Codes.
(s) Water intended for use in construction shall also be tested as per relevant IS Codes.

(t) Electrical conductivity test on soils as per IS:14767
(u) Electrical conductivity test on water as per IS:11624
(v) Silt factor shall be provided (if sought by OWNER /Consultant)
(w) Laboratory tests on rock samples shall be carried out for Specific Gravity, Unit Weight, Water absorption, Porosity, point load index for broken /weathered rock cores /lumps, Uniaxial Compressive Strength (in-situ & saturated), etc.

2.22 On completion of all field and laboratory work, the BIDDER shall submit a soil investigation report to OWNER / ENGINEER approval. The interpretative geotechnical investigation report shall contain field and laboratory observations/ data/ records, analysis of results and recommendations on type of foundation for different type of structures envisaged for all the areas of work. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils (including CNS layer thickness), etc. shall also be covered in the report, as applicable.

The report shall provide complete recommendations on type of foundations most suitable for the MMS structure, any other building foundation, any foundation for any other equipment depending on soil strata encountered. If hard rock is encountered at surface, recommendations shall be provided for foundations having minimum 0.6m inside rock. If pile foundations are recommended, capacities shall be furnished for axial, uplift and lateral capacity (free head) considering all diameters and lengths. In lateral pile capacities, the projection of pile above ground level shall be considered as per actual condition / as approved by the Owner. The Design shall be made considering worst result amongst the bore holes.

SBC shall be provided for foundations of varying width and depth and rafts / isolated at below existing ground level considering all shapes (square, strip, rectangular) from both shear criteria and settlement criteria (25mm, 40mm, 50mm) considering worst condition of water table (existing ground level)

For other structures such as buildings and equipment foundations, diameter of pile shall be considering with varying depth and Diameter. Capacities shall be provided for axial, uplift and lateral (both free and fixed head condition) considering pile cut off.

Soil consultant shall understand through local enquiry and by visiting nearby project and ascertain information on foundation systems being implemented

Soil report shall also examine the feasibility of adopting rammed metal posts and provide capacities for axial, uplift and lateral based on standard theories.

For short Piles, Brom's theory shall be adopted for lateral capacity evaluation. All pile capacity calculations shall be as per IS-2911 (Part-1-Sec-2) /IS:14593 (Bored piles founded in rock). The BIDDER is required to initially submit draft of the complete report for comments and approval by e-mail. On receiving comments, the BIDDER shall incorporate all the comments the corrected draft to the ENGINEER by e-mail. On written approval of the corrected Draft Report, the BIDDER shall submit two (2) copies of the report. All these shall

be as outlined in the Standard Specifications "Geotechnical Investigation and Report – General Purpose".

On completion of all field tests, Bidder shall interact with OWNER /ENGINEER and plan for initial test pile construction and test the same after 28 days for axial, uplift and lateral capacities up to failure condition. In case SPT data shows the possibility of liquefaction, same condition shall be simulated in site during trial testing

D3 - HYDROLOGY AND AREA DRAINAGE STUDY

The hydrology study report furnished by OWNER shall be considered for the information only. BIDDER shall review the hydrology study report w.r.t scope of work as given below and if anything required to complete the following scope of work bidder shall arrange the same by Bidder at its own cost.

a) Site visit for reconnaissance survey and collection of data required for successful completion of the study. Bidder need to acquaint himself regarding complete site - specific information before start of work. An interim report covering site visit report, identification of outfall locations and preliminary planning schemes of drainage network will have to be submitted to OWNER

b) Estimation of rainfall intensity and run-off corresponding to 25-year, 50 year and 100-year return period

c) Report shall cover flood risk analysis and inundation map at project site for various rainfall return period of 100, 50 and 25 years.

d) Preparation of digital elevation model (DEM) for the study area for delineation of catchment and delineation of drainage network for comparison with drains of topo-sheet.

e) Estimation of high flood levels at various critical locations of project site.

f) Catchment area of streams entering the plot and outer catchment contributing to drains within the plot to be identified

g) Natural streams/rivers, direction of water flow and width, depth, invert levels of streams to be captured

h) Estimation of run off coefficient and recommendation for plant drainage System.

i) In post project scenario, the plot plan will have to be considered while planning

j) network within plant area. Runoff at critical points (at proposed culverts) of the proposed drainage network including at all outfall locations will have to be estimated.

k) Finalization of outfall points to evacuate flood waters from plant area.

l) Review of safe grade elevation based on the high flood level and other considerations such as free board including optimization for land filling

m) Remedial measures to prevent site flooding.

n) Providing technical services as and when called for by the OWNER.

Bidder is advised to follow the natural contour with specific requirements as below. Owner reserves the right for any changes and final decision.

D4 - LIST OF FACILITIES AND BUILDINGS

1.0. Following is the list of minimum facilities and buildings but not limited to the following only. BIDDER shall provide all facilities/buildings that are required for smooth and efficient performance of proposed solar power plant.

(a) Inverter Platform (RCC) with Structural steel Shed over Inverter area & PEB structure for rest of the equipment or foundation for string inverters.

(b) Inverter Yard (Transformer, burnt oil pit, NIFPS pit (if applicable), Fencing and other foundation)

(c) String inverter foundations (if applicable)

(d) Inverter combiner boxes foundations (if applicable)

(e) String Combiner Box (SCB) foundation as applicable

(f) Sub pooling station (RCC) platform with superstructure PEB type building (RCC CUM PEB Building) or RCC Frame Structure type Building.

(g) Sub Pooling station/ Control Room Building consist of PV Plant SCADA Monitoring room, Mandatory spare room /Store room, conference room, O&M room, Shift In-charge room, Technician room, LT or other equipment room, Battery room etc. along with Toilets and Pantry facilities.

(h) Design of Module Mounting Structures and Its foundation

(i) Inverter Yard Cable tray and foundation

(j) ESE LA foundation

(k) Earthing pits

(l) Weather Monitoring foundation works

(m) Foundation for Water Storage Tanks

(n) Roads

(o) Storm Water Drainage & Sewerage System, as applicable

(p) Plumbing and Sanitation

(q) Plant periphery Fencing as per layout / Main Gates & other fencing

(r) Security Cabins and Duty Cabins

(s) Structural steel work and foundation

(t) Site Office with facilities as required during execution stage

(u) Foundations for Lighting Poles

(v) All the civil works for Module cleaning system including structural sheds

(w) Dewatering works

(x) Site enabling and site infra works

(y) Site Survey and Investigation works

(z) All the civil works which are not mentioned above but required for successful commissioning of Solar PV Plant

D5 - LAND DEVELOPMENT FOR SITE ACTIVITIES

The Bidder is responsible for making the site ready and easily approachable by clearing of bushes, felling of trees (if required with appropriate approval from concerned authority), levelling of ground (wherever required) etc. for commencing the project. Site grading level shall be fixed with due reference to site drainage of the whole area, existing drainage pattern, maximum flood level (from topography survey) and system requirements. If the land pocket needs any filling, it is to ensure that the filled area is filled with good quality earth and well compacted as per the relevant IS standards.

D6 - FOUNDATIONS

1.0. The BIDDER is responsible for the detailed soil investigation and subsequent foundation design of the structures in the plant. The foundation of buildings and other important structures shall be approved by OWNER/ENGINEER prior to construction. The BIDDER shall provide the detailed design and calculations of the foundation. The foundations shall be designed considering the weight and distribution of the structure and assembly and designed to withstand wind speed applicable for the proposed site and as per relevant IS code. Seismic factors, wind zone etc. for the site shall be considered for the design of the foundation.

1.1. No foundation shall be allowed to rest directly on backfilled or swelling type of soil. Final founding level shall be as per foundation design, recommendation given on soil investigation report and as per Owner approval. Minimum depth of foundation shall be 1 m below NGL.

D7 - EXCAVATION, BACK-FILLING AND DISPOSAL OF EARTH

1.0. Excavation for foundations, trenches, pits, sumps, underground tanks, roads, boundary wall, pathways shall be considered in all types of hard & soft soil, weathered & soft rock, hard rock etc. using appropriate mechanical equipment.

1.1. Ground shall be level to prevent water logging, soil erosion, etc

1.2. Back filling shall be carried out either with good quality excavated earth as approved by OWNER/ENGINEER or good quality earth brought from borrow areas. Backfilling shall be carried out in layers with minimum 95 % proctor density and required test. Poor quality excavated earth and surplus excavated earth shall be disposed outside the plant premises

at unobjectionable areas irrespective of any lead. BIDDER shall obtain all local statutory approvals for bringing earth from outside and disposal of earth outside.

1.3. If blasting is required for excavation, the BIDDER shall carry out control blasting with the help of licensed charger by obtaining all necessary approvals from local statutory authorities.

D8 - TRANSFORMER YARD CIVIL WORKS

1.0. Transformer and Switchyard (along with Transmission line) equipment's foundations shall be founded on piles/isolated spread footings depending on the final geotechnical investigation report. Transformer foundations shall have its own soak pit which would cover the area of the transformer and cooler banks, to collect any spillage of oil or oil drainage in case of emergency. The oil pit shall be filled with granite stones of 40 mm size uniformly graded. The Bidder shall be required to furnish a performance guarantee of three years for the anti-weed treatment. The transformer foundation work shall be carried out as per requirement of CEA and other IS codes.

1.1. The individual oil pits shall be connected to an oil collection pit by pipe with slope 1:100 which shall be sized to accommodate oil volume of the largest transformer connected to it, without backflow. The oil pit shall be connected to oily water drainage system. The discharge pipe shall be designed considering rainfall intensity also. The above requirements shall be applicable based on type of transformer - Oil type transformer / Dry type transformers. Burnt oil pit shall be RCC type. The sizing and arrangement shall be as per applicable regulations and codes and standard.

1.2. The area around the transformer and Switchyard equipment's shall be covered with gravel and galvanised chain link fence (PVC coated in case of high corrosive area) of height min 1.8 m with fence posts and gates shall be provided. All fence posts shall be 65X65X6 MS angles spaced at 2.5m c/c distance and all other specification mentioned for Fencing and gate shall be followed. M.S. angle posts shall conform to IS: 2062.All structure steel shall be hot dip galvanized with galvanization coating thickness mentioned in Tender document. In addition, a small gate, 1.2 m wide shall be provided for man entry. Transformer track rails shall conform to IS: 3443. The requirement of fire barrier wall between transformers shall be as per Electricity Rules and IS: 1646 recommendations. The transformer shall be placed minimum 750 mm above NGL and higher as applicable during detail engineering.

1.3. Burnt oil and NIFPS pits shall be RCC tank shall be provided with membrane type internal water proofing. It shall have C.I man hole cover (750 x 750 mm) and rungs to enter the pit.

D9 - SUB POOLING STATION/ CONTROL ROOM BUILDING WITH RCC FRAME STRUCTURE OR RCC PLATFORM WITH SUPERSTRUCTURE PEB TYPE BUILDING (RCC CUM PEB BUILDING)

1.0. Sub pooling station shall have auxiliary transformer, distribution boards, UPS with battery, 110V DC system, 33kv switchgears, Inverters, NIFPS, SCADA panel other equipments etc. for each Solar Project and all other facilities as required.

1.1. Dimension of all rooms shall be based on area covered by electrical / I&C equipment's including working space, utility and other facility and reserved space and / or required for future installation of equipment's if any.

1.2. Sub Pooling Station or Control Room Building shall be RCC Frame Structure building or RCC Platform with PEB type Superstructure building (RCC cum PEB Building)

1.3. The FFL of building shall be minimum 1 m above NGL or 700 mm from HFL (Highest Flood Level) whichever is higher. Equipment rooms shall be sized and designed as per the OEM recommendations to ensure desired life of equipment. The static live load on floor shall be higher of 1000 kg/m2 or actual equipment load.

1.4. Bidder shall furnish the architectural and construction drawings of the proposed building to the OWNER / ENGINEER for approval, prior to construction. The layout, design, and drawings for all RCC structure, etc. and foundation system shall be approved from OWNER/ENGINEER before start of works. The buildings and allied works shall be designed to meet national building code (latest edition) requirements.

1.5. The Sub Pooling Station/ Control room Building shall include (but not limited to) following rooms:

a) PV Plant SCADA & monitoring room
b) Switchgear room
c) Conference room
d) O&M office room
e) Mandatory spare room
f) Store room
g) Pantry & dining Room
h) Battery room
i) UPS, Battery Charger, LT DB, UPS DB, DC DB etc.
j) Toilet rooms
k) Any other room as required by Owner.

1.6. The Sub Pooing Station or Control room building shall have internal and external illumination, requisite furniture's and workstations, Air Conditioning and Ventilation system (where ever applicable) and other equipments as per specifications.

1.7. The minimum detailed specifications of Control room building shall be as described below.

(a) The building shall have conference room. Minimum size of Conference shall be 24 sq.m carpet area. Conference room shall have minimum 1- Conference table, 10 nos. revolving chairs, 43" HDMI / Wi-Fi enabled TV Screen and 1 – sufficient size cub board. It shall have sufficient power socket of 16 A and 6 A as required.

(b) The building shall have main O&M Office having separate room for workstation and shift in charge room. Minimum carpet area of O&M office (housing workstation and Shift in charge room) shall be 18 sq.m. It shall have minimum 1 - Cubical, 4-Workstations , 7-Nos.-revolving chairs, tables, cupboard and other facilities in shift in charge as required for O&M. It shall have minimum 4 locks having 5 lockers.

(c) The building shall have store room .Minimum carpet area for store room shall be 20 sq.m. It shall have 4 nos. of cupboard with lock and key arrangement. It shall have heavy duty slotted angle racks (minimum 10 Nos.) with minimum thickness of 10

guage and approved make of MEK Engineering/or as approved by OWNER. It shall have sufficient power socket of 16 A and 6 A as required.

(d) Plinth protection 1000 mm wide and 100 mm thick shall be provided around the buildings in PCC M15 grade of concrete. Garland drain shall be provided all round building. Building peripheral drains shall be stone/brick masonry/concrete works. These side drains shall be connected to nearest drain network.

(e) Switchgears room shall have Granolithic or cement concrete flooring with non-metallic floor hardener. SCADA room shall have Heavy duty vitrified ceramic tiles. Battery room shall have 50/75 thick acid/alkali resistance tile flooring and dado up to 2100 mm with compatible cement mortar. Lobby shall have Heavy duty vitrified ceramic tiles and skirting of 150 mm matching with floor tiles.

(f) 20 mm thick Kota stone/Granite shall be provided for steps. Storeroom shall have 50 mm thick cement concrete flooring with non-metallic floor hardener.

(g) Flooring for Air-conditioned areas area shall be provided with vitrified ceramic tiles of size 600X 600 mm of min 9 mm thickness, laid with 3 mm ground joints as per approved pattern.

(h) The SCADA/Conference/O&M office room shall be provided with false ceiling of 15 mm thick mineral fibre board, in tile form of size 600mm x 600mm, along with galvanised light gauge rolled form supporting system in double web construction pre painted with steel capping, of approved shade and colour, to give grid of maximum size of 1200x600 mm as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts(if required), return air grills (if required), light fixtures, etc., all complete. The SCADA cabin shall be fitted with split type air conditioning units. However, OWNER / ENGINEER's approval shall be obtained.

(i) Mandatory spare room size and requirement shall be decided during detail engineering.

(j) Roof of the Building shall consist of Either Cast-in-situ RCC slab or PEB Puff roof Panels. Cast-in-situ RCC slab with an approved water proofing system suitable for local climatic conditions with 10 years of leak-proof guarantee. The roof of the building shall be waterproofed with approved Polymeric membrane type waterproofing and laid as per manufacturer's recommendation. The roof shall be designed for minimum superimposed load to 150 kg/m2. Also, Chajja, canopy shall have water proofing as explained above.

(k) For efficient disposal of rainwater, the runoff gradient for the roof shall not be less than 1:100 and the roof shall be provided with projection of minimum 600mm all-round. This gradient can be provided either in structure or subsequently by water-proof screed concrete of grade M20 (using 10 mm down-graded coarse aggregate) and/or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface.

The roof of building shall project out by at least 750 mm all around the building from its external walls with and parapet wall above the roof beam. Height of parapet wall shall be minimum 600 mm above top of roof level. This is applicable in case of RCC roof.

(l) Stair shall be provided to access the roof of the building.

(m) Required number of tables, printer tables, desk, water filter, revolving chairs etc., shall be as per approved by Owner. Bidder shall provide the list of all furniture details/plan for Owner approval.

(n) The floor finish for toilet shall be vitrified ceramic anti-skid tiles and Dado glaze ceramic tiles up to 2.1m shall be used. The normal size of Ceramic tiles shall be 300 mm X 300 mm X 9 mm and shall comply IS: 15622.

(o) Battery room shall have 50/75 thick acid/alkali resistance tile flooring and dado up to 2100 mm with compatible cement mortar. Lobby shall have Heavy duty vitrified ceramic tiles and skirting of 150 mm matching with floor tiles.

(p) It shall have entry lobby and portico with roof. It shall be designed to have clear view through glass windows on all sides. Suitable access shall be provided.

D10 – Deleted

D11 - INVERTER PLATFORM (RCC) WITH STRUCTURAL STEEL SHED OVER INVERTER AREA & PEB STRUCTURE FOR REST OF THE EQUIPMENT'S

1.0. Inverter Platform shall have Inverters, 33kv switchgears, battery banks, Various LT Panels, various distribution boards, Auxiliary transformers (if applicable) etc. and provided based on manufacturer recommendation, easy passage of O&M persons and cable trench layout required.

1.1. Outdoor inverter (including containerized solution) platform shall be Min. 1000mm from NGL or 700 mm from HFL (Highest Flood Level) whichever is higher. Cable bending radius and other relevant factors to be considered during platform design. This shall be reviewed during detailed engineering.

1.2. Inverter shall be placed over a raised RCC platform with sheds to cover from sun light and rains. The structural shed shall have covered roof extending minimum 0.9 m all round to avoid rainwater from sides. Handrail shall be provided all round. The platform shall be sufficient wide to accommodate O&M requirement and inverter manufacturer requirement. RCC staircase to access the platform along with GI handrails shall be provided to access the platform. The minimum coating shall be as per technical specification. Width of staircase shall be minimum 1000 mm. This shall be further reviewed during detail engineering. The structural shed can be placed over inverter area as per codes and standard and manufacturer's recommendation. In case of PEB it shall match the requirement generally in line with that of PEB of other building.

1.3. For Outdoor Inverters (without containerized solution) complete assembly shall be placed inside a shed made of structural steel section preferably tubular/hollow section and color coated metal sheets for roof with BMT 0.5 mm and at least 900 mm projection in all side. Structural steel and paints for shed shall be as per ISO 12944-5. The shed structural steel shall be GI with minimum coating thickness as per technical specification.

1.4. The other equipment shall be housed in PEB or containerised solution based on manufacturer's recommendation. For containerized solution separate shed is not required, however, the container shall have projection of at least 900mm wherever an opening in the inverter door exposes the inverter component to outside environment. It shall match the requirement generally in line with that of PEB.

1.5. 1000 wide and minimum 75 mm thick plinth protection in concrete grade M15 over 75 mm bed of dry brick ballast 40 mm nominal size well rammed and consolidated and grouted with fine sand including finishing the top smooth, shall be provided around the Pre-Engineered Building.

1.6. Flooring, including preparation of surface, cleaning etc. shall be of Granolithic or cement concrete flooring as per IS: 2571 with non-metallic floor hardener with glass/PVC strips.

2.0 **PEB Specifications**

2.1 The specification covers the general requirements and the specific technical requirements for the Pre-Engineered Building works (PEB), which are not covered by any of the other technical specifications but are required to be carried out for the satisfactory completion of the work. It shall be noted that all Codes of Practice and Standards shall be those of latest issue.

2.2 The Bidder shall design the building as per latest version of IS: 800 and the technical requirements furnished by OWNER / ENGINEER. Fabrication & erection shall start only after getting approval on design & drawings from the OWNER / ENGINEER.

2.3 The Bidder shall be fully responsible for the complete structural design, fabrication, transportation to site and safe erection of the building at site, within the agreed time frame and Structural Stability Certificate for the structure for intended life period. Any approval from ENGINEER or OWNER shall not relieve the Bidder from the responsibilities for correctness of his designs and drawings.

2.4 Some of the major and mandatory requirements are as indicated below:

a) The layout shall be designed for a life of 25 years as per requirement of Equipment and as per clearances required. The Bidder shall have to get the structural design done as per the prevailing Indian standard codes and International Standard. The structural design of shed shall be submitted to OWNER for approval before actual starts of the work.

b) The general arrangement and architectural drawing of insulated roofing & cladding system for providing general idea about work to be performed under the scope of the contract shall be submitted to OWNER as bid submission.

c) The PEB shall have robust water tightness at all joints and connections. The building shall have a high-class durability and performance during the adverse weather conditions.

d) PEB shall be complete with painting, metal facia, metal gutter, rainwater down comers, sun-shades, openings, etc., along with associated structural steel, cladding and roofing work insulation, Trims & Flashings. Each item of PEB like panels, masonry, plastering, flooring, foundation, fittings etc. shall be suitable for complete life of solar plant. (e) The design basis and construction methodology for PEB shall also be submitted to OWNER for approval before start of works.

e) The design basis and construction methodology for PEB shall also be submitted to OWNER for approval before start of works.

f) Generally straight/ uniform / tapered solid web Steel portal frame shall be provided, as per OWNER's requirements.

g) Roof slope shall be as flat as possible. Preferably roof shall not be steeper than 1:10 to horizontal. Roof shall be non-piercing type.

h) Nylon safety net shall be provided below roof sheeting as a safety measure during the roof sheeting erection.

i) A suitable arrangement of rainwater down takes shall be provided to collect the rainwater discharge from the roof to the ground level. The PEB CONTRACTOR shall design rainwater gutter size. The downspout shall be provided at appropriate locations.

j) Rainwater down take pipes shall be provided up to ground level and up to nearest storm water chamber. All the necessary fittings, bends, elbows, etc. shall be provided by the PEB CONTRACTOR. The connection of rainwater down takes to the PVC pipe provided in the nearest inspection chamber below ground shall be provided by the Bidder.

k) The cage ladders shall be provided wherever required as per the OWNER's requirement. The colour of the cage ladder and staircase structure shall match the sheeting colour and patterns.

l) The supporting arrangement for all rolling shutters shall be provided by the PEB Bidder. For fixing the rolling shutters, the Jamb headers shall be clamped to plinth beams below using mechanical fasteners. Thickness of supporting members of jamb headers shall not be less than 6mm.

m) Roof shall be solid steel web portal frame with double skin insulated roofing composed of 0.5 mm TCT Plain Galvalume sheeting of minimum 550 MPA yield strength, seating above the purlin members. The sheeting shall be fixed to purlin with “Standing Seam” system. The roof shall be totally non-pierced type. The material of PEB shall be compatible as per relevant Standards.

n) Side sheeting shall be provided for the entire perimeter and full height. Insulated wall cladding, or roofing shall consist of double skin metal cladding composed of 0.5mm TCT galvalume sheeting of minimum yield strength of 550 MPa with Poly Urethane Foam (PUF). PUF must be made of continuous method PU foam and must be CFC free, self-extinguishing, fire retardant type with density 40 +/-2 kg/m3 and thermal conductivity 0.019-2.2 W/ (m.K) at 10°C. The PUF panels shall be a factory-made item ready for installation at site.

o) The PEB Panel shall be made of Sandwich insulated panels 80 mm or higher thickness with Poly Urethane Foam (PUF) as filler material between polyester pre-coated cold rolled steel. PUF insulated panels Metal Sheet for Roofing and side cladding consist of external sheet as troughed permanently colour coated sheet & internal sheet as plain permanently colour coated sheet.

p) The type and locations of inner vertical bracing will be decided during detail engineering. Bracing system shall be provided for the columns in the entire building, wherever required as per design. The access as demarcated in the general arrangement drawings shall be free of bracing. On grids having rolling shutters, portal bracings up to rolling shutter level shall be provided and above cross angle bracings may be provided.

q) PEB Bidder shall plan the bracing bays and shall take approval from OWNER/ENGINEER on patterns and location before going for detailed engineering.

r) Rod / Angle / pipe / tube bracing shall be provided for the roof, wherever required as per design. The vertical bracings shall be of angle / channel / pipe / tube members only.

2.5 Primary members fabricated from plates shall conform to IS: 2062 min Grade E250 Quality BR/ ASTM A572-12 Grade 50 with minimum yield strength of 345 MPa. Steel shall be semi-killed/killed. Minimum thickness of steel plates shall be 6 mm. Hot rolled primary structural members and Rod /Angle bracing shall conform to IS: 2062 Grade E250 Quality A.

2.6 A secondary member for Purlins and Girts shall conform to the specification of IS: 811 or ASTM: A1003-12 made from steel sheets conforming to ASTM: A1011- 12b Grade 50 having minimum yield strength of 345 MPa. The minimum thickness of secondary members shall be 3 mm.

2.7 Primary structural framing shall include the transverse rigid frames, columns, corner columns, end wall wind columns, beams, truss member, base pate.

2.8 Secondary structural framing shall include the purlins, girts, eave struts, bracing, flange bracing, base angles, clips, flashings and other miscellaneous structural parts. Suitable wind bracings sag rods to be reckoned while designing the structure.

2.9 Sealant used for cladding shall be butyl based two parts poly sulphide or equivalent approved, non-staining material and be flexible enough not to interface with fit of the sheets. Any gap between floor and wall PUF panel shall be grouted with Fosroc-GP2 or equivalent material.

2.10 Solid or closed cell closures matching the profiles of the panel shall be installed along the eaves, rake and other locations.

2.11 Flashing and / or trim shall be furnished at the rake, corners, eaves, and framed openings and wherever necessary to provide weather tightness and finished appearance. Colour shall be matching with the colour of wall. Material shall be 26 gauge (0.455mm) thick conforming to the physical specifications of sheeting.

2.12 Gutters and down-comers shall be fabricated out of same material as that of sheeting. It shall be brought down to the ground level for smooth discharge of water.

2.13 Steel bolts, nuts and washers complying with relevant IS codes. High Strength Bolts for Primary Connections IS: 1367 (Part III) Gr. 8.8 . Bolts for Secondary Connection are: 1367 (Part III) Gr. 4.6 . Anchor/foundation Bolts shall conform to IS: 5624 and relevant IS code.

2.14 The external wall of Inverter room facing the transformer area shall be as per IS: 1646 - Code of practice for fire safety of buildings (general): electrical installations.

2.15 Door frames shall be of T-iron frame of mild steel Tee-sections. All doors shall be provided necessary fittings like hinges, handles, mortise locks, tower bolts, stopper, hydraulic door closer, etc. of CP brass complete.

2.16 Internal doors shall be anodized aluminium provided with extruded built up standard tubular sections, appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, including necessary filling up of gaps at junctions with required PVC/neoprene felt etc. including hinges / pivots and double action hydraulic floor spring of approved brand and manufacture IS: 6315 marked, lock, handle and all necessary fittings as per the details submitted by Bidder in shop drawing and approved by OWNER / ENGINEER.

2.17 The door entrance shall include pressed steel single leaf door. The structural steel shall conform to IS: 7452 and IS: 2062. The holdfasts shall be made from steel flats (50 mm and 5 mm thick). The fixtures, fastenings and door latch are to be made with same materials.

2.18 Window frame shall be anodised aluminium section frame of size 92x31 mm, minimum 16 gauge (1.519mm) thick as per approved design. Tinted glass and aluminium grill shall be provided.

2.19 Ventilators shall have anodized aluminium frame of minimum size 62x25 mm and 16 gauge thick as per approved design. Ventilators/duct shall be provided with bird guard. Size of opening at wall for ducts shall be as per Inverter manufacturer and min 18-gauge (1.214mm) GI sheet ducts shall be supported with suitable means, as approved during detail engineering. All accessible ventilators and windows of all buildings shall be provided with min. 4mm thick float glass, tinted for preventing solar radiations. Suitable sunshades made out of approved colour sheet will be provided to all external windows and doors. The minimum projection for the sunshades will be 600 mm and 300mm wider than the width of the opening.

2.20 Rolling shutter (Hand operated) shall be fabricated from 18 gauge (1.214mm) steel and machine rolled with 75 mm rolling centres with effective bridge depth of 12 mm lath sections, interlocked with each other and ends locked with malleable cast iron clips to IS:2108 and shall be designed to withstand a wind load without excessive deflection. Metal rolling shutters and rolling grills as IS: 6248.

2.21 The structural steel shall be hot-dipped galvanized, conform to IS: 4759 or relevant Indian standard. Minimum thickness of galvanization shall be as per Tender document for all the structures.

2.22 Self-Weight of Structure including Purlins, Sheeting, Girts, Bracings, lighting fixture, fire sprinkler pipes, fire header pipe, and turbo ventilators to be considered as Dead load etc. Live loads shall be as per IS: 875.

2.23 Point load of 0.15 kN shall be considered at centre span of each purlin. Miscellaneous collateral load of 0.5 kN/m2 on projected plan area of the building shall be considered for design of Portal beams and columns.

2.24 The basic wind speed of the site and values of K1, K2, K3 and K4 and other pressure coefficients shall be as per IS: 875-(Part 3) latest version. It shall be as per Pd defined in specification.

2.25 The Seismic forces shall be considered as per IS: 1893 (latest version).

2.26 The limiting permissible vertical and horizontal deflection for structural steel members shall be as per IS 800 code (latest version) where ‘h’ is height of building at eaves from FGL.

D12 - ANTI-TERMITE TREATMENT

Anti-treatment shall be provided injecting chemical emulsion for pre-construction and creating a chemical barrier (through agency approved by Owner) complying to IS 6313. Using Chlorpyriphos Emulsifiable 1.0 % concentration by weight under and all-around foundation pits, wall trenches, basement excavation, top surface of plinth filling, junction of wall and floor, along the external perimeter of building, expansion joints, surrounding of pipes, water conduits or at places suggested by Engineer etc. complete (Plinth Area at ground floor only shall be measured). Performance guarantee for at-least 10 years from handing over date shall be submitted to OWNER by BIDDER.

D13 - REINFORCED CONCRETE AND ALLIED WORKS

1.0 All RCC works shall be design mix as per IS: 456. As chloride is encountered along with sulphates in both sub-soil and ground water, Portland slag cement Or Sulphate Resisting Cement may be used for all buried RCC structural members.

1.1 Only automated batching plants will be deployed. Details of the batching plant to be submitted for GIPCL review before installation. Ajax flori like batching arrangement is not accepted. Batching plant should have facility for printing the batch slips. Calibration of the batching plant will be done as per IS 4925 at the required frequency. 1st calibration after the installation has to be done in the presence of 3rd party apart from Owner. All necessary test related to materials of concrete mix like cement, sand, steel, aggregates etc shall be carried out regularly as per relevant IS code. Test related to concrete like compressive strength, workability etc shall be carried out as per relevant IS Codes. Bidder shall carry out any special treatment below foundation, below RCC cable trenches, below RCC floor slab/plinth as required for strengthening sub-base of foundation base on soil characteristics

1.2 Type of cement for sub/super-structures shall be decided based on the final Soil Investigation report.

1.3 Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383.

1.4 Sand shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Sand, when used as fine aggregate in concrete shall conform to IS: 383. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116.

1.5 However, based on the Geotechnical Investigation carried out by the Owner, it may be inferred that near soils are typically slightly alkaline and are extremely corrosive to uncoated steel and are very highly corrosive to rebar in concrete materials. Based on

1.6 chemical test results of subsoil and ground water, project site can be classified in Class 4 as per Table - 4 of IS: 456. Accordingly, minimum cement content, maximum water cement ratio, cover to reinforcement shall be provided.

1.7 Chloride is encountered along with sulphates in both sub-soil and ground water. Considering the chloride values high than the acceptable limit hence to protect the concrete additional cover with epoxy coating is required for substructure works. Environmental exposure condition for exposed concrete surfaces shall be considered as ‘severe’ and for buried concrete, it shall be adopted as ‘very severe’, as per IS: 456.

1.8 Reinforcement steel shall be of high strength deformed TMT steel bars with corrosion inhibitors, Corrosion Resistant Steel (CRS) re-bars of grade minimum Fe-500D conforming to IS: 1786. Ductile detailing in accordance with IS:13920 shall be adopted for superstructure and substructure of all RCC buildings / structures. Dense concrete around reinforcement, provision of thick covers, and addition of corrosion protection with re-bars shall be provided to the RCC structures.

1.9 All RCC structural elements shall have minimum grade of M-25 for normal site condition and M35 for site with high saline/corrosion zone, with 20/40mm downgraded coarse aggregates

1.10 Unless stated otherwise, plain cement concrete below foundations, trenches and wherever specified shall be M15 grade of concrete with 20mm downgraded coarse aggregates.

1.11 The BIDDER shall carry out the design mix of all possible grades & cement make envisaged in the project with and without admixtures. The design mix shall be approved by OWNER / ENGINEER before start of work. Mix design shall comply to the duration from mixing to placing of concrete.

1.12 In case Geotechnical investigations require any special kind of cement or higher grade of concrete, the same shall be provided. The foundation system shall be made which transfer loads safely to the soil for the module mounting structures, depending on soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability etc. All foundation system and foundation depth shall be decided based on the approved geotechnical investigation report. Foundation shall not be placed on back filled soil and foundation depth shall be minimum 1000mm below natural or existing ground level.

1.13 All loads shall be considered in line with IS: 875 (latest revision). A seismic load for design shall be in accordance with IS: 1893 (latest revision). and relevant Standards. IS: 2502 Code of Practice for Bending and Fixing of Bars for concrete Reinforcement must be complied for reinforcements. IS: 5525 (latest edition) and SP: 34 shall be followed for reinforcement detailing.

1.14 A minimum 75 mm thick PCC shall be provided below RCC wherever RCC is laid over the ground. Proper and sufficient formwork/shuttering shall be provided for the required period as per IS: 456.

1.15 Clear cover to main reinforcement shall be as per the exposure condition as specified in IS: 456.

1.16 Bidder shall provide all test certificate for material and same shall be carried out at third party test laboratories approved by GIPCL. Reinforcement steel shall be tested in conformance to IS:1786. Sampling shall be done at the rate of minimum 2 Nos/Cast/Heat.

1.17 Testing for cement shall be as per approved MQP.

1.18 Manufacturer Test Certificates (MTC) for all materials shall be provided. In addition to that, the materials shall be tested in conformance to relevant applicable standards at NABL accredited laboratories.

1.19 A fully equipped quality control laboratory shall be established at site with qualified personnel to conduct acceptance test on all construction materials, concrete cubes.

1.20 Cement and Reinforcement shall be as per approved make list approved by OWNER.

1.21 Reinforcement: Reinforcement fixing shall be as per IS 2502. Reinforcement supports shall include all spacers, chairs, ties, slab bolster, clips, chair bars, and other devices for properly assembling, placing, spacing; supporting, and fastening the reinforcement. Spacers shall be cast from concrete of the same quality as that in which they will be embedded. Concrete block spacers shall be cast in metal moulds with an approved means of separating blocks and of ensuring that the blocks are of the proper size. Coated binding wire shall be incorporated into the blocks to enable them to be securely attached to vertical or horizontal bars and the Bidder shall demonstrate both that the blocks are of the requisite strength and that the means of attachment to the reinforcement are adequate.

1.22 Formwork: Formwork shall be designed and constructed so as to remain sufficiently rigid during placing and compaction of concrete and shall be such as to prevent loss of cement slurry. The face of formwork in contact with concrete shall be cleaned and treated with form release agent. Striping out formwork shall be as per IS:456 standards. Formwork shall be in good condition to have good surface of concrete. Approved quality make and same grade of Concrete spacer block shall be provided as a cover in concrete structure.

1.23 Waterproof Ply shuttering of adequate thickness shall be used for above ground & underground water tank work with heavy-duty supporting system as approved by OWNER

2.0 Concrete placement

Concrete shall be placed in the forms as close as possible to its final position in a single operation to the full thickness of slabs and beams and shall be placed in horizontal layers, not exceeding 2.5 m height in a single pour in walls, columns, and similar members.

The Bidder shall organize the pouring of concrete in such a manner that once concreting of a section has started the operation shall be continuous and each operation shall be completed prior to a stoppage.

The temperature of concrete shall not exceed 40°C measured at discharge into the works.

The maximum allowable temperature of any point within any cast element is 60°C. The maximum allowable temperature differential between any two points in the same element is15°C. Additional temperature control measures during construction (such as the use of insulated formwork) will be required. Bidder to prepare a process control chart and method statement verifying measures to achieve these requirements. Temperature monitoring of concrete work is required where:

a) The minimum dimension of any casting is 0.8 m^3or more, or

b) Where otherwise instructed by the Owner Where specified on the drawings, construction, expansion, or contraction joints shall be provided, and the concrete shall be poured continuously between two adjacent joints. No other joints than shown on the drawings shall be permitted. Stoppage (cold) joints formed between two concreting operations separated by more than 6 hours' time shall be subject to the same treatment as the construction joints. Concrete shall not be dropped into place from a height exceeding 1.5 metres. Concrete which has partially hardened shall not be exposed to injurious vibration or shock, except for controlled re-vibration where specified. When concreting of a certain large structural element is specified strictly as to be poured continuously, then the concreting operations shall be organized for day and night working, in long shifts, as necessary.

2.1 **Compaction and mechanical vibration of concrete**: As concrete is being placed it shall be compacted by mechanical vibrators complying withIS:2505, IS:2506, IS:2514 & IS:4656, to obtain a dense material free from honeycombing from water and air holes. The Bidder shall ensure that the vibrators are used in such manner that the reinforcement is not displaced, the formwork not damaged and no segregation caused, but complete compaction of the concrete is achieved

2.2 **Finish of concrete: The concrete face shall have the finishes indicated on the** drawings or in the present specification. The finished surface of the concrete shall be sound, solid and free from honeycombing, protuberances, air holes or exposed aggregate. No plastering, cement wash, mortar or paint shall be applied to cover defective concrete surfaces.

2.3 Contractor shall submit batch report of each concrete batch. All necessary test related to materials of concrete mix like cement, sand, aggregates etc. shall be carried out regularly as per relevant IS code. Test related to concrete cubes like compressive strength, workability etc. shall be carried out. If any treatment required for foundation surface for strengthening soil characteristics i.e. application epoxy for protection against soil nature shall be applied based on geo-technical investigation report. Unless otherwise specified all the backfilling i.e. in foundation, plinth, trenches after concrete shall be carried by using fine sand only.

D14 - CURING

Concrete shall be protected from loss of moisture for not less than 7 days after the concrete is placed. Trowelled surfaces, except those that receive a separate finish or coating, shall be cured with a membrane curing compound. Float finished surfaces, except those that receive a separate finish, may be cured with either a membrane curing compound or with water. Only water curing shall be used if the surface receives a separate finish.

1.0 **Water curing**

Water saturation of concrete surfaces shall begin as quickly as possible after initial set of the concrete. Water curing shall begin within 12 hours in dry weather and within 24 hours in damp weather. The rate of water application shall be regulated to provide complete surface coverage with a minimum of runoff. The application of water may be interrupted for surface rubbing. The concrete surface shall not be permitted to dry. After the rubbing has been completed, rubbed surfaces shall be covered with burlap and kept saturated for the remainder of the curing period.

1.1 **Membrane curing:**

Membrane curing compound shall be applied within 30 minutes after final finishing of the surface or as soon as possible after finishing without causing damage to the surface. Membrane curing compound shall be spray applied at a coverage of not more than 7.4 square meters per litre. Membrane curing shall not be used on surfaces that shall be covered at a later date with mortar, concrete, damp—proofing, tile, or any coating. Membrane curing shall not be used on cast-in-place concrete bases for field erected tanks.

D15 - MASONRY WORK

1.0 All brick works shall be done using at least class designation 7.5 of approved quality as per IS: 1077, IS: 2212 and IS: 3495. All concrete blocks shall be of minimum compressive strength of 7.5 N/mm^2 and shall be of Grade-A as per IS: 2185. All stone masonry work

shall be ashlar masonry work with stone of minimum compressive strength of 7.5 N/mm^2. The stone masonry work shall be in line with IS: 1597, IS: 1122 and IS: 1126.

1.1 The cement mortar for all kind of masonry work shall be in the ratio 1 cement: 4 sand by weight.

1.2 Bricks/blocks required for masonry work shall be thoroughly soaked in clean water tank for approximately two hours. Brick shall be laid in English bond style. Green masonry work shall be protected from rain. All masonry work shall be kept moist on all the faces for a period of seven days.

1.3 The external wall for the building shall be 230mm thick brick walls or 200mm thick concrete block walls and internal wall 230 & only toilet partition wall shall be 115mm brick walls or 200/100mm thick concrete walls as per requirements. The external wall of control room facing the transformer area shall be minimum 350mm or as per IS: 1646 (latest edition) - Code of practice for fire safety of buildings (general): electrical installations.

1.4 Walls of 115/100 thick shall be constructed with CM 1:4 with horizontal RC band at every 1m interval in vertical direction. RC band shall be with M15 grade concrete with 4-8mm bars and 8mm stirrups at 200c/c.

1.5 Suitable damp-proof course shall be provided the proportion of cement, sand& aggregate shall be 1:2:4 using 6 mm down stone chips with a water proofing admixture. The thickness of damp-proof course shall be minimum 40 mm.

D16 – PLASTERING

1.0 All external surfaces shall have 18 mm sand faced water-proof cement plaster in two coats along with adding waterproofing admixture (dosage as per manufacturer's recommendation), under layer 12 mm thick cement plaster 1:5 and finished with a top layer 6 mm thick cement plaster 1:6.

1.1 White cement primer shall be used as per manufacturer's recommendation. At least one coat of plaster shall be applied to interior walls by hand or mechanically, to a total thickness of 12 mm using 1:6, 1 cement and 6 sand.

1.2 Plastering shall comply to IS: 1542, IS: 1661, IS: 1630. Oil bound washable distemper on smooth surface applied with minimum 2 mm thick putty for control room.

1.3 Putty conforming to IS: 2402 and IS: 1661 shall be used for punning. Underside of concrete floor shall have 6mm thick plaster in cement mortar 1:3.

1.4 To avoid cracks all concrete/masonry joints shall be fixed with 24-gauge chicken wire mesh before plastering.

D17 - WINDOWS, DOORS, VENTILATORS AND ROLLING SHUTTERS

1.0 Doors and windows on external walls of the buildings shall be provided with RCC sunshade over the openings with 300 mm projection on both sides of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings except for main entrance door to the control room where the projection shall be 1500mm.

1.1 Aluminium framed doors, Windows and ventilators shall conform to IS: 1081 with necessary glass panels including of all fixtures and painting etc. complete on the external faces. All internal doors and windows shall be made of heavy duty aluminium sections. All sections shall be 20 microns anodized. Sections of doorframe and window frame shall be adopted as per industrial standards and approved by OWNER / ENGINER. Door shutters shall be made of aluminium sections and combination of compact sheet and clear float/ wired glass as per the requirement of OWNER. Fire doors shall be provided wherever necessary as per the statutory requirements.

1.2 All doors of toilet areas shall be PVC doors. Minimum size of door provided shall be 2.1 m high and 1.2 m wide. However, for toilets minimum width shall be 0.75 m and office areas minimum width shall be 1.20 m.

1.3 All accessible ventilators and windows buildings shall be provided with min. 4mm thick float glass, tinted for preventing solar radiations, unless otherwise specified. For single glazed aluminium partitions and doors, toughened float glass of 10 mm thickness shall be used. All glazing work shall conform to IS: 1083 and IS: 3548. The glass to be used shall be from approved brand / manufacturer and as approved by OWNER. The glass should be free from distortion and thermal stress.

D18 - PAINTING & FINISH

1.0 The paint shall be anti-fungal quality of approved brand suitable for masonry. All painting on masonry or concrete surface shall preferably be applied by roller. If applied by brush, then same shall be finished off with roller. For painting on concrete, masonry and plastered surface, IS: 2395 shall be followed. Minimum 2 finishing coats of paint shall be applied over a coat of approved and compatible primer.

1.1 The following minimum painting specifications shall be followed unless noted otherwise by the OWNER.

SCADA room/O&M Office/Conference Room	Acrylic Emulsion
All other rooms in plant	Oil bound distemper
External faces of walls	Exterior emulsion paint
Walls of battery room	Chlorinated rubber paint on exposed walls above Dado. 2100 mm high Dado of Acid / Alkali Resistant tiling.

All Ceiling	Oil bound distemper (office rooms without false ceiling), Acid resistant resin-based Epoxy coating (Battery rooms), and Whitewashing (all other areas)

1.2 All metal surfaces and support structures shall be thoroughly cleaned of rust, scale, oil, grease, dirt etc. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surface shall be made free from all imperfections before undertaking the finishing coat.

1.3 The type of surface preparation, type of primer, intermediate and finishing paint shall be according to the codes and standard.

1.4 A standard colour scheme for the different buildings/structures shall be prepared by the Bidder and the approval of the Owner shall be obtained, before commencement of work.

1.5 For painting of steel doors, ventilators IS 2338, IS 1477 (Part I & II) shall be followed.

D19 - STRUCTURAL STEEL

1.0 All structural steel design shall be carried out as per IS 800. Structural steel shall conform IS 2062, Pipe shall be as per medium/high grade of IS 1161, Chequered plates shall conform to 3502 and Hollow steel sections for structural use shall conform to IS: 4923. For all Hot dip Galvanised Structures, Galvanization shall be measure with elcometer or the material can be sent for testing laboratory as and when required. No averaging is allowed for measuring the thickness of galvanization. Inner side galvanization with same specification of any hollow components of module mounting structure is mandatory

1.1 Structural Steel/Steel Sheet Painting

All non-hot dip galvanized structural steel (excluding Module Mounting & SCB structure)/Outdoor metal containers/ Enclosure/ Rolling shutter items shall be provided with paint designed for a minimum maintenance-free life of fifteen (15) years (high durability) as per **ISO 12944 and IS 800 or equivalent for its corrosion category**. For finishing coat suitable colour pigment shall be added. All paints including primer shall be of the reputed brand/manufacturer and as approved by the Owner. The method of application shall be as per the recommendations of the manufacturer. Corrosive category and requirement shall be as specified in Project information Section of this Tender.

D20 – GROUTING

Non-shrink flow-able grout shall be used for grouting work below base plate of columns and equipment base frames. The minimum thickness of grout shall be of 25 mm. Non-shrink cum plasticizer admixture shall be added in the grout. Crushing strength of the grout shall generally be one grade higher than the base concrete and minimum grade shall be of M30 for high saline zone and M20for normal site condition.

D21 - PLUMBING AND SANITATION

1.0. UPVC pipes of Grade I PVC 1120 conforming to ASTM D-1785 and fittings conforming to ASTM D-2466/2467, of approved make and brand shall be used for water supply. PVC pipes (Minimum Pressure 6 kg/cm^2) conforming to IS 13592 and fittings conforming to IS 14735, of approved make and brand shall be used for sanitation. The make and brand shall be approved by OWNER / ENGINEER.

1.1. Toilet shall be designed as per number of occupancy as directed by OWNER for minimum persons or as directed by OWNER / ENGINEER; and constructed with following finish

a) Door : PVC Door

b) Ventilators: Mechanical exhaust facility

c) Plumbing fixtures: Approved make

d) Sanitary ware: Approved make

e) EWC: 390 mm high with health facet, toilet paper roll holder and all fittings

f) Urinal (430 x 260 x 350 mm size) with all fittings.

g) Wash basin (550 x 400 mm) with all fittings.

h) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing

i) CP brass towel rail (600 x 20 mm) with C.P. brass brackets

j) Soap holder and liquid soap dispenser.

k) GI pipes (B class) or UPVC of approved makes

l) Overhead water tank equivalent of 1,000 litre capacity with required pumping facility

1.2. Gully trap, inspection chambers, septic tank and soak pit shall be provided for designed occupancy.

D22 - WATER SUPPLY

1.0. Suitable arrangement of water shall be ensured to cater the day-to-day requirement of drinking water and cleaning needs of Solar Photovoltaic panels during entire O&M period.

1.1. For operation people, potable water storage tank (six layer) either Sintex or equivalent conforming to IS: 12701 shall be provided over the roof of the control room. The capacity of the tank shall be at 45 litres per day per person with minimum two days storage capacity, complete with all fittings including float valve, stop cock etc. The capacity of the tank shall not be less than 1000 litres.

1.2. The Bidder shall estimate the water requirements for cleaning the photovoltaic modules at-least once in every week in order to operate the plant at its guaranteed plant performance.

1.3. All necessary arrangement for wet cleaning of the solar panels shall be in the scope of the Bidder and accordingly the Bidder has to provide all the necessary equipment, accessories, tool & tackles, pumps, tankers, tractors and piping arrangement which are required for the same.

1.4. All necessary arrangement for wet cleaning of the solar panels shall be in the scope of the BIDDER and accordingly the BIDDER must provide all the necessary equipment,

accessories, tool & tackles, pumps, tankers, tractors and piping arrangement which are required for the same based on module cleaning specification section A-7.

D23 - ROADS

1.0. All roads shall be WMM to carry safe and easy transportation of equipment and material at the project site shall be made. The road shall provide easy and fast approach to each facility of the plant. These roads are to be designed optimally to carry the crane load with all necessary chambers, gradients, super-elevation, and radius of curvatures for the easy movement of cranes, trucks and public transport.

1.1. Internal road work shall be done prior to construction commencement to ensure proper access for construction and transportation of equipment/materials to the work locations.

1.2. Road works from main road of the Solar Project to inverter Station, Control room Building, and any other approach as required shall be in scope of Bidder. These roads shall be WMM road as per codes. Internal roads shall connect to all inverter stations, ensuring easy and approachable to various facilities, gates, & module cleaning stations, etc. The methodology of road design and construction with material specifications shall be in line with latest IRC-37 / MORTH and shall be submitted for approval before start of works.

1.3. All Roads are to be constructed with sufficient carriage width of minimum 3.5 m width for access Internal and approach road. Shoulders of 0.5m wide on both side of road. The final finished roads shall have a camber of 1in 50.

1.4. The minimum road section shall be as relevant IRC codes (Latest edition). The thickness of road section shall withstand the traffic loads for the entire life of plant. The road section shall be designed by BIDDER based on the design parameters specified by the OWNER /ENGINEER after award of work.

1.5. Locally available good, borrowed soil, minimum 125 mm thick shall be provided for shoulder. The minimum thickness of subgrade (Borrowed earth) shall be 150 mm compacted thickness on a well compacted ground (minimum 95 % proctor density), 200 mm compacted thickness of GSB layer and followed by minimum 150 mm compacted thickness of WMM shall be provided. The finishing coat over WMM shall be 20 mm with query dust. The WMM shall be done after major construction works completed as directed by Owner. However, bidder to design the road as per CBR and provide minimum layer thickness as mentioned above in case lower thickness required.

1.6. Sub-grade under road and its shoulders shall be compacted to achieve 95% or more of standard proctor's MDD. CBR value of the sub grade level shall be minimum 4%. If actual CBR is less than 4% in a particular stretch, then the same material shall be modified with increase in GSB thickness.

1.7. NP-3 Hume pipe/Culvert shall be provided across the road as required for drainage, electrical requirement, trenching works with sufficient soil cover in case of hume pipe to avoid damage. At road crossing hume pipe shall have RCC encasement all round.

2.0 **Borrow Earth Material**

a) Earth material used for filling shall be selected earth material as per technical specification and approved by the Engineer irrespective to lead and lift from working site and free from organic and other objectionable matter. All clods of earth shall be broken or removed.

b) Expansive soil shall not be used.

c) Soil having plasticity index less than 20 and maximum proctor laboratory dry density more than 1.5 gm/cc shall only be used. Adequate dewatering facilities like dewatering pumps, pipes etc. shall be arranged by the Bidder for this work including for excavation in borrow areas at his own cost.

d) The materials used for filling up of the site and for road embankment formations shall be well graded soil or any other material approved by the Engineer-In-Charge. The fill material shall have a maximum laboratory dry density of not less than 1.5 gm/cc when tested as per IS: 2720 (Part 8). The maximum particle size of coarse material in the mixture of fill shall not be more than two-thirds of the compacted layer thickness.

e) The following types of materials shall be considered unsuitable for fill:
   i. Materials from swamps, marshes and bogs.
   ii. Materials susceptible to spontaneous combustion.
   iii. Materials in a frozen condition.
   iv. Clay having liquid limit exceeding 70 and plasticity index exceeding 20.
   v. Expansive clay with free swell index exceeding 50% when tested as per IS:2720

f) The Bidder shall give the samples of the earth proposed to be used for filling with the following characteristics of the material to the Engineer for approval prior to collection and use along with the laboratory test results. The filled up soil shall be uniform in its composition and engineering properties for all layers of filling.

   i. Grain size distribution as per IS: 2720 Part 4
   ii. Liquid Limit and Plastic Limit as per IS: 2720 Part 5
   iii. Moisture – Density relationship as per IS: 2720 Part 8

3.0 Compaction

a) The fill shall be constructed in layers, each layer being compacted to the required density before the next layer is laid. The compacted thickness shall be 250mm or less for each layer.

b) Compaction shall be carried out using steel wheeled or rubber tyred rollers as appropriate. The Bidder shall determine the number of passes of the roller required as appropriate. The Bidder shall determine the number of passes of the roller required to achieve the required density by first conducting trials over a test stretch. Vibrating roller shall be used if it allows faster compaction.

   The number of passes shall be reviewed and adjusted in consultation with the Consultant/Owner, as required during the course of the work.

c) All lumps and clods in the fill material shall be broken before rolling. The top surface of each layer shall be roughened before placing the subsequent layer to ensure proper keying in between layers.

d) Prior to rolling, the moisture content of the material shall be brought to within ± 2% of the optimum moisture content as obtained from the tests by addition or removal of water,

accompanied by thorough mixing to ensure a uniform moisture content. Each layer shall be compacted to at least 95%, subgrade and embankments, of the maximum dry density as obtained from the modified Proctor Test.

e) e) Each layer shall be tested to ensure that the specified density has been achieved. At least two tests shall be carried out for every 3000sq.m of graded area of every layer. If the testing indicates that any part of the fill does not meet the requirements, that part shall be reworked by the Bidder at his own cost till the specified density is achieved.

f) The Bidder shall submit daily laboratory and observations report as per IS 2720 Part XVIII. This shall provide details of location of sample, time of collection, time it was placed in oven, the moisture content and density test results.

D24 - PRECAST BOUNDARY WALL (AS PER DRAWING), FENCING & MAIN GATE

1.0. The objective to provide a fencing is to demarcate the boundary and to keep away the unauthorized access to plant. The BIDDER shall provide precast Boundary wall . The Precast Boundary wall shall be provided with aesthetically designed main entry gate. The construction of Pre cast wall shall conform to the relevant IS standards and practice.

1.1. The contractor shall provide and install smooth finish and uniform shape & size Precast compound wall of concrete grade M30 with use of OPC 53 Grade of GIPCL approved brand cement, reinforced with 3mm wiron (Phosphorous Carbon steel) of TATA Make using pre-stressed technology, 1.80m high from finished ground level, Vertical post size 150mmx150mmx 2700mm, reinforced of 7nos.- 3mm dia PC steel of TATA Make, grouted below ground level by Augur Piling or excavation trench of 300mm dia, 900mm depth and grouted with PCC of 1:1.5:3 proportion of cement concrete equivalent to grade M20 at 1.80m clear distance between two vertical posts, also providing extra columns at corners and at every 15 nos. columns as expansion post . In addition to expansion joint, extra columns shall be erected at maximum original ground level difference of 300mm, horizontal planks of size 1800mm x300mm x 50mm thick, reinforced with 3nos.-3mm dia. PC Steel, TATA Make, fixed in groove of vertical posts, provision of weep holes in bottom horizontal plank wherever necessary as per site condition, also provision of 12 mm dia MS bolt (7" length) grouted at the time of casting with 2" outside for fixing of angle on top of each column for Barbed wire fencing. Four nos. 12x14 swg GI barbed wire (IS278-2009) Heavy Coated 230/240 gsm Zink on wire of TATA make shall be provided on top of pre-cast compound wall and fixed over 450 mm high MS HDG “L” angle (40mm x 40mm x 5mm). The MS angle with 8 mm bottom plate shall have galvanization of minimum 80 microns shall be provided over each post. Top built up section of “L” angle is provided with 4 nos. of GI barbed wire 12X14 gauge thickness (TATA Make) as per approved drawing. The tentative drawing of the Fencing is attached as (Annexure-A4).

1.2. All fencing materials shall be galvanized. the galvanization thickness shall be as per Tender specification. Concrete foundations (as per soil investigation report) for the angle iron posts and stays shall be provided. At drain entry/exit culverts shall be provided. Fencing shall be provided on culvert.

1.3. At Inverter duty Transformer yard and Switchyard (if applicable) GI/PVC coated chain link fence of height minimum 1.8 m shall be provided. All fence post shall be placed at 2.5 m

c/c. Details of fencing, post and other details shall be same as boundary fencing. The transformer yard fencing work shall conform to applicable regulation and codes.

1.4. Main entry of Solar Project Site shall have minimum 6 m wide double leaf lockable gate shall be provided. One-man movement passage gate (minimum 1.2m width) shall also be provided. The gate shall be with guide track, castor wheel, all fitting and fixture like hinges, AL drops, locking arrangement, posts etc. The width of approach road shall cover the gate width at the main entrance with suitable transition. The gate shall include RCC/Pre-fab Security office including toilet facility and disposal system. All members used in gates shall be finished by cleaning of steel surfaces as per IS: 1477 (Part-II) and galvanized with minimum coating thickness shall be as per tender specification. Main gate shall be provided with the name of Owner. The material of Letter shall be of Acrylic or as directed by Owner. Size/Pattern of the Letter shall be as per the direction of the Owner.

1.5. All the drawings/ specifications for main entry gate design/ planning shall be submitted to OWNER for approval prior to construction for their accord.

D25 – STORM WATER DRAINAGE

1.0. The storm water drainage (Trapezoidal section with RR PITCHING) shall be planned as per outcome of area drainage study. It is recommended that the drainage for the plant shall be designed keeping the natural flow of water to the nearest exit point.

1.1. Storm water drainage network consists of Hume pipe (Class NP3)/culvert across internal road and also across peripheral road at outfall location to discharge storm water.

1.2. Invert level of the Hume pipe/ culvert should be existing ground level at that location.

1.3. Laying of Hume pipe (NP3) should be in line with IS.783.

1.4. Stone pitching thickness 230 mm shall be provided on both upstream and downstream of pipe culvert to protect the culvert from scouring.

1.5. At outfall location, maximum water level in the pipe culvert should be higher than water level in connecting drain (outside plant boundary).

1.6. Pipe culvert shall be designed considering “maximum hourly rainfall intensity” at the site considering 50 years of return period as per recommendation of IMD. Also based on hydrology study report and IMD data worst condition shall be taken for design of drainage system. At no time for entire service life of 25 years, water stagnation shall happen, and care shall be taken to maintain slope and prevention of waterlogging. The surface run off coefficient shall be considered as per site soil condition and shall not be less than 0.6 for the design of drainage system. The velocity within the pipe culvert shall not be less than self-cleansing and not more than erosion limit of lining material. The drainage scheme shall be designed considering the BIDDER’s plot area and nearby catchment area contributing to the plot drainage.

1.7. The complete drainage scheme, type & design of pipe culverts shall be submitted to OWNER / ENGINEER for review and approval before start of drainage work at site.

1.8. The minimum & maximum flow velocity in pipe culvert shall be 0.6 m/sec and 1.80 m/sec respectively.

1.9. BIDDER shall also ensure that drainage from the plot does not encroach/flood into the adjacent property and adjacent solar plots.

All above parameters may be suitably adjusted based on inputs being made available by Owner for reference purpose. Also, any specific reference mentioned for Drain design in any IS Code or IRC Code would also be acceptable subject to approval of overall design

during detailed Engineering stage. All project drains would connect to the main drains of Park as per detailed layout to be prepared during detailed Engineering stage.

D26 - SECURITY CABIN

1.0. The Minimum size of watchmen's (duty Cabin) cabin is 1.5 m x 1.5 m size and height of 2.4m with appropriate roof at the top. Location of the duty Cabin will be as directed by the OWNER or his representative. The Prefabricated/RCC Security Cabin of size 3 m x 3 m at the main entrance gate shall be designed and constructed by the BIDDER keeping in view the safety and security of the power plant. Security cabin shall have toilet facility and proper sewage disposal shall be provided for each Solar Project

1.1. Each Solar PV Plant shall have one main entry gate and main Security cabin with all sewage/plumbing facility.

1.2. Material spec, drawing and design shall be provided for approval.

D27 – CABLE TRENCHES AND CIVIL WORKS FOR MODULE CLEANING SYSTEM

1.0. Trenches shall be constructed in reinforced cement concrete of minimum M-25 grade for normal site conditions and M35 for high saline/corrosive site condition with minimum wall thickness of 125 mm. The top of trenches shall be kept at least 150 mm above the grade level so that rain water does not enter the trench. Trench walls shall not foul with the foundations.

1.1. Outdoor Cable Trenches: RCC cable trenches with pre-cast RCC removable covers and lifting arrangement, edge protected with suitable galvanized angle iron designed to withstand self-weight of top slab + concentrated load of 150 kg at centre of span on each panel. The trench shall be designed for surcharge of 10kN/Sq. m unless noted.

1.2. Indoor Cable Trenches: RCC indoor cable trenches shall be provided with 50X50X6 mm angles grouted on the top edge of the trench wall for holding minimum 6 or 8 mm thick mild steel chequered plate covers (600 mm in length except at ends & bends) with lifting arrangement. Angle or channels shall also be grouted at distances of 600 mm across the indoor cable trenches to support the chequered plates.

1.3. Trench Drainage: The trench bed shall have a slope of minimum 1/500 along the length & 1/250 along the width. Suitable drain sump at lowest point of the trench shall be provided for pumping out the water.

1.4. Vehicle load on precast slab to be considered if applicable.

1.5. All the civil and structural works required for module cleaning system shall be included in Bidder scope of work.

D28 - QUALITY CONTROL

Bidder shall establish fully equipped quality control laboratory at site to conduct all acceptance test on all construction materials, concrete cube test, compaction of soil testing. This shall be housed with covered buildings. All testing equipment like Owen, Electric operated cube testing equipment, sieves for grading of sand and aggregates, flakiness and elongation index testing sieve, density of aggregates, abrasion testing equipment, impact testing equipment, bitumen testing equipment like thermometer, Marshall test apparatus. Other apparatus like cube moulds, sump cones. Vicat apparatus, moisture meter, dry film thickness gauge meter.

1.0. Bidder shall arrange for design mix of concrete for each grade of concrete from GIPCL approved laboratory or NABL (National accreditation board for testing and calibration laboratories)

1.1. Bidder shall arrange for gradation mix for road works-Murram, granular subbase, Wet mix macadam, Water Bound macadam, dense bitumen macadam, bituminous coarse etc.

1.2. All testing equipment's shall be periodically calibrated to the satisfaction of owner and as per manufacturer manual and instruction.

1.3. Bidder shall submit & get approval from OWNER for field quality plan for all construction material & all civil activity (concrete, excavation, backfilling, masonry, plaster, Road work etc) as per relevant IS Code.

D29 - INSPECTION AND TESTING

The Owner shall always have free access to those parts of the manufacturer's works which are concerned with fabrication of the steel work and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with the provisions of this specification.

1.0. Unless specified otherwise, inspection shall be made at the place of manufacture prior to dispatch Tolerance for fabricated structures shall be as per IS:7215.

1.1. Bidder to note that if any structure or part of a structure be found not to comply with any of the provisions of this specification, it shall be liable to rejection. No structure or part of the structure once rejected shall be resubmitted for test, except in cases where the Owner considers the defect as rectifiable.

1.2. Defects which may appear during fabrication shall be made good with the consent of and according to the procedure laid down by the Owner.

1.3. All gauges and templates necessary to satisfy the Owner shall be supplied by the manufacturer.

1.4. The Owner may, at his discretion, check the test results obtained at the manufacturer's works by independent tests at the Government Test House or elsewhere, the costs of such tests shall be borne by the Bidder.

1.5. Before dispatch from fabrication shop, prototype of each structure shall be shop assembled and checked for fabrication tolerance. Also, if ordered, by the Owner, the same shall be presented for inspection.

D30 - DRAWINGS & DOCUMENTS

1.0. The Bidder shall submit his detailed schedule for submission of all information, documentation, calculations, drawings, schedules etc within such periods or dates, which are required to guarantee a smooth handling of the project without delays.

1.1. After award of contract, the Bidder shall submit the designs, layout and construction drawings and detailed working drawings including fabrication drawings and bar bending schedules for all structures and items covered under the scope of this contract. The quality of the submitted documents must be in accordance with acceptable national practice and allow a speedy checking procedure.

1.2. The design drawings shall consist of general arrangement drawings showing location of tower and various equipment foundation along with cable trenches and all other related items / services required for the project. Subsequently detailed drawings along with design calculation shall be submitted by the Bidder for approval. Subsequent to approval of GA drawings, fabrication drawings for steel structures and Bar Bending Schedule for RCC structures shall be submitted before commencement of construction.

1.3. Detailed dimension drawings and design calculation for all civil and structural works shall be submitted to the Owner for scrutiny and approval. No construction shall commence prior to obtaining of written approval from the Owner. Any approval given by the Owner to the designs & drawings shall not relieve the Bidder of his responsibilities for the correctness of the same and for execution of the work in accordance with the terms of the specifications. Detailed drawings approved by the Owner shall supersede the general drawings when they differ from them.

1.4. The drawings bearing the Owner's approval or drawings corrected in accordance with the comments of the Owner shall be deemed to be contract drawings and no variation there from shall be taken without the Owners written consent.

1.5. The successful Bidder shall submit the following after award of Bidder in line with the scope of work for Civil Works including design basis and detail engineering drawings and as built drawings.

1.6. Unless otherwise stated, the Bidder shall be responsible for all necessary lists such as indents, rivet and bolt lists, material lists, Dispatch lists and lists for all bought out items.

1.7. Fabrication work shall not be taken in hand until the relevant shop drawings have been approved by the Owner. The Bidder shall consider any revisions in drawings furnished by the Owner at no extra cost.

D31 - CODES & STANDARDS

Following codes and standards shall be applicable for complete plant as applicable the latest codes shall be used. In case of any conflict OWNER decision/approval will be final.

1.0. GENERAL

IS: 875-I	Code of Practice for Design Dead Loads for Building and Structures
IS: 875-II	Code of Practice for Design Imposed Loads for Building and Structures
IS: 875- III	Code of practice for design loads (other than earthquake) for Buildings and structures
IS:1893	Criteria for earthquake resistant design of structures.
IS: 4326	Earthquake resistant design and construction of buildings

2.0 FOUNDATIONS

IS: 1080	Code of practice for design and construction of shallow foundations in soils (other than raft, ring and shell)
IS: 1904	Code of practice for design and construction of foundations on soils general requirements

IS: 2911	Design & Construction of Pile Foundation – Code of Practice
IS: 2950	Code of practice for design and construction of raft Foundations
IS: 6403	Code of Practice for determination of bearing capacity of shallow foundations
IS: 8009	Code of Practice for foundation settlement calculations

3.0 CONCRETE STRUCTURES

IS: 456	Code of practice for plain and Reinforced concrete
IS: 3370	Code of practice for concrete structures for the storage of Liquids
IS: 3414	Code of Practice for design and installation of joints in Buildings
IS: 5525	Recommendation for detailing of reinforced concrete works
IS: 6313	Code of practice for anti-termite measures in buildings
IS: 1786	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement – Specification
IS: 1893-IV	Criteria for earthquake Resistant design of structure

4.0 STEEL STRUCTURES

IS: 800	Code of practice for use of structural steel in general building Construction
IS: 801	Code of practice for use of cold-formed light gauge steel structure members
IS: 802	Code of Practice for use of Structural Steel in over Head Transmission Line Towers
IS: 806	Code of practice for use of steel tubes in general building Construction
IS: 808	Dimensions for hot rolled steel beam, column channel and angle section
IS: 811	Specification for Cold Formed Light Gauge Structural Steel Sections
IS : 812	Glossary of Terms relating to welding and cutting of metals
IS: 813	Scheme of symbols for welding
IS: 1079	Hot Rolled carbon Steel Sheet and Strip – Specification
IS 1161	Steel tubes for structural purpose
IS: 2062	Hot Rolled Medium and High Tensile Structural Steel - Specification

IS: 2721	Galvanized steel chain link fence fabric - Specification
IS: 4923	Hollow steel sections for structural use
IS: 1905	Code of Practice for structural use of un-reinforced masonry
IS: 3067	Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings
SP: 6	Handbook for structural engineers (all parts)
SP: 7	National Building Code of India
SP: 34	Handbook of concrete reinforcement & detailing
IRC:19	Standards Specifications and Code of Practice for Water Bound Macadam
IRC: SP – 72	Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads
IRC: SP – 20	Rural Roads Manual
IRC: SP – 50	Guidelines on Urban Drainage
IS : 1786	High strength deformed steel bars and wires for concrete reinforcement specification
IS : 4000	High strength bolt in Steel Structures-Code of practice
IS : 4736	Specification for Hot-dip zinc coating on mild steel tubes
IS 4759	Hot-dip zinc coatings on structural steel and other allied products
IS 6623	High Strength Structural Nuts
ISO 9223	Corrosion of metals and alloys -- Corrosivity of atmospheres -- Classification, determination and estimation
ISO 9224	Corrosion of metals and alloys -- Corrosivity of atmospheres -- Guiding values for the corrosivity categories

5.0 PAINTING AND COATING

IS:1868	Anodic coatings on aluminum and its alloys
IS 2395- I	Painting of Concrete, Masonry and Plaster Surfaces – Code of Operations and Workmanship
IS 2395-II	Code of practice for painting concrete, masonry and plaster surfaces: Schedule
IS 1477-I	Code of Practice for Painting of Ferrous Metals in Buildings: Pre-treatment
IS:1477-II	Code of practice for painting of ferrous metals in buildings: Painting
IS: 4736	Hot-dip zinc coatings on mild steel tubes

IS: 4759	Hot-dip zinc coatings on structural steel and other allied products – Specification

6.0 WATER SUPPLY AND SANITARY

IS: 1172	Code of basic requirements for water supply, drainage and Sanitation
IS: 1239	Mild steel tubes and tubulars and other wrought steel fittings
IS: 1742	Code of Practice for building drainage
IS: 2470	Code of Practice for installation of septic tanks
IS: 4985	Un-plasticized PVC pipes for potable water supplies
IS:10124	Fabricated PVC fittings for potable water supplies

7.0 OTHERS

IS:269	Ordinary and low heat Portland cement
IS:4032	Method of chemical analysis of hydraulic cement.
IS:6452	High alumina cement for structural use
IS:8041	Rapid hardening Portland cement
IS:8112	High strength ordinary Portland cement
IS:12330	Sulphate resisting Portland cement
IS:455	Blast furnace slag cement
IS:383	Coarse and fine aggregates from natural sources for concrete
IS:2386	Methods of test for aggregates for concrete
IS:2430	Methods of sampling of aggregates for concrete
IS:460	Test sieves
IS:516	Methods of test for strength of concrete
IS:1199	Methods of sampling and analysis of concrete
MORT&H	Specification for road and bridge works of Ministry of Road Transport and Highways(Ministry of shipping& Transport (Roads wing)) Published by the IRC.
IRC37	Guidelines for design of flexible pavements.

IRC - 19	Standard specification and code of practice for Water Bound Macadam.
IRC 73-1980	Geometric design standards for Rural (Non Urban) Highways.
IRC – 109	Guidelines for Wet Mix Macadam
IS : 458	Specification for Concrete Pipes.
IS : 783	Code of Practice for Laying of Concrete Pipes.
IS : 2720	Methods of Test of Soil (All parts).
Morth Spec	Morth Specification for Roads and Bridge works
AS 1214	Hot dip galvanized coatings on threaded fasteners
AS 1627.1	Preparation and pre-treatment of surfaces - Removal of oil, grease and related contamination
AS 1627.4	Preparation and pre-treatment of surfaces - Abrasive blast cleaning of steel
AS 1627.5	Preparation and pre-treatment of surfaces - Pickling
AS 2309	Durability of galvanized and electrogalvanized zinc coatings for the protection of steel in structural applications – Atmospheric
AS/NZS 2312	Guide to the protection of structural steel against atmospheric corrosion using protective coatings
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.