

- a. Preventive / Routine Maintenance: This shall be done by the Contractor regularly and shall include activities such as cleaning and checking the health of the Plant, cleaning of module surface, tightening of all electrical connections, and any other activity that may be required for proper functioning of the Plant as a whole. Necessary maintenance activities, preventive and routine for Transformers and associated switchgears also shall be included.
- b. Breakdown/ Corrective Maintenance: Whenever a fault has occurred, the Contractor has to attend or to rectify the fault, the fault must be rectified within **48 hrs** time from the time of occurrence of fault failing which the Contractor will be penalized as per terms and conditions of this Tender.

5.2: Civil work:

5.2:1 Civil work:

- The proposed location of solar project may be flat/uneven/hilly/submerged during monsoon. Bidder has to visit the site before pre bid meeting and accordingly discussed with the GSECL official for any query.
- Bidder shall have to execute the work of proposed solar project i.e. @ 10 MW to 55 MW in one/two/three/four pocket for proposed location as per the acquired government clear land, accordingly precast boundary wall of each pocket shall be provided for security point of view.
- Bidder shall have to make its own arrangement for construction water as well as water required during O & M period.
- The fresh OPC/PPC 53 grade cement and TMT steel reinforcement bars Fe 500 CRS shall be used confirming to relevant I.S. Specifications of the approved manufacturers of GSECL.
- The concrete mix design test shall be carried out in Govt. certified laboratory or NABL accredited laboratory for minimum M20 grade with 400 kilograms of cement.
- The all material, installations, fixtures, accessories etc. to be provided shall be as per the relevant I.S. specifications and of best quality and of standard manufacturer as approved by the EIC.
- Bidder shall have to keep the full proof records of purchase and consumption along with original purchase bills of Cement and Steel as per the GSECL procedures and rules.
- Bidder shall have to provide best workmanship with skilled manpower for all the civil items as per the standard specifications/ best practice as approved by the EIC. If there is dispute in the items of civil works/no standard specifications of civil work items, in that

case CPWD/ PWD/ booklet of Standard specification shall be applicable. GSECL will not supply any material for this work.

- To obtain necessary approval from Govt. / semi Govt. body etc. as a statutory requirement bidder has to approach the government organization, GSECL will provide required supporting documents for the purpose.
- Bidder has to obtain BOCW certificate & labour license for the proposed solar site from concern government department.
- All such items and materials not specifically mentioned in the Contract/ Tender Document but required as per site condition during execution for completion of proposed solar project / during O & M period of Solar PV Power Plant, bidder has to execute the same without any extra cost.
- For all the civil work of proposed solar project bidder has to submit the drawing for approval of GSECL.

5.2.2 Topographical Survey:

GSECL will show the proposed project site physically to bidder , necessary required survey work for co-ordinate of site will be carried out by bidder and accordingly final plot layout (As per JMS sheet) drawing shall be submitted to GSECL for further approval. Topographical survey shall have to be done by the Bidder for the proposed site at 5 mt. interval with the help of Total Station or any other suitable standard method of survey. All necessary Reduced Levels (RL) as entered in the Field Book/Soft Copy have to be submitted along with pre contour layout of the total site. The formation levels of the proposed solar power plant have to be fixed with reference to High Flood Level of the proposed site. The ground level and plinth level of structures shall be fixed taking into consideration on the highest flood level and surrounding ground profiles.

5.2.3 Soil Test:

The soil testing of proposed project site shall be carried out by the agency. Contractor is solely responsible to carry out detailed Geotechnical investigation to ascertain soil parameters of the proposed site for the use of planning / designing / construction / providing guarantee / warranty of all civil works including but not limited to foundations / piling for module mounting structures, HT lines, 66 kV switchyard equipment etc. The Contractor shall carryout soil investigation through NABL accredited labs. These reports shall be furnished to the Company prior to commencing work. All RCC works shall be provided of required grade of concrete as per relevant IS specifications as well as soil data considering appropriate earthquake seismic zone, wind velocity, whether effect ,soil characteristics etc. The minimum Bore hole for soil investigation report should be done as per IS Code. Soil testing is in the scope of bidder.

5.2.4

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The scope of soil investigation covers execution of complete soil exploration including boring, drilling, collection of disturbed & undisturbed soil sample 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. The design will done based on considering the worst result among the bore holes. Contractor has to carry out also Electrical Resistivity Test.

5.2.5

The bidder shall have to carry out Shadow Analysis at the site and accordingly design strings and arrays layout considering optimal use of space, material and manpower and submit all the details / design to Company for its review / suggestions /approval.

5.2.6

The foundations should be designed considering the weight and distribution of the structure and assembly, and wind speed **as per IS 875 for calculations of Vz. Bidder shall take basic wind speed value for respective sites as per following.**

Site wise wind speed to be mentioned here as **per IS875**

Success full Bidder shall also plan for transport and storage of materials at site and shall arrange for its own construction power and water. However, the Contractor can avail construction power connection from Discom by applying for temporary connection and necessary charges will be borne by the bidder. Client will help for supporting documents.

5.2.8 Land Development and Cleaning:

Site leveling:

The bidder shall have to level the site, as required, so as to compact the plant in minimum possible area and also to minimize shading losses because of solar PV module structures. Removal of debris and bush-cutting is mandatory. Leveling & area grading of the site is to be done if required for easy drain of surface water naturally to avoid the accumulation of rainy water in plant area. During execution of work if any hidden masonry / concrete foundation / pipe line etc. found then agency has to execute / remove / reroute the same without any financial implication. The bidder shall visit the site to ensure the land development work if any and shall carry out the topographical survey to ensure land development work such that land is perfectly flat. The Contractor has to clean the site from small trees and shrubs, removal of debris, if any; filled the depression area and excavates and level the high level areas wherever required even though contractor follows the natural ground level for entire

plant execution. The Contractor can also use the natural contour of the land, if shadow is not affecting the generation. However, the Contractor shall take reasonable care to ensure that the plant is aesthetically designed. Bidder shall have to Level the uneven area of each pocket of the proposed location as per site requirement. If any hidden structure beneath land is found, bidder may leave that portion of land.

5.2.9 Storm Water Drainage System:

The Contractor shall provide storm water drainage system for entire plant.

The drain is to be designed as per actual site requirement and to avoid accumulation of water in solar Plant area. The peripheral drain and all other internal drains to inverter room, control room, switchyard of solar project shall be of brick lining which is backed up by PCC (75 mm thick C.C. 1:4:8) on side slope and at bottom of drain with brick lining and all joints of Brick lining are to be filled up with cement mortar in C.M. 1:4. Also, the bidder shall provide RCC Hume pipe (NP3 grade) at the crossing of road and drains and at required locations. And also necessary arrangement for disposing / lifting of accumulated surface water is to be made by providing pump and RCC sump of required capacity shall be provided by bidder as per site requirement or naturally as per site conditions.

Storm water drain for each pocket of proposed location shall be designed by the bidder in such a way that rainy water will not be accumulated in pocket area and discharge the same smoothly to nearest village nalla /palika drain etc.

If huge quantity of rainy water entered into the proposed solar project site area than bidder shall have to construct bund/protection wall with necessary storm water drain shall be provided for each pocket of proposed solar project site and divert the same smoothly into nearest village nalla /palika drain to avoid the damage the solar project site etc. during monsoon.

5.2.10 Foundations:

The Contractor shall design and construct appropriate civil foundations for MMS RCC Pile Foundation, prefabricated structures / **RCC frame structure of control room**, transformers, switchyard equipment, feeder bay etc. During execution of work if any hidden masonry / concrete foundation / any structure /pipe line etc. found then agency has to execute / remove / reroute the same without any financial implication. Site is found to be more or less flat.

Civil foundation design for Module Mounting Structures (MMS) as well as control room, inverter room, switch yard transformer / equipment shall be made in accordance with the Indian Standard Codes and soil conditions, with the help of Chartered Structural Designer having substantial experience in similar work. The Successful Bidder shall submit the detailed structural design analysis along with calculations and bases / standards.

Module Mounting Structures Design is to be certified by Chartered Structure Engineer and certificate to be produced along with the design details for approval by GSECL. Switchyard

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structures / transmission line structure designs shall be strictly as per GETCO design. The Contractor shall design, fabricate, supply and install module mounting structures with all required accessories like clamps, nuts, bolts, cable ties etc., The structures can be of fixed/seasonal tracker are accepted.

Pile integrity test of minimum 5% at random of total piles to be casted for MMS Structure.

5.2.11 Solar PV Module Cleaning System (RCC/ PVC water Tank):

Cleaning frequency shall be decided by the Bidder to meet the guaranteed generation. For this the Contractor has to design as per relevant IS codes, submit and take approval from GSECL, construct and operate 10,000 litter /MW capacity RCC / PVC water storage tank, the PVC water storage shall be of first quality and shall be approved EIC. The Contractor also has to drill a bore and construct pipeline for carrying water to storage tank, provide electric panel and pump for bore and total water. Silting chamber for filtration of the water before the inlet and which shall match with invert level of Storm Water drain. Design of RCC water tank shall be such that it shall resist Earth pressure and Water pressure and satisfy all IS codes. Design of water tank shall be done strictly based on Soil Investigation Report with complying all latest IS codes.

Cleaning system. For module cleaning, the contractor can provide new tanker with pump, water jet and hose pipe or establish a pipeline network with valves.

5.2.12 Approach / Internal Roads and Pathway & Peripheral Road:

Main road connecting to Government palika/village road to proposed site for each location for construction purpose as per site requirement shall be WBM 4.00 mtr.wide plus side shoulders both side.

The road connecting from the main gate to control room and switch yard shall be accessed by Asphalt road having 4.00 mtr.wide plus side shoulders both side.

Peripheral roads & road connected to inverter transformer shall be of WBM. Width of WBM/ Asphalt road shall be 4.00mtr.wide plus side shoulders both side.

The Contractor shall provide internal roads and approach roads / pathways of WBM type. If plant is being installed in more than one pockets, each pocket shall have internal connectivity by WBM road. Peripheral roads & road connected to inverter transformer shall be of WBM. Width of WBM/ Asphalt road shall be 4mtr.

Bidder shall have to construct road as per site requirement of proposed solar project capacity i.e. @ 10 MW to 55 MW shall be executed in one/two/three/four pocket of each location, as per site availability for internal connectivity with each pocket necessary WBM road, culvert with side slope rubble pitching, laying NP-3 pipe of sufficient diameter wherever required etc. shall be executed as per site requirement for road crossing.

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5.2.13 Cable Trenches:

Construction of RCC cable trenches with cable trays and covers for inverter and control rooms, earthen excavated cable trench with alternate layers of sand and brick as per relevant IS from PV arrays to inverter room to control room to switchyard shall be provided by the Contractor.

5.2.14 Watchman’s Cabin and Main Entrance Gate

The Contractor shall provide main gate of structural steel material of appropriate design. Also, necessary arrangement shall have to be made by Contractor to erect the main gate on pylon stone.

An all-weather main gate with width of at least 6 meter shall be erected at the entrance of the plant site and another gate (4 mt. width) for each pocket shall be provided for internal connectivity with of proposed location.

The Prefabricated Security Cabin of size 3.5 meter x 3.5 meter at the main entrance gate shall be designed & constructed by the Successful Bidder keeping in view the safety and security of the power plant. The Bidder shall provide detailed civil, electrical, plumbing, etc. drawings and equipment specifications for the security cabin in “(B) Technical Offer” of the Bid document.

5.2.15 Security Cabin:

Security Cabin – Security cabin shall be provided at the entry of each pocket(i.e. if utilized for installing Solar PV Project) of project site.

The Contractor shall provide 4 (four) numbers of prefabricated Watchman’ portable cabin at minimum 4 (four) corners of the boundary of each pocket of proposed Plant such that safety of the plant is ensured along with one Watchman’s cabin at the boundary of each pocket of proposed location. The minimum size of watchmen’s (Security Cabin) cabin shall be 1.2 meter x 1.8 meter size and height of 2.10 mt. with appropriate roof at the top, considering minimum height of 6 mt above ground level. Location of the watch Cabin (Security Cabin) shall be as directed by GSECL. Bidder shall have to submit the design of supporting structure with ladder & railing for safety point of view. Security cabin of galvanized steel with roof will be submitted for the approval of EIC.

5.2.16 Fencing:

The bidder shall provide RCC precast boundary wall with barbed wire for entire plant area. **Internal fencing for PCU, X’mer, HT SWGR -Aux. Chain link fencing of 2.0 mtr. Height with provision of gate shall be considered.**

A. Precast compound wall column

Supply and installation of smooth finish and uniform shape & size precast compound wall column of concrete grade M30 with use of OPC 53 Grade of GSECL approved brand

cement, including shuttering, reinforced with 3mm wiron (phosphorous carbon steel) of TATA make using pre stressed technology, 1.8m high from finished ground level, vertical post size 150mmX150mmX2700mm, reinforced of 7 nos-3mm dia PC steel of TATA make with a provision of 300 mm long (12”)having 12mm dia MS bolt (9" length) grouted at the time of casting with 3" outside for fixing of angle on top of each column for barbed wire fence as per drg. Precast compound wall columns shall be provided with groove for wall panel slab fixing and grouted below ground level by Augur piling or excavation of 300mm dia, 900mm depth and grouted with PCC of M20 (1:1.5:3 proportion of cement concrete)

B. Precast compound wall panel slab

Supply and installation of smooth finish and uniform shape & size precast compound wall panel slab of concrete grade M30 with use of OPC 53 Grade of GSECL approved brand cement, including shuttering, reinforced with 3mm wiron (phosphorous carbon steel) of TATA make using pre stressed technology, wall panel slab size 1800mmX300mmX50mm thick, reinforced of 3 nos-3mm dia PC steel of TATA make, fixed in groove of vertical posts as per drg. Wall panel slab shall be fixed in groove of vertical column/posts with engraved precast logo in each section with text of GSECL on each one panel of each span and with provision of excess water flow weep holes having reinforced of 4 nos-3mm dia (phosphorous carbon steel of TATA make, fixed in groove of vertical posts as per drg. The two coat of 1st quality exterior premium emulsion paint with one coat of primer shall be applied on both side of pre-cast compound wall. The exterior paint shall be of 1) Asian Paint : Apex Ultima , 2) Nerolac Paint : Excel Total, 3) ICI Dulux (Akzo Nobel) : Weather sheild Max, 4) Berger Paint : Weather Coat All guard.

C. Angle Post

Angle size of 40x40x5, 90cm. Long with Galvanize coating of minimum 80 micron & 8mm Plate to be provided for angle fixing 100x100mm size.

D. Barbed GI wires

Providing and fixing barbed GI wires four nos 12x14 SWG GI barbed wire (IS 278-2009) heavy coated 230/240 GSM zinc on wire of TATA make shall be provided on top of precast compound wall and fixed over 450mm high MS HDG 'L' angle (40mmx40mmx5mm).The barbed wire has to be fitted in direction longitudinally between two posts fitted & fixed with GI staples, turn buckles, with all hardware etc, complete as per direction of Engineer-in –charge.

5.2.17 Water supply:

All necessary arrangement for wet cleaning of the solar panels shall be in the scope of the bidders and accordingly bidder shall have to provide all the necessary equipment, accessories, tool & tackles, pumps, tankers, tractors and piping arrangement which is required for the same. Bidder shall have to make its own arrangement for construction water as well as water required during O & M period.

5.2.18 Pre-fabricated Invertor Room (for indoor inverters only)& R.C.C./PEB Control Room

Bidder has to submit the design drawing for approval of Pre-fabricated Inverter Room & R.C.C./PEB Control Room. Civil work for Pre-fab Inverter Room & R.C.C. Control cum Conference room shall be of adequate size and of be of standard manufacturer with sufficient lighting points and RCC cable trenches with oil painted edge angle of 65mm x 65mm x 6mm and checker plate covers of 8 mm thickness and shall have exhaust chimney and also sufficient ventilation. All prefab inverter room and Control Room shall be laid on RCC plinth with sufficient foundation and reinforced grade slab with finished Kotah of 25mm thickness /Vitrified of 8-10 mm thickness tile flooring and 100 mms skirting of same tiles. The plinth shall be minimum 500 mm high from formation level of the plant. Plinth protection shall be given throughout perimeter of width 1.2m with rough kotah of 25mm thickness on its top for Inverter rooms and Control Rooms. Sufficient steps at the entry of the room with rough Kotah on its top and RCC ramp of sufficient angle shall be provided for shifting the equipment in the rooms for all Inverter rooms and Control Room. Rain water pipe at various locations with gutter at the top shall be provided to discharge rain water. The bidder shall provide to GSECL the detailed civil, electrical, plumbing, etc. drawings and equipment specifications for the inverter room & control room and shall obtain approval of the same. The drawings of Panels with the make of components should be approved from GSECL.

For inverter transformer Chain link fencing of 2.0 mtr. height With provision of gate shall be provided

i. RCC frame structure below plinth

Inverter Rooms/Control cum Conference Room shall have adequate size of footing, pedestal columns, plinth beam, grade slab with reinforcement as per relevant IS specifications considering seismic zone, wind & soil detail etc. Back filling material shall be of Laboratory tested Murrum or Sand. Grade slab shall be laid on 100 mm thick PCC. Also, Termite proofing is required before preparation of grade slab and plinth protection. The Control cum Conference Room shall have a rolling shutter at the front side.

ii. Control room

It shall be of adequate size (minimum height 3.6 mtr) for fixing the panels, battery banks etc. With; a) SCADA Room with Work station, Desktop and Chairs; b) Store Room with almirah; c) Pantry unit of sufficient size with sandwich type of platform with plumbing fixture and exhaust fan; d) Toilet unit for Gents with urinals and Ladies having wash basins in each; e) RCC cable trenches with covers and cable trays and all openings of cable entry shall have vermin proofing using spray foam or mortar; f) Furniture like conference table, chair and sofa etc.; g) Lighting points and fixtures; and h) Plumbing fixtures.

iii. Facilities required for Control cum Conference Room:

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It shall also have adequate size SCADA cabin with necessary 2 numbers of work station with drawers of Godrej/ Durian/ Zuari make, 2 numbers Computer and 1 number of LED TV of 48 inch of Sony/ Phillips / Samsung make, 4 numbers of chairs for workstation, 2 Nos. of almirah and split A.C of 1.5 Ton of Voltas/ Hitachi/ Samsung/LG make for operating staff for work station. Conference Room shall also be equipped with conference table of 10 persons with Power Sockets with 10 chairs of Godrej/ Durian/ Zuari/ Usha/ Lexus and sofas. In Control cum Conference room, except control room (where panels are fixed) all other rooms like SCADA cabin, conference room, store, pantry and passage shall have False ceiling that shall consist of 600 x 600 x 20 mm gypsum board with one coat of primer and two or more coat of Acrylic emulsion paint. The suspension system shall consist of 6 mm diameter galvanised steel rods suspended from ceiling supporting by aluminium grid of 38 x 25 x 1.5 mm and cross tie of 25 x 25 x 1.5 mm and aluminium angle of 25 x 25 x 1.5 mm. Conference room shall be equipped with an all-in-one printer cum scanner, landline phone, refrigerator (150 litre) of Voltas/Godrej/Whirlpool make, projector and screen of 2m x 2m. All material, installations, accessories to be provided shall be of best quality and of standard manufacturer as approved by the EIC/ GSECL. All units of the Control cum Conference Room shall have marked signage of SS sheet of 1mm along with engraving words and filled with black color at all facilities within Control cum Conference room and on all equipment. The lighting points and fixtures shall be of Anchor/Philips make. The fans shall be of Khaitan/Usha/Bajaj make and lights (only LED shall be used) shall be of Philips/Syska/Havells make.

iv. Structural Steel, Insulated Walls and Roof for Super structure (prefabricated inverter room):

Design of Super-Structure i.e. Steel Structure like purlin, rafter, columns, truss etc. for fixing the Pre-Fabricated Panels conforming to relevant IS codes and of Jindal/Tata/ RINL make. It shall include all necessary fitting like nuts, bolts, washers etc. of good quality. All structural steel shall be treated with two coats of red oxide and three coats of Oil paint (Asian Paints, Berger, Durex). The gap between base plate of structural members and concrete top of foundation shall be filled with GP-2 grouting material of reputed make. The material of all J-bolts shall be of 8.8 Class. The Insulated panels should be of required size for roof and walls. The insulated wall and roof panels shall be sandwich type. The panels shall be made out with 0.35 mm thick pre coated steel sheet on both side of Poly Urethane Foam (PUF) for both wall and roof. The density of PUF shall be 40 ± 2 kg/m³ and thermal conductivity shall be within range of 0.019-0.021 W/m^{°K} at 10°C. The total thickness of the panels for walls shall be 60mm and for roof is 40mm. The panels shall be joined together by tongue and groove method. The joints of the panels shall be filled with silicon or equivalent filling material. Panels shall be cuts such that the exposure of PUF and patch work is avoided. The fixing of the panels shall be such that there should not be any gaps at joints like wall and roof, wall to wall, etc. from which air and water particle can pass (Air and Water tight). Roof panel shall be extended 300 mm from the eaves wall and 150 mm from Gable walls. Rain water gutter shall be provided throughout the periphery with rain water pipes (CPVC pipes) with proper clamping at regular interval. Provision of future installation of Solar panels on the top of the roof shall be done by I or C section with Small base plate assembly.

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v. Landscaping:

Landscaping in surrounding area of 2 meter of Main Control Room is to be done using aesthetically pleasing and suitable varieties of flora.

vi. Flooring:

Best quality Vitrified tile flooring having min size of 600 mm x 600 mm x 8-10 mm thickness of standard manufacturers as approved by EIC.

vii. Toilet:

Toilet shall be designed for 10 persons; and constructed with following finish

- Floor: Vitrified tiles
- Door and window: made out of aluminum brown anodized sections, 6mm float glass
- Ventilators: Mechanical exhaust facility
- Plumbing fixtures: Jaquar and Kohler make
- Sanitary ware: Hindware, Cera or equivalent make
- EWC: 390 mm high with health facet, toilet paper roll holder and all fittings
- Urinal (430 x 260 x 350 mm size) with all fittings.
- Wash basin (550 x 400 mm) with all fittings.
- Bathroom mirror (600 x 450 x 6 mm thick) hard board backing
- CP brass towel rail (600 x 20 mm) with C.P. brass brackets
- Soap holder and liquid soap dispenser.

vii. Doors and Windows:

Doors and windows shall be made of aluminum sections. All sections shall be 20 microns anodized. Sections of door frame and window frame shall be adopted as per industrial standards. Door shutters shall be made of aluminum sections and combination of compact sheet and clear float/wired glass. All windows of Control cum conference room shall be protected by Sun film protection sheet. The control room shall require a number of windows/louvers to be provided for ventilation/ fresh air circulations. All fixtures for doors and windows shall be of Dorma, Godrej and Kich make.

viii. Water Supply for Toilets:

GI pipes (B class) Tata or equivalent make. Separate Overhead water tank Sintex or equivalent of 2,000 liter capacity.

ix. Drainage for Toilets:

Drainage pipes shall be of CPVC (6 kg/cm²) Supreme, Prince or equivalent make. Gully trap, inspection chambers, septic tank for 10 person and soak well to be constructed for abovementioned requirement.

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x. Air Conditioner for Control Room:

The control room shall be equipped with appropriate numbers of fans for effective heat dissipation. The SCADA cabin and Conference room shall have split type air conditioning units.

xi. Fire Extinguishers:

Liquefied CO2 fire extinguisher shall be up right type of capacity 10 kg having IS: 2171. 7 IS: 10658 marked. The fire extinguisher shall be suitable for fighting fire of Oils, Solvents, Gases, Paints, Varnishes, Electrical Wiring, Live Machinery Fires, and All Flammable Liquid & Gas. Bidder shall provide Min. 10 no of fire extinguisher is envisaged for main control room.

xii. Sand Bucket:

Sand buckets should be wall mounted, made from at least 24 SWG sheet with bracket fixing on wall conforming to IS 2546. Bucket stands with four buckets on each stand shall be provided in the Transformer Yard – 4 Nos.

xiii. Sign Boards:

The sign board containing brief description of various components of the power plant as well as the complete power plant in general shall be installed at appropriate locations of the power plant.

- For Switchyard and Transformer Yard:

The Sign boards shall be made of steel plate of not less than 3 mm. Letters on the board shall be with appropriate illumination arrangements.

- All Inverter Rooms and Control and Conference Room:

The name boards shall be made of acrylic sheet of 300mm height and fixed at the entry of the all facilities.

The Contractor shall provide to GSECL, detailed specifications of the sign boards.

5.2.19 Module Mounting Structures (MMS):

The Contractor shall design and construct appropriate civil foundations for MMS.

The array structure shall be so designed that it will occupy minimum space without sacrificing the output from Solar PV panels at the same time it will withstand severe cyclonic storm with wind speeds as per IS 875 for calculations of Vz. Bidder shall take basic wind speed value for respective sites as per following.

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Site wise wind speed to be mentioned here as per IS875

Pile casting for testing shall be as per IS before approval of drawing & design. Testing of pile by NABL accredited laboratory

It shall support Solar PV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. There shall be no requirement of welding or complex machinery at site and is strictly not allowed.

Seismic factors for the site to be considered while making the design of the foundation/ramming etc. or any technology. The design of array structure shall be based on soil test report of the site and shall be approved from GSECL/Consultant.

The Contractor has to plan for pilot test like pull out; lateral and compression of minimum 10,10,3 are required to be conducted for each floor at strategic location, immediately. Based on the results of above-mentioned tests, final approval for design of pile shall be provided.

The material of construction, structural design and workmanship shall be appropriate with a factor of safety of not less than 1.5.

For multiple module mounting structures located in a single row, the alignment of all modules shall be within an error limit of 5 mm in vertical / horizontal line.

The Contractor shall provide to GSECL the detailed design, specifications and calculations of the MMS and take approval from GSECL.

The Contractor shall specify installation details of the Solar PV modules and the support structures with appropriate diagrams and drawings.

The Module Mounting Structure design shall be certified by a chartered structural engineer and it is mandatory.

The Contractor should design the structure height considering highest flood level at the site. The minimum clearance between the lower edge of the module and the ground shall be the higher of (i) above highest flood level at the site and (ii) minimum 500 mm.

The Contractor shall provide to the Company the detailed design, specifications and calculations of the MMS during **detailed engineering**.

Curing of all piles shall be done thrice a day and be maintained for a period of seven days from the date of casting.

The Contractor has to ensure sufficient lighting arrangement for all concreting activities during night time. Sufficient illumination should be ensured in and around areas wherever civil and construction activities take place during night time.

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The Contractor shall specify installation details of the Solar PV modules and the support structures with appropriate diagrams and drawings.

The Bidder shall be permitted ramming of the module mounting structure provided that they obtain consent of EIC. EIC shall provide such consent once it is convinced that such ramming shall not in any way deteriorate the strength of the structure and shall not reduce the structure’s strength to enjoy a working life of more than 25 years.

Civil foundation design for Module Mounting Structures (MMS) as well as control room, inverters room shall be made in accordance with the Indian Standard Codes and soil conditions, with the help of Chartered Structural Designer having substantial experience in similar work. The Successful Bidder shall submit the detailed structural design analysis along with calculations and bases/ standards in the Bid.

Module Mounting Structures Design is to be certified by Chartered Structure Engineer and certificate to be produced along with the design details for approval by GSECL. Switchyard structures / transmission line structure designs shall be strictly as per GETCO design.

All the civil defects, rectification, repairing, replacement related to civil works shall be in the scope of contractor during the O&M period, the Contractor shall be responsible for rectification of any defect in the civil work and maintain the structure/buildings in good condition with proper maintenance. The Contractor shall be responsible for the maintenance of each civil works carried out as mentioned below.

1. Buildings Control room premises, Underground water tank includes:
 - I. Water tightness/ leak proof of roof and walls.
 - II. Painting to the structure either PEB/ RCC Framed structure at regular interval (not more than five years).
 - III. Plumbing & Sanitation related defects/replacement.
 - IV. Chalking / overflow of septic tank and soak pit.
 - V. Replacement / repairing of water tank if major/minor leakage observed.
 - VI. Leakage of water to be attended by suitable crack filler.
 - VII. Repairing/replacement of doors, windows, ventilators & rolling shutter.
2. Road WBM or Bitumen:
 - I. Crack repairing of the road surface.
 - II. Pot-holes over the top road surface to be rectify.
 - III. Maintenance of shoulders for the rain cuts or damage due to some external reasons.

- IV. Re-carpeting of the road surface at every five years interval.
3. Storm water Drainage:
 - I. Before and after the monsoon season the storm water drainage shall be maintained & cleaned for smoother flow of storm water.
4. Main Entry gate & Fencing:
 - I. Maintain the elegance of entry gate with painting as & when required.
 - II. Repairing & painting of precast boundary wall as & when required.

The above list is not exhaustive but indicative only. Although most of the structures are covered here in, any other system (Civil, Structural and Architectural) required for successful operation and maintenance of the works shall form a part of this contract and shall be deemed to be included in the scope of works. The scope of Bidder/EPC Contractor shall include supply of all required materials, mobilization of labour, and arrangement of required tools tackles and equipment to carry out all above civil maintenance works.

5.2 DETAILED ELECTRICAL WORK (For each S/s)

5.3.1 Photovoltaic modules

In line with OM no 283/54/2018 GRID SOLAR-Part-I dtd 10.03.2021(Requirement for compulsory registration), Order 2019, PV modles are to be sourced from ALMM Annexure - 1 of above OM and amended from time to time.

The Contractor shall employ solar PV module of Crystalline-Si (Poly / Multi or Mono / Single) solar technology only. The Contractor shall provide detail Technical Data Sheets, Certifications of Standard Testing Conditions (STC: defined as Standard Testing Condition with air mass AM1.5, irradiance 1000W/m², and cell temperature 25°C) as per the latest edition of IEC 61215 and IEC 61730 and as tested by IEC / MNRE recognized test laboratory. The Bidder shall also specify the minimum guaranteed energy output of solar PV module as per the site condition in the RFP.PV module must be registered with BIS.

- i. The PV modules to be employed shall be of minimum 72 cell configuration with rated power of module ≥ 300 Wp as certified for solar PV module power performance test as prescribed by latest edition of IEC 61215 and IEC 61730 and as tested by IEC / MNRE recognized test laboratory. The maximum tolerance in the rated power of solar PV module shall have maximum tolerance up to +3%. No negative tolerance in the rated capacity of solar PV module is allowed.
- ii. PV module must be registered with BIS.

- iii. All modules shall be certified IEC 61215 2nd Edition (Design qualification and type approval for Crystalline Si modules), IEC 61730 (PV module safety qualification testing @ 1000 V DC or higher). IEC 62804 Certified PV modules should be PID free, documents for the same should be submitted with conditions of the PID test should be for a humidity of 85 % and a cell temperature of 85⁰ C at 1000Volts , IEC 62716 , IEC 61701.
- iv. The certified Bill of Material (BOM) to be used in the PV Modules should be the same as used during the IEC certification of reference PV Module certified by renowned agency like TUV, UL, etc.
- v. Minimum certified module efficiency shall be 15% for crystalline with minimum fill factor of 0.75. The permissible maximum temperature coefficient of power (Pmpp) shall be -0.43%/⁰C or better.
- vi. All photovoltaic modules should carry a performance warranty of >90% during the first 10 years, and >80% during the next 15 years.
- vii. Further, module shall have performance warranty during the first year of installation as under.
 - Mono > 97%
 - Poly > 97.5%
- viii. The module mismatch losses for modules connected to an inverter should be less than **1%.(Maximum)**
- ix. SPV module shall have module safety class-II and should be highly reliable, light weight and must have a service life of more than 25 years.
- x. The PV modules shall be equipped with IP67 or higher protection level junction box with min. 3 by pass diodes of appropriate rating and appropriately sized output power cable of symmetric length with twist locking connectors.
- xi. The SPV module shall be made up of high transmittivity glass & front surface shall give high encapsulation gain and the module shall consists of impact resistance, low iron and high transmission toughened glass. The module frame shall be made of corrosion resistant material, which shall be electrically compatible with the structural material used for mounting the modules.
- xii. The SPV modules shall have suitable encapsulation and sealing arrangements to protect the silicon cells from environment. The encapsulation arrangement shall ensure complete moisture proofing for the entire life of solar modules.
- xiii. The module frame should have been made of Aluminium or corrosion resistant material, which shall be electrolytically compatible with the structural material used for mounting the modules with sufficient no. of grounding/installation.

- xiv. All materials used for manufacturing solar PV module shall have a proven history of reliability and stable operation in external applications. It shall perform in relevance as per IEC standards.
 - xv. Modules only with the same rating and manufacturer shall be connected to any single inverter. Modules shall compulsorily bear following information in the form of ID encapsulated with solar cell in the manner so as not to cast shadow on the active area and to be clearly visible from the top.
 - xvi. The Bidder shall provide to GSECL in the Bid, power performance test data sheets of all modules. The exact power of the module shall be indicated if the data sheet consists of a range of modules with varying output power.
 - xvii. Only those crystalline modules (above 300Wp) of the same module manufacturer which has supplied for a capacity more than 0.75MW x *awarded project capacity, in other projects in India with minimum 1 project size of 0.075MW x*awarded project capacity. On this account, the Contractor shall provide full information, to the satisfaction of GSECL, before placing final order for the modules. The Contractor shall also submit the proof of original purchase.
- * this is to be noted that , cumulative capacity of awarded project shall be considered in case of single bidder are awarded project for more than one Site.
- xviii. GSECL or its authorized representative reserves the right to inspect the modules at the manufacturer’s site prior to dispatch.
 - xix. The Bidder is advised to check and ensure the availability of modules prior to submitting the Tender Document.
 - xx. The Contractor would be required to maintain accessibility to the list of module IDs along with the above parametric data for each module.

Table 5-1 Information to be displayed on solar PV module

Sr.	Particulars
1	Name of the manufacturer of the PV module and RFID code
2	Name of the manufacturer of solar cells
3	Month & year of the manufacture (separate for solar cells and modules)
4	Country of origin (separately for solar cells and module)
5	I-V curve for the module at standard test condition (1000 w/m ² , AM 1.5, 25°C

6	Wattage, Imp, Vmp, Isc, Voc, temperature co-efficient of power and FF for the module
7	Unique Serial No. and Model No. of the module
8	Date and year of obtaining IEC PV module qualification certificate
9	Name of the test lab issuing IEC certificate
10	Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO 14001

5.1.6 Junction Box/ Combiner Box

- i. The Contractor shall provide sufficient no. of Array Junction Boxes / PV combiner boxes / DCDBs.
- ii. All switch boards shall be provided with adequately rated copper bus-bar, incoming control, outgoing control etc. as a separate compartment inside the panel to meet the requirements of the Chief Electrical Inspector of Government (CEIG). All live terminals and bus bars shall be shrouded. The outgoing terminals shall be suitable for connection to suitable runs and size of cables required for the Inverter/Transformer rating.
- iii. The degree of protection for following equipment shall be:
 - Indoor Junction box : IP 21
 - Outdoor Junction Box: IP 65
- iv. All junction/ combiner boxes including the module junction box, string junction box, array junction box and main junction box should be equipped with appropriate functionality, safety (including fuses, grounding, etc.), string monitoring capabilities, and protection.
- v. The terminals will be connected to copper bus-bar arrangement of proper sizes to be provided. The junction boxes will have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable markings shall be provided on the bus-bars for easy identification and cable ferrules will be fitted at the cable termination points for identification.

Each Array Junction Box shall have suitable Reverse Blocking Diodes / Fuses of maximum DC blocking voltage of 1000 V with suitable arrangement for its connecting. The Array Junction Box shall also have suitable surge protection device. In addition, over voltage protection shall be provided between positive and negative conductor and earth ground such

as Surge Protection Device (SPD) or on-load DC dis-connectors with shoes. All incoming & outgoing cables must be terminated with Brass Gland for Cu Cables & Steel Gland for Al Cables. Bidder can also provide polyamide glands and MC4 connector. All Glands must be of Double Compression type for Outdoor duty & Single Compression type for Indoor duty. The rating of the Junction Boxes shall be suitable with adequate safety factor to inter connect the Solar PV array.

- vi. The Junction Boxes shall have suitable arrangement for the followings
- vii. Combine groups of modules into independent charging sub-arrays that will be wired into the controller.
- viii. Provide arrangement for disconnection for each of the groups.
- ix. Provide a test point for each sub-group for quick fault location.
- x. To provide group array isolation
- xi. The rating of the Junction Boxes shall be suitable with adequate safety factor to inter connect the Solar PV array.
- xii. The junction boxes shall be dust, vermin, and water proof and made of thermoplastic/ metallic in compliance with IEC 62208, which should be sunlight/ UV resistive as well as fire retardant & must have minimum protection to IP 65(Outdoor)/ IP 21(indoor) and Protection Class II or higher.
- xiii. The terminals shall be connected to copper bus-bar arrangement of proper sizes. The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables.
- xiv. The current carrying rating of the Junction Boxes shall be rated with standard safety factor to interconnect the Solar PV array.
- xv. Suitable markings shall be provided on the bus-bars for easy identification and cable ferrules will be fitted at the cable termination points for identification.
- xvi. Adequate capacity solar DC fuses & isolating miniature circuit breakers / MCCB should be provided if required. Fuses for string and outgoing DC dis-connector for SMB are allowed. The Junction Box must have space for the maintenance and 10% Spare Install Capacity for future integration.
- xvii. Detailed junction box specifications and data sheet shall be provided in the Technical Bid document.
- xviii. Other Sub systems and components used in the SPV power plants (Cables, connectors, Junction Boxes, Surge Protection devices, etc.) must also confirm to the relevant international /national standards for electrical safety besides that for quality

required for ensuring expected service life and weather resistance. It is recommended that the cables of 600-1800 Volts Dc for outdoor installations should comply with the draft EN 50618 for service life expectancy of 25 years.

5.1.7 Inverter and Power Conditioning Unit (PCU)

Bidder shall consider Central or String Inverters as per specifications mentioned in NIT

(A) Central Inverters

- i. Only those PCUs/ Inverters which are commissioned for more than ****0.75 MW¹x** awarded project capacity, capacity in other solar PV projects till date shall be considered for this project. The Contractor has to provide sufficient information to the satisfaction of GSECL before placing the final order for PCUs/Inverters. Power Conditioning Unit (PCU) shall consist of an electronic inverter with latest technology available in the market along with associated control, protection and data logging devices and must be fully communicable to SCADA with OPEN Communication Protocol. If any software required for the communication & SCADA, the same to be made available within the EPC package by the Contractor.
- ii. All PCUs should consist of associated control, protection and data logging devices and remote monitoring hardware, software for string level monitoring.
- iii. Dimension and weight of the PCU shall be indicated by the Bidder in the Bid.
- iv. Capacity of single unit of inverter shall be min. 1,000 kW. This plant shall be divided into 40-50 identical Solar PV arrays “sections”, wherein the capacity of each section varies depending upon supplier’s product capacity.
- v. No. of inverters to be supplied shall be worked out by the Contractor based on DC rating of inverter, Pnom ratio, limit on overloading capacity.
- vi. The Bidder shall guarantee average annual power loss due to non-threshold condition to be less than 0.1% and shall support the claim with necessary document / data / graphs in the Bid.

**This is to be noted that 0.75 MWx awarded project capacities for the Inverter manufacturer to test their strength and capability for supplying for this Project. Also, cumulative capacity of awarded project shall be considered in case of single bidder awarded project for more than one site.

- vii. DC Injection into the grid: This shall be avoided by using a step-up transformer at the output of the inverter. DC injection shall be limited to 1% of the rated current of the inverter as per IEC 61727.
- viii. Inverters shall be capable of operating at varying power factor preferably between 0.85 lag to 0.85 lead and shall be able to inject or absorb reactive power.
- ix. Inverters shall operate at ambient temperature of 50°C without deration.
- x. The up-time of Inverters should be of 99% in a year, in case of failing to achieve this due to failure of any component of inverter the Contractor shall either replace the inverter or the component at his own cost.
- xi. All inverters shall be tested for IEEE 519 & IEC 62116 standard.
- xii. DC input terminals must be in enough numbers so as each terminal is connected to dedicated single input. Two DC inputs can not be connected on the single input DC terminal of the inverter. If adequate number of input are not available in the selected inverter by the Contractor then a DC junction box with protection devices such as fuse, DC disconnects may be incorporated in to design. The Bidder has to indicate the selected parameters in the Bid.
- xiii. The minimum European efficiency of the inverter shall not be less than 98% measured at 100% load as per IEC 61683 standards for measuring efficiency. The Bidder shall specify the conversion efficiency at different loads i.e. 25%, 50%, 75% and 100% in the Bid. The Bidder should specify the overload inverter capacity in the Bid.
- xiv. The PCU shall be tropicalized and design shall be compatible with conditions prevailing at site. Provision of exhaust fan with proper ducting for cooling of PCU's should be incorporated in the PCU's, keeping in mind the extreme climatic condition of the site.
- xv. The inverters shall have Protection Class II or higher and minimum protection of IP as under:
Outdoor : IP 65(Electronics)/ IP 54 (Magnetic)
Indoor : IP 21
- xvi. Nuts & bolts and the PCU enclosure shall have to be adequately protected taking into consideration the atmosphere and weather prevailing in the area.
- xvii. (Grid Connectivity) Relevant CERC/GERC regulations and grid code as amended and revised from time to time shall be complied. The system shall incorporate a uni-directional inverter and should be designed to supply the AC power to the grid at load end. The power-conditioning unit shall adjust the voltage & frequency levels to suit the Grid.

- xviii. All three phases shall be supervised with respect to rise/fall in programmable threshold values of frequency.
- xix. The inverter output shall always follow the grid in terms of voltage and frequency. This shall be achieved by sensing the grid voltage and phase and feeding this information to the feedback loop of the inverter. Thus control variable then controls the output voltage and frequency of the inverter, so that inverter is always synchronized with the grid. The inverter shall be self-commutated with Pulse width modulation technology.
- xx. This should be capable to synchronize maximum within 1 Minutes.
- xxi. The PCU shall be capable of controlling power factor dynamically.
- xxii. Maximum power point tracker (MPPT) shall be integrated in the power conditioner unit to maximize energy drawn from the Solar PV array. The MPPT should be microprocessor based to minimize power losses. The details of working mechanism and make of MPPT shall be mentioned by the Bidder in the Bid. The MPPT must have provision for constant voltage operation. The MPPT unit shall conform to IEC 62093 or **EN50330** for design qualification.
- xxiii. The system shall automatically “wake up” in the morning and begin to export power provided there is sufficient solar energy and the grid voltage and frequency is in range.
- xxiv. Sleep Mode: Automatic sleep mode shall be provided so that unnecessary losses are minimized at night. The power conditioner must also automatically re-enter standby mode when threshold of standby mode reached.
- xxv. Stand – By Mode: The control system shall continuously monitor the output of the solar power plant until pre-set value is exceeded & that value to be indicated.
- xxvi. Basic System Operation (Full Auto Mode): The control system shall continuously monitor the output of the solar power plant until pre-set value is exceeded & that value to be indicated.
- xxvii. The PCU shall include appropriate self-protective and self-diagnostic feature to protect itself and the PV array from damage in the event of PCU component failure or from parameters beyond the PCU’s safe operating range due to internal or external causes. The self-protective features shall not allow signals from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the PCU, including commutation failure, shall be cleared by the PCU protective devices. In addition, it shall have following minimum protection against various possible faults.
 - a. Earth Leakage Faults: The PCU shall have the required protection arrangements against earth leakage faults and –Ve DC directional protection.

- b. Over Voltage & Current: In addition, over voltage protection shall be provided between positive and negative conductor and earth ground such as Surge Protection Devices (SPD).
 - c. PCU shall have arrangement for adjusting DC input current and should trip against sustainable fault downstream and shall not start till the fault is rectified.
 - d. Galvanic Isolation: The PCU inverter shall have provision for galvanic isolation. Each solid state electronic device shall have to be protected to ensure long life of the inverter as well as smooth functioning of the inverter.
 - e. Anti-islanding (Protection against Islanding of grid): The PCU shall have anti islanding protection. (IEEE 1547/UL 1741/ equivalent BIS standard).
 - f. Unequal Phases: The system shall tend to balance unequal phase voltage.
 - g. Heat Transfer / Cooling / Built in Ventilation Systems must be provided with 20% Spare capacity. Bidders to Submit Heat Rejection / Transfer calculation for Air Conditioning of Inverter Room.
 - h. Inverter must be provided with –Ve earthing for protection of PV modules against possible “Potential Induced Degradation”.
- xxviii. Reactive Power: The output power factor of the PCU should be of suitable range to supply or sink reactive power. The PCU shall have internal protection arrangement against any sustained fault in the feeder line and against lightning in the feeder line.
- xxix. Isolation: The PCU shall have provision for input & output isolation. Each solid-state electronic device shall have to be protected to ensure long life as well as smooth functioning of the PCU.
- xxx. All inverters/ PCUs shall be three phase using static solid state components. DC lines shall have suitably rated isolators to allow safe start up and shut down of the system. Circuit breakers used in the DC lines must be rated suitably.
- a. Sinusoidal current modulation with excellent dynamic response.
 - b. Compact and weather proof housing.
 - c. Direct use in the outdoors with outdoor housing.
 - d. Comprehensive network management functions (including the LVRT and capability to inject reactive power to the grid).
 - e. No load loss < 1% of rated power and maximum loss in sleep mode shall be less than 0.05%.
 - f. Unit wise & integrated Data logging