



SECTION II:

Scope of Work and Technical Specifications (SoW)

SELECTION OF EPC CONTRACTOR FOR SURVEY, DESIGN, ENGINEERING, SUPPLY, PROCUREMENT, INSTALLATION, ERECTION, CONSTRUCTION & COMMISSIONING OF GRID-CONNECTED 12 MW (AC) SOLAR PV POWER PLANT FOR CAPTIVE CONSUMPTION INCLUDING LAND ON LEASE FOR 27 YEARS AND COMPREHENSIVE OPERATION & MAINTENANCE FOR 10 YEARS AT ANY LOCATION IN THE STATE OF GUJARAT

TENDER DOCUMENT NO:

e-TENDER ID- 215408

TABLE OF CONTENTS

1.	GENERAL SCOPE OF WORK.....	4
1.1	Planning and Designing:.....	4
1.2	Approval of Designs / Drawings.....	6
1.3	Statutory Requirements:	7
1.4	Civil and Other Non-Electrical Work:	8
1.5	Tracking Structures:	10
1.6	Electrical Work: -	10
1.7	Evacuation of Power & Metering Point:	11
1.8	Communication:	11
1.9	Plant Safety Equipment:	13
1.10	Final Commissioning	14
1.11	Comprehensive Operation and Maintenance (O&M):	14
2.	CIVIL WORK	17
2.1	Land Procurement and Arrangements for 27 Years	17
2.2	Topographical Survey:	17
2.3	Soil Test:.....	18
2.4	Shadow Analysis:	18
2.5	Weather Parameters:	18
2.6	Land Development and Cleaning:.....	18
2.7	Storm Water Drainage System:	19
2.8	Roads:	19
2.9	Boundary Wall (Fencing):.....	19
2.10	Watchman's Cabin and Main Entrance Gate:.....	20
2.11	Security Cabin:	20
2.12	Foundation design:	21
2.13	RCC structures for control room:.....	21
2.14	RCC Conference cum Control room	21
2.15	Walls and Roof for RCC Super structure:	24
2.16	Underground RCC water Tank/HDPE Water Tank:	25
2.17	Water supply:.....	25
2.18	Water for Module Cleaning:	26
2.19	Toilet:	26
2.20	Area Lighting	26
2.21	Quality Control Laboratory	27
2.22	Building Material.....	29
2.23	Clean up of Work Site	32
3.	MODULE MOUNTING STRUCTURES (MMS)	33
3.1	Switchyard structures / transmission line structure designs	35
3.2	Structural Steel Work.....	35
3.3	Hardware	36
4.	DETAILED ELECTRICAL WORK	38
4.1	Photovoltaic Modules:.....	38
4.2	Junction Box / Combiner Box/String Monitoring Box:	40
4.3	Cables and Wires	41
4.4	Technical Specification of LT XLPE Cables	44
4.5	Technical Specification of HT XLPE Cables	45
4.6	Clamps and Connectors	47
4.7	Lightning protection for PV Array	49
4.8	Earthing for PV array.....	50
4.9	Inverter and Power Conditioning Unit (PCU) (String/central Inverter):	51
4.10	AC Network	55
4.11	HV Substation Block:.....	57
4.12	Isolators cum Earthing Switches, Contacts, Insulators, Busbars.....	69



4.13	Insulators:	71
4.14	Busbars:	72
4.15	Control & Relay Panel Specifications	72
4.16	Low Voltage Switchgear.....	73
4.17	Control & Relay Panel Specifications for 415 V TP&N Power Control Centre (PCC).....	73
4.18	Control Room Electrical Wiring.....	74
4.19	Auxiliary Power Supply	75
4.20	DC Battery & Charger.....	75
4.21	Earthing (General Plant):	75
4.22	Lightning Protection for PV plant & Earthing (General Plant):	77
4.23	General Technical Specifications of Control Panel	78
4.24	Metering System.....	80
4.25	SCADA and Remote Monitoring System	82
4.26	Management Information System (MIS) for 12 MW (AC) Project:.....	90
4.27	Testing Instrument for Electrical & Electronic:.....	90
4.28	Electronic LED Display Board:	90
4.29	CCTV Camera System:.....	91
4.30	Fire Alarm System	92
4.31	Fire Extinguishing System	93
4.32	Clean up of Work Site	94
5.	INTENT OF LAND ON LEASE:	95
5.1	Criteria for Selection of Land:	95
5.2	General Terms & Conditions.....	96
5.3	Terms & Conditions of Payment	97
5.4	Arbitration:	98
6.	VENDOR LIST	99
7.	OPERATION AND MAINTENANCE (O&M).....	107
7.1	Operation & Maintenance period	107
7.2	Guideline for Operation and Maintenance (O&M) after O&M Period:	107
8.	PROJECT TIMELINE	111
8.1	Proposed Schedule	111
8.2	Delay in Execution or Failure to Supply	112
8.3	Liquidated Damages for Delay and Underperformance	113
8.4	Penalty for Generation during Operation & Maintenance (O&M).....	115
8.5	Important Timelines and Dates	116
9.	PAYMENT TERMS (12 MW PROJECT)	118
9.1	Terms of payment for Supply	118
9.2	Terms of payment for Work	119
9.3	Terms of payment for O&M	119
9.4	Terms of payment for Land Lease	120
9.5	Payments Procedure.....	121
10.	QHSE Requirement:	123
10.1.	SCOPE AND APPLICATION	123
10.2.	RESPONSIBILITIES.....	123
10.3.	MOBILIZATION	123
10.4.	EXECUTION	124
10.5.	QHSE GUIDELINE (AS APPLICABLE) FOR ALL TYPE OF CONTRACTS.....	124
10.6.	HSE & CPAR related Penalty Matrix.....	125
10.7.	FORMATS	128
11.	List of Annexure:.....	136
11.1.	Annexure 1: List of sites for the captive consumption	136
11.2.	Annexure 2: Check list of land documents	136

1. GENERAL SCOPE OF WORK

The Tender is invited by GGL for installation of 12 MW (AC) Solar PV project to achieve minimum 24.07% CUF at Plant end 66 kV Substation on 12 MW (AC) for first year. Along with land acquirement on lease by Selected EPC contractor to install DC capacity under Standard Test Conditions (STC) as per latest revision of IEC61215 and IEC61730 to achieve minimum CUF 24.07% at Plant end 66 kV Substation end for first year. The Contractor shall comply that the AC capacity which shall be 12 MW (AC).

Scope of Selected EPC contractor is to select and provide the land on lease to GGL anywhere in Gujarat state as per requirement of 12 MW (AC) Solar PV Project anywhere in Gujarat to meet guaranteed NEEG given in tender. EPC contractor shall also arrange ROW for HT/LT line power evacuation infra structure up to GETCO Substation. Charges of ROW shall be included in EPC cost and not be claimed extra by EPC contractor to GGL.

The general scope of work for SITC Of 12 MW (AC) Ground Mounted Grid Connected Solar Photovoltaic Power Plants with Land on Lease at Any Location in Gujarat with Comprehensive Maintenance Up To 10 Years and evacuation of power into the nearest GETCO's 66 kV substation of corresponding to the guaranteed plant performance in the form of guaranteed energy output. Supply Laying Testing & Commissioning of 66 kV HT XPLE cable or OH line as per GETCO's requirement to be considered as mentioned in the tender.

The following size of plot required anywhere in Gujarat

Name	Area (In Acre)	Max. MW (AC)	Company/Owner /Client
Plot Required (Approx.)	60-65 (Land requirement May Vary Based on the module wattage offered by EPC Contractor)	12 MW	GGL

Bidder has to consider power evacuation through underground 66 KV cable (3 + 1 spare) of appropriate size from switchyard(s) or Overhead line as per GETCO standard and specifications to GETCO – S/S. The Termination at GETCO end shall be in evacuation bay for 12 MW (AC) project. Evacuation cable and transmission lines shall be GETCO approved and as per current carrying capacity and voltage drop selection criteria.

1.1 Planning and Designing:

- The Contractor shall plan and design for the electrical / mechanical / civil requirements including but not limited to plant configuration, space optimization, distance between rows of modules, sufficient passage for vehicle and man-power movement in the plant, mounting structures, location of Conference cum Control Room, cable routing, selection of equipment and items, procurement plan etc. to enhance plant output.



- ii. The Contractor must carry out the complete soil investigation of the site, through Government approved laboratory or laboratory mentioned in this tender before designing various civil structures. EPC contractor must send samples in the laboratory as directed by GGL/GGLs Consultant. The design of all civil foundations, R.C.C structures, buildings etc. will be carried out considering appropriate seismic zone of the area. All appropriate loads, wind velocity, seismic factors etc. will be considered as per the relevant IS Specifications while designing any civil structure. Also, the environmental conditions, soil characteristics, atmospheric effect, ground water table level, rain water data, land profile, etc. must be considered as per site actual condition and accordingly appropriate precautions and preventive measures will be taken while designing the structures. RCC structures will be adopted considering surrounding weather and soil conditions of site and as per the relevant IS codes. The concrete mix design test of minimum M25 grade with minimum 350 kilograms of cement content per cubic meter concrete shall be carried out in Govt. certified laboratory or NABL accredited laboratory.
- iii. The Contractor shall take into consideration all parameters like wind speed, seismic zone, safety factor and safe Soil Bearing Capacity (SBC) etc. for the purpose design and construction of civil foundations for all civil work as per relevant IS codes.
- iv. All The Contractor shall carry out Shadow Analysis at the site and accordingly design strings and arrays layout considering optimal usage of space, material and labour.
- v. All designs & drawings have to be developed based on the governing standards and requirements of the project and also keeping in mind basic design specifications. GGL may approve minor deviations or suggest required modifications in the same which are meant for increasing plant performance without sacrificing quality / workmanship norms.
- vi. All designs, specifications, reports, etc. submitted or used by the Contractor at any point in time shall first be approved by the Owner /Consultant and revised by Owner /Consultant, if required, prior to execution.
- vii. The technology offered shall be commercially established technology and at least one Project based on this technology shall be satisfactorily operational for at least one year in India. Details of the Project with location and the successful operational period of the Project utilizing this technology shall also be mentioned before the submission of first set of drawings for approvals.
- viii. The Owner reserves right to modify the specifications at any state as per local site conditions / requirements and EPC contractor shall comply with modification without any extra cost and time.
- ix. The Contractor has to arrange the facility for testing bulk material at site such as Elcometer for testing galvanization, cube-testing machine for testing the strength of cube samples, Sieve Analysis accessories, Flakiness and Elongation Index accessories.
- x. The Contractor has to send samples of the material to Govt. accredited / NABL accredited laboratory for testing as when required by the Owner/consultant.



- xi. The Contractor shall provide and maintain one (1) fully furnished office container at site for use by the Client and Consultant team (up to 8 persons). The office container shall be equipped with adequate seating arrangements, work tables, air-conditioning, lighting, electrical points, drinking water facility, and any other amenities as may be reasonably required by the Client/Consultant during the project period. The Contractor shall be responsible for installation, maintenance, and upkeep of the container throughout the duration of the Contract.

1.2 Approval of Designs / Drawings

- i. All designs, specifications, reports, etc. submitted or used by the Successful Bidder at any point in time shall first be approved by GGL/GGL's Consultant and shall be revised by Successful Bidder as per instructions given by GGL if required prior to execution, for 12 MW (AC) project.
- ii. The Bidder shall submit in the Bid a comprehensive project management schedule in the form of a Gantt chart CPM/PERT chart and shall be liable for abiding by the schedule.
- iii. The Bidder shall submit in the Bid general engineering drawings of all civil work, including but not limited to, layout of the power plant indicating rows of photovoltaic modules, SLD, location of control panels, DC and AC Distribution Boxes, MMS design, civil foundations and anchoring design / details, shading analysis and generation estimation report etc.
- iv. The bidder shall submit in the Bid technical specifications / Drawings / Designs and datasheets for all electrical work including but not limited to electrical components of the power plant including photovoltaic modules, cables, connectors, junction boxes, inverters, transformers, monitoring and auxiliary systems, etc. for 12 MW (AC) project.
- v. The Bidder shall submit a comprehensive maintenance schedule for operation and maintenance of the photovoltaic power plant along with checklists and shall be liable for abiding by the schedule. All construction, operation and maintenance procedures shall be carried out through appropriate relevant standards, regulations and labour laws. or any other laws applicable during construction, operation and maintenance.
- vi. The Bidder/EPC Contractor shall submit the drawing as per Tender specifications. Any revision in drawing based on Owner's/Consultant's observations, in case not confirming to tender specification, then revised document shall be submitted within 3 days. In normal circumstances approval/comments on submitted drawings will be given by Owner within 10 working days from date of submission of drawings by Bidder. In case of multiple revision of documents/drawings then complete time taken by Bidder for revision of documents/drawings will be attributed to Contractor's account and no claim will be entertained by Owner on account of delay in approval of drawing/documents.
- vii. The Successful Bidder shall submit to the Owner the documents in hard copy (3 Set) and soft copy to both with proper reference and drawing numbers.
- viii. The Successful Bidder shall submit all drawings in AutoCAD format in addition to PDF.



- ix. The Successful Bidder shall also be submitted a structural Design Basis Report (DBR) for each design, Input / source file of STAAD/STRAP/STRUD/ETABS/ etc for the structure to the Owner/Consultant in hard copy and soft copy for review and approval. For time saving it is preferred to submit the drawing for review/approval in soft copy but upon approval for Owner/Consultant the drawing released for execution shall be submitted to Owner/Consultant for stamping on 3 set of hard copies.
- x. The Successful Bidder has to provide Input/Source file of STAAD/STRAP/STRUD/ETABS/etc and AutoCAD drawings for the patented designs also. Any denial for the same shall be treated as breach of contract. The Bidder Shall submit detailed design calculations of foundation, columns, walls, stairs, beams & slabs – all the structural elements in hard as well as soft copy.
- xi. No revisions are entertained once the drawing is approved. If GGL is allowing for revision in approved drawing due to valid reason, then time required for approval process shall not be accounted for any extension.
- xii. The Contractor has to submit all drawings which are related to plant for approval and the Contractor, shall not claim any drawing as their intellectual property. Drawing which is developed for project will be the intellectual property of the Owner.

The Contractor shall submit a comprehensive maintenance schedule for operation and maintenance of the photovoltaic power plant along with checklists before commencement of work on site and shall be liable for abiding by the schedule. All construction, operation and maintenance procedures shall be carried out through appropriate relevant standards, regulations and labour laws.

1.3 Statutory Requirements:

All construction, operation and maintenance procedures shall be carried out through appropriate relevant standards, regulations laid by GUVNL/GETCO /CEIG/DISCOM/ GEDA / GGL/ GoI / MNRE and / or any other agency as and when applicable. Further, this shall comply with the applicable labor laws. The Bidder shall make himself aware of such requirements and shall not solely depend on the Company to avail themselves full of information.

- i. All other approvals, as necessary for setting up of a solar power plant including CEIG, connectivity of entire plant including 66 kV Substation, construction power, power evacuation, GEDA, GETCO, GPCB etc., as per the suggested guidelines.
- ii. CT, PT and Metering system testing at ERDA or other lab as per GETCO requirements.
- iii. All other statutory approvals and permissions not mentioned specifically but are required to carry out hassle free construction and operation of the plant.
- iv. Statutory charges related to the project will be paid by the contractor and also, all liaisoning with the concern authorities, DISCOM / GEDA / CEI / GETCO / SLDC / Revenue Dept/Environment department and any another as applicable for the project shall be borne by the contractor till the project execution



and commissioning only. During O&M Statutory charges (except DSM Charges) related to the project shall be borne by GGL. The bidder are requested to quote accordingly.

For DSM charges.

1. EPC/O&M contractor shall be responsible for carrying out scheduling & forecasting work.
2. All cost associated towards scheduling & forecasting activity like charges for hiring of Qualified Coordinating Agency (QCA), additional SCADA requirements if any for accurate scheduling & forecasting work, related to DSM regulation by CERC/GERC in existence and amended from time to time, shall be in the scope of EPC/O&M contractor.
3. EPC/O&M contractor shall have to bear total 100% DSM charges.
4. EPC/O&M contractor shall be responsible for selection of QCA Agency as per regulation of CERC/GERC/SLDC regulations and amended time to time before the time of the commissioning/part commissioning of the power project.
5. EPC/O&M contractor has to select the QCA Agency and shall be able to start the scheduling and forecasting work immediately with the commissioning/part commissioning of the plant. If EPC/O&M contractor fails to do so, then EPC/O&M contractor shall be liable to pay 100% DSM charges for that particular period.

All approvals, equipment, item and works which are not specifically mentioned in this document but are required for completion of work including 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 this bid. All Statutory & regulatory approval and renewal of the same from time-to-time up to Point of Consumption (Each COCO station) is in Contractor's scope.

1.4 Civil and Other Non-Electrical Work:

- i. **Module Mounting Structures (MMS):** 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 structure, seasonal tracker, or any other tracking are accepted.
- ii. **Foundations:** The Contractor shall design and construct appropriate civil foundations for MMS, prefabricated structures/ RCC, transformers, switchyard equipment, feeder bay, for inter connection of cable for the plot, 66 KV lines from switchyard to GETCO end substation etc. Grade of reinforced cement concrete shall be M25 with minimum 350kg of cement. Contractor must submit mix design for reinforced cement concrete along with admixture. Contractor has to submit batch report of each concrete batch if RMC or Ajax concrete mixer is used. In Ajax concrete mixer necessary display must verify the content of mixture used.

All necessary tests 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 is 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 and pits of substation after concrete shall be carried by using river sand or Murrum only. No other material shall be allowed for backfilling.

The Contractor shall design and construct appropriate RCC civil foundations for MMS, prefabricated structures/ RCC, transformers, switchyard equipment, LA, Area lighting poles, water tank, street light, fencing, feeder bay, foundations for cable over existing cable corridor, for inter connection of cable for different plots, 66 KV lines from switchyard to GETCO end substation (applicable in case of overhead Transmission line) etc. Grade of reinforced cement concrete shall be M25 with minimum 350kg of cement. All types of PCC i.e. at the base of all types of foundation, base of plinth beam, for fencing pits. shall be of M15 only Contractor has to submit mix design for reinforced cement concrete along with admixture. In all types of RCC, minimum reinforcement as per codal provision is to be provided.

Contractor has to submit batch report of each concrete batch. All necessary tests related to materials of concrete mix like cement, sand, aggregates etc shall be carried out regularly as per relevant IS code at GGL approved or lab mentioned in this tender. Test related to concrete cubes like compressive strength, workability etc shall be carried out. If any treatment is 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.

- iii. **Prefabricated/RCC Structures:** The following prefabricated / RCC structures are to be planned and constructed by the Contractor for the 12 MW (AC) Solar PV project:
- RCC control Room of minimum size 15-meter x 30 meters with Office room, SCADA room, Store room, Battery room, control room, conference room, Toilet units (Separate for Ladies and gents) and Pantry on ground floor and Three bedrooms, kitchen, toilet unit with necessary furniture on first floor.
 - Prefabricated Watchman's cabin (At Main Gate (s))
 - Prefabricated Security Cabins at any four locations directed by GGL.
- iv. **Storm Water Drainage System:** The Contractor shall provide storm water drainage system with brick masonry or RCC Drain for entire plant.
- v. **Solar PV Module Cleaning System:** Cleaning frequency shall be decided by the Bidder to meet the guaranteed generation, but the cleaning cycle shall not exceed 10 days. For this, the Contractor must design as per relevant IS codes, submit and get approval from owner / consultant and construct and operate 1,50,000-liter underground RCC water tank or Sintex water tank on RCC platform for 12 MW (AC) Project. For module cleaning, the contractor must establish a pipeline network with valves. The



pipe line network should be designed in such a way that it should reach every corner. Pipe line network shall be laid above ground. Pipe line shall be rested on RCC pedestal.

- vi. **Precast Boundary Wall (Fencing):** The Contractor shall provide Precast boundary wall including “L” shape GI angle with 4 no’s of barbed wire fencing of the entire plant boundary for 12 MW (AC) plant sites. Height shall not be less than 2 Meter from Ground Level or as per approval of GGL/GGLs Consultant.
- vii. **Approach / Internal Roads and Pathways:** The Contractor shall provide internal roads and approach roads to MCR and 66 kV Switchyard of asphalt type for 12 MW (AC) Solar Plant site. All roads shall be Asphalt type.
- viii. **Cable Trenches:** Construction of RCC cable trenches with cable trays and covers in Conference cum control rooms, earthen excavated cable trench with alternate layers of sand and brick as per relevant IS from PV arrays to inverter cum control room to switchyard shall be provided by the Contractor.
- ix. **Main Gate:** The Contractor shall provide main gate of structural steel and RCC material of appropriate design. Also, necessary arrangement must be made by Contractor to erect the pylon stone on supporting RCC column of main gate.
- x. **Site levelling:** The Contractor shall level the site, as required, to compact the plant in minimum possible area and minimize shading losses because of solar PV module structures. Removal of debris and bush-cutting is mandatory. Levelling of the site is to be done by EPC contractor if required by GGL before starting of Operation and Maintenance period.

1.5 Tracking Structures:

The Owner encourages Bidders to employ proven and reliable seasonal tracking or any other tracking system, The Bidder shall submit in the Bid, the details / specifications / designs / guarantees and warranties / and any other claims on performance / output of the solar tracking solutions in the Bid document.

1.6 Electrical Work: -

Consisting of installation of solar PV modules, junction boxes, grid-tied inverters, AC combiner panels, transformers, meters, control panel, HT switchgear, 66 kV switchyard for evacuation, 66 kV Overhead /UG cable work up to 400/220/66 kV Switchyard, interconnection through wires, cables, bus bars, etc.; plant lighting system, automatic weather monitoring station (AWMS), SCADA and remote web-based communication & monitoring hardware, software, etc.

Plant and human safety and protection equipment including danger signs CCTV, Safety Siren etc. UPS system shall be provided at Control room. Sump pumps shall be provided in Control Room (s) & Switchyard (s). Anything is not mentioned in the list but still required to finish the EPC contract of Solar Plant capacity to be considered for the BID and shall not be denied by EPC contractor.

1.7 Evacuation of Power & Metering Point:

For the purpose of this project, the evacuation voltage shall be at 66 kV AC (three phase) wherein evacuating point cum metering point shall be installed at 66 kV (AC) (three phase) wherein evacuation point cum metering point through ABT meter shall be 400/220/66 kV GETCO SS at nearest Substation. Scope of work shall also include 66 kV Overhead /Under Ground cable work from proposed GGL Plots solar plant substation to Nearest 400/220/66 kV substation as per GETCO's guidelines. For evacuation considering maximum current capacity and minimum voltage drop criteria for each evacuation line, maximum power that can be evacuated from single circuit shall be as per GETCO guidelines.

Bidder has to quote and consider for 66 kV underground cable for power evacuation from 12 MW (AC) project up to GETCO SS However, if overhead transmission line feasibility is established and permitted by GETCO between GETCO premises to GGL Plant, Vendor to work accordingly, in this manner GGL's Decision will be considered as final decision.

1.8 Communication:

The Contractor shall provide complete plant SCADA (Software based) with SCADA server having string level monitoring capabilities over remote server. Contractor shall lay the cable in appropriate cable trench, connect with suitable connectors and terminate to the SCADA server inside control room. The Contractor shall also provide necessary internet connection through GPRS enabled modem along with LAN connectivity for data communication over remote server and shall bear the cost of the same during the Contract period including O&M. The Contractor shall provide 4 nos. of Web Client License for remote monitoring per Project. The Contractor shall provide necessary provision of RTU for communication with SLDC. The Contractor shall submit the below mentioned Technical Data Sheet for String RTU, TCP String, Central RTU in the prescribed format.

Type Code

Power Entry Characteristics

AC input voltage range ($V_{ac, min}$ $V_{ac, max}$)

Nominal AC input voltage ($V_{ac,n}$)

Rated frequency (f_r)

DC Input Voltage Range ($V_{dc, min}$ $V_{dc, max}$)

Nominal DC input voltage ($V_{dc,n}$)

RS485 Section

Serial interface type

Baud rate

Protocol

Number of devices

Line biasing resistor (wherever necessary)

Termination resistor
RS485 MODBUS section
Serial interface type
Baud rate
Protocol
Number of devices
Line biasing resistor (wherever necessary)
Termination resistor
Physical and Environmental
Environmental protection rating
Ambien temperature range
Relative humidity
Compliance
Isolation
Marking
Safety and EMC standard

Essential list of I/O and equipment is given herewith, but scope is not limited to the Essential List, contractor is fully responsible to provide complete SCADA System which can be extensible / communicable with add additional / future solar plant.

Sr.	Equipment to be monitored	Data to Be Monitor (Real Time)	Type of IO
1	String Monitoring / Array Monitoring	Each PV string needs to be monitored.	Through Communication with SJB PLC/Card
2	String Junction Box / Array Junction Box (SJB = AJB)	SJB Bus Voltage and Current	Through Communication with SJB PLC/Card
3	Inverter	All Electrical Parameters of Inverter along with Scanning, Records & Error communication	Through Communication with SJB PLC/Card
4	Inverter Transformer	Oil and Winding Temp Monitoring	Analog Input
5	HV (11/33 kV) RMU / VCB	ON/OFF and Trip position of Each RMU / VCB and Energy Meter RS-485 communication	DI and Communication



Sr.	Equipment to be monitored	Data to Be Monitor (Real Time)	Type of IO
6	66 KV Switchyard	All Equipment details including Power Transformer, Breakers, C&R Panels, Isolators, Earth Break Switches, Metering & Protection Devices etc.	DI and Communication
7	Weather Monitoring Station	Two no. of Class A Pyranometer (According to Latest edition of IEC 61724-1) (one for GHI, one at PV plane collector angle), Two numbers of contact type temperature sensors one at module front and the other at backside of the module. Ambient temperature sensor, Wind velocity and speed sensor.	Through Communication
8	Aux. Equipment's	Aux. Transformers, UPS, NIFPS, Fire Alarm Panel, CCTV	AI / DI / Communication for Information / Records / Logging
9	Main and Check Meter	All electrical parameters recorded by energy meter	Through RS-485/MODBUS communication

Note: The Contractor shall arrange online remote monitoring of the plant at the GGL office, Gandhinagar or at any other location as instructed by GGL.

1.9 Plant Safety Equipment:

The Contractor shall provide appropriate numbers of foam type fire extinguishers / CO2 extinguishers, sand buckets and transformer discharge rod at Control Room, Security Cabin and Switchyard/Substation. Further, all high voltage places to be provided with danger sign boards with appropriate size and material to last for 25 years.

1.10 Final Commissioning

The commissioning procedure shall be as per GUVNL/GETCO / DISCOM / GEDA / GGL/ Chief Electrical Inspector to Government (CEIG) requirements. The Contractor shall also ensure the following:

- i. Obtaining written certificate of commissioning of the facility and permission to connect to the grid from the office of the Chief Electrical Inspector of the state and any other authorized representative from Government of India (GoI) / GoG / GETCO / GGL/DISCOM/GEDA/ GUVNL.
- ii. Inspection and successful electrical commissioning certificate from the Owner.
- iii. Obtaining all certificates required by Dis-Com from agency appointed by them.
- iv. Satisfactory completion certificate towards completion of all other contractual obligations by the Contractor as stipulated by the Owner.

Terminal Point for the EPC Project

- a. Complete EPC work for 12 MW (AC) Solar PV Project up to interconnection at nearest 66 kV GETCO sub-station.
- b. GETCO supervision charges for 66 kV cable laying/overhead line and termination shall be in scope of EPC Contractor and all coordination, work execution, paper work shall be carried out by EPC Contractor.
- c. Land lease cost will be paid by GGL as per lease agreement.
- d. Development of bay(s) at GETCO end substation –Charges related to development of bay shall be paid by EPC Contractor to GETCO.

1.11 Comprehensive Operation and Maintenance (O&M):

The scope of work includes Operation and Maintenance (O&M) of the plant up to 10 Years, wherein the plant shall generate at least equivalent to the guaranteed Performance of the plant. The Bidder shall submit in the Bid a comprehensive project execution schedule as well as Operation and Maintenance (O&M) schedule with resource planning in the form of Gantt chart and shall be liable for abiding by the schedule. It is the responsibility of the Contractor to perform the necessary maintenance/ timely replacement of all Civil /Mechanical or Electrical components of the project during this O&M period such that the guaranteed performance of the plant is not compromised.

Any damage to CIVIL/ ELECTRICAL/ MECHANICAL components of the plant is to be reworked/ replaced/ supplied without any extra cost and time by the Contractor during complete O&M period. The Operation and Maintenance shall be comprehensive. The maintenance service provided shall ensure project functioning of the Solar PV system as a whole and Power Evacuation System to the extent covered in the Contract. All preventive/ routine maintenance and breakdown/ corrective maintenance required for ensuring maximum uptime shall have to be provided. Accordingly, Comprehensive Operation and Maintenance shall have two distinct components as described below:



- i. **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, Transmission line and associated switchgears also should be included.
- ii. **Breakdown/ Corrective Maintenance:** Whenever a fault has occurred, the Contractor must attend 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.

The Contractor shall deploy, as a minimum, 1 Site In-Charge (Day Shift only) (Degree or Diploma with 8 Years Experience), 1 Engineer day shift (Diploma with 5 Years Experience), 2 Technicians round the clock (Diploma with 2 Years Experience), and 5 Security Personnel round the clock, Contractor may increase the manpower as required to meet site conditions or as per owner requisite.

The date of Comprehensive Operation and Maintenance Contract period of the Project as contractor O&M responsibility to be O&M of solar plant, O&M of 66 KV Switchyard, O&M of GETCO's side bay and transmission line shall begin on the date as defined in the NIT of this Tender. 66 KV line maintenance including Capital Intensive cost to be borne by the Contractor during the O&M Period. Detailed scope of comprehensive Operation & Maintenance has been described in Chapter 7 of this document. However, operation of the Power Plant means operation of system as per bidding schedule and workmanship in order to keep the project trouble free covering the guarantee period.

Disclaimer: Any civil / electrical / other work, which is not mentioned or included in this Tender document but necessary for the construction and O&M of 12 MW (AC) with Solar PV plant shall be borne by the Contractor. The Contractor shall, unless specifically excluded in the Contract, perform all such works and /or supply all such items and materials not specifically mentioned in the Contract/ Tender Document but can be reasonably inferred from the Contract as being required for attaining completion, commissioning and performance of the facilities, delivering NEEGG and maintaining the plant & achieving NEEGG during O&M period of 12 MW (AC) Solar PV Power Plant as if such work and / or items and materials were expressly mention in the Contract without any extra cost implication and liability to GGL. All specifications mentioned in this Tender indicates minimum technical requirement. The Contractor may propose alternate specifications or design though the final acceptance of the same is subject to the Owner's discretion.

--- End of Section---

2. CIVIL WORK

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 manufacture as approved by the Engineer In-charge (EIC), when there are no standard specifications. The fresh 53 grade OPC cement and TMT steel reinforcement bars Fe 500D shall be used confirming relevant I.S Specifications of the approved manufacturers of GGL. The Contractor has to keep the full proof records of purchase and consumption along with original purchase bills of Cement and Steel as per the GGL 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 EIC. The booklet Standard Specifications for Civil Works will be applicable wherever there is dispute in the items of civil works. GGL will not supply any material for this work.

2.1 Land Procurement and Arrangements for 27 Years

The Bidder shall procure/arrange land with ownership or lease rights for 27 years within 4 km of the nearest 66 kV substation, obtain necessary RoW clearances for the 66 kV line, and submit finalized land documents in full legal compliance as per annexure 3 and annexure 4.

2.2 Topographical Survey:

- i. Topographical survey shall have to be done by the Contractor of the proposed site at 10 m interval with the help of Total Station/DGPS 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 power plant have to be fixed with reference to High Flood Level (shall be arranged by EPC contractor) of the proposed site. The ground level and plinth level of structures shall be fixed taking into consideration the highest flood level and surrounding ground profiles.
- ii. Carrying out the Bench Mark (GTS) to site/sites under survey by parallel levelling, establishing and constructing bench mark, grid and reference pillars in the field and spot level survey of the entire area/areas at solar panels locations shall be in the scope of bidders.
- iii. The work shall be executed according to the specifications and good standard practice necessary to fulfill the objective of the survey work, strictly in accordance with the instructions and satisfaction of the Owner.
- iv. The Contractor shall shift Bench Mark by fly-leveling from nearest GTS Bench Mark or available source as approved by the Owner and establish two permanent Bench Mark at site. All subsequent transfer of levels shall be carried out with respect to this shifted permanent Bench Mark. The work shall also include constructing permanent reference pillars at suitably locations as approved by the Owner. These reference pillars shall be labelled permanently with their respective coordinates and reduced levels for future use. The Bench Marks and reference pillars shall be shown in the survey drawings.



- v. The field work including shifting of co-ordinates for each pile, shifting levels for construction activities shall be carried out using Total Station Survey Equipment and shall be in the scope of bidders.
- vi. Bidder shall use DGPS for establishing initial co-ordinates and bench marks.

2.3 Soil Test:

- i. Contractor is solely responsible for carrying 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 work including but not limited to foundations / piling for module mounting structures, HT lines, 66 kV switchyard equipment etc. The Contractor shall carry out soil investigation through NABL accredited laboratory only. These reports shall be furnished to the Owner prior to commencing work. All RCC works shall be provided of required grade of concrete as mentioned in the tender or as per relevant IS specifications (whichever is more) as well as soil data considering appropriate earthquake seismic zone, wind velocity, whether effect, soil characteristics etc. Or grade of concrete submitted in tender whichever is higher.
- ii. 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. The design is to be done by Contractor based on considering the worst result among the bore holes of the soil investigation. **Contractor must carry out Electrical Resistivity Test also.**

2.4 Shadow Analysis:

The Contractor shall 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 GGL for its review / suggestions / approval.

2.5 Weather Parameters:

The Contractor shall obtain and study earthquake and wind velocity data for design of module mounting structure, and considering all parameters related to the weather's conditions like Temperature, humidity, flood, rainfall, ambient air etc.

2.6 Land Development and Cleaning:

The Contractor has to clean the site from wild vegetations, small trees and shrubs, uprooting of all vegetations, removal of all debris or soil, 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.

2.7 Storm Water Drainage System:

The Contractor has to design, submit and take approval from the Client/Consultant for storm water of the plant. Contractor shall carry out hydrology study and drainage should be design accordingly. It shall be designed considering rain fall, catchment area, natural gradient of the plot, outlet of the plot and in a way that it can be easily drain off rain water outside the plant premises at proper identified location and water required for module cleaning by providing sufficient slope. Storm water drain shall be of Trapezoidal section. All the storm water drains on any one side of the road shall be of brick which is backed up by cement mortar bed which is backed by PCC on side slope and at bottom of drain and all joints of Brick/Stone masonry are to be filled up with cement mortar in C.M. 1:4, further, plaster is to be applied in case of brick masonry surface. The Contractor shall provide RCC Hume pipe (NP3 grade), RCC culvert at the crossing of road, cable corridor/network, other cross drains at required locations as cross drainage work. The storm water drainage shall be design in such a way that there shall not be any water stagnation problem in Solar Field area. Also, the Contractor shall provide RCC Hume pipe (NP3 grade) at the crossing of road and drains and at required locations. The drainage and it's materials shall be conformed to relevant IS Codes.

2.8 Roads:

All the roads within plant premises shall be of Asphalt Road with sufficient base courses like Sub grade, GSB, Wet Mix Macadam layer, SDBM and BC layer and at top Seal Coat etc. Asphalt road width shall be of 3.75 m plus shoulder (minimum 750mm both side) and with sufficient thickness to access heavy equipment like transformers/inverters/ switchyard equipment transportation. Contractor shall provide RCC culvert with RCC ramp with suitable gradient for approaching to control room and at main entry point from solar park approach to inside plant etc as required. Bidder shall provide NP3 class 300 mm to 600mm diameter Hume pipes for internal Road, Cable, Pipeline and Drain crossing Further unless otherwise specified all pipes shall be encased with M15 grade of concrete keeping 150 mm cover at all sides. Contractor shall resurface the road after laying of the Hume pipes." Roads shall be provided in entire periphery of the plant and from main gate to control room & Switchyard. The road construction and materials shall be conformed to relevant IS, IRC and MORTH Codes.

2.9 Boundary Wall (Fencing):

The contractor shall provide and install smooth finish and uniform shape & size Precast compound wall of concrete grade M25 with use of OPC 53 Grade of GGL 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 every corners and at every 15nos. 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. 12 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 12-gauge thickness (TATA Make) as per approved drawing.

Further, the Contractor shall ensure that the name "Gujarat Gas Limited (GGL)" is visibly and permanently printed/engraved on the outer side of the boundary wall at regular intervals, as per directions of GGL Engineer-in-Charge.

2.10 Watchman's Cabin and Main Entrance Gate:

- i. An all-weather main gate with at least 6 meters of width shall be erected at the entrance of the plant site. Along with 6 meter gate, 1 meter gate for human movement shall also be provided. Minimum height of the gate shall be 3 mtr or as per approval of GGL/GGLs Consultant. At the top of gate at sufficient height for aesthetic purpose Arch shall be provided in which name of Owner shall be Embossed.
- ii. The Prefabricated Watchman Cabin of size 3.5 meter x 3.5 meter and height 3.3 meter at the main entrance gate with toilet unit shall be designed in the constructed by the Successful Bidder keeping in view the safety and security of the power plant. Watchman Cabin shall be rested on RCC foundation and Plinth. Floor of watchman cabin shall be 450mm high from ground level. The Watchman's cabin shall be equipped with necessary table, chair and wardrobe. Watchman's cabin shall also be provided with necessary light and Fans. Watchman's cabin shall have necessary separate toilet unit for security staff with water arrangement along with Soak pit.
- iii. The Bidder shall provide detailed civil, electrical, plumbing, drainage etc. drawings and equipment specifications for the Watchman's cabin.

2.11 Security Cabin:

The Contractor shall provide 4 (four) numbers of prefabricated Security cabin /watch tower / portable cabin at any 4 (four) corners of the boundary of plant such that safety of the plant is ensured along with one Watchman's cabin at the Main Gate of plant The minimum size of Security Cabin is 1.2-meter x 1.8-meter



size and height of 2.4m with appropriate roof at the top. Security cabin shall be rested on RCC platform/RCC column & Floor of security cabin shall be minimum 450mm from ground level Location of the Security Cabin along with CCTV monitoring system will be as directed by GGL.

2.12 Foundation design:

The foundations should be designed considering the weight and distribution of the structure and assembly, and maximum Seismic factors for the site have to be considered while making the design of the foundation. Successful 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 has to bear all cost for the same.

2.13 RCC structures for control room:

RCC structures for control room shall be strict as per relevant IS standards.

2.14 RCC Conference cum Control room

Civil work for RCC Conference cum Control room: Civil work for Conference cum Control room shall be of minimum size 15 meter x 30 meter x 3.5 meter height 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 in terms of approved make aluminium windows and ventilators with MS grill, approved make exhaust fans and louvers for air circulation. Opening of min. 3.00 m x 3.00 m with approved make rolling shutter shall be provided for the access of the panels. Conference cum Control Room shall be laid on RCC plinth with sufficient foundation, and reinforced grade slab, RCC column and RCC slab with Vitrified of 8-10 mm thickness tile flooring and 100 mm skirting of same tiles. The plinth shall be at a minimum of 1000 mm high from formation level i.e., from finished ground level of the plant. Plinth protection shall be given throughout perimeter of width 1.2m for Control cum Conference Rooms. Plinth protection shall lay on proper filling material with proper compaction. Sufficient steps at the entry of the room and RCC ramp of sufficient angle shall be provided for shifting the equipment in the rooms for Conference cum Control Room. Rainwater pipe at various locations at the top shall be provided to discharge rainwater. Approved make of GI rolling shutter shall be provided for Control room.

- i. RCC frame structure below plinth for 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 and soil detail etc. Backfilling material shall be as per tender specifications. Grade slab shall be laid on 100mm thick PCC. Also, Termite proofing is required before preparation of grade slab and plinth protection. The Control cum Conference Room shall have approved make rolling shutter at the front side and also provision of additional emergency exit door. RCC cable trenches shall be provided with suitable notch angle, insert plates and shall be covered with chequered plate. The dimension of cable trenches shall be based on electric, SCADA panel



dimensions and control cables with sufficient maintenance space. Provision of sump with suitable capacity pump shall be provided in the cable trench for dewatering purposes. Conference cum Control room shall be of adequate size for fixing the panels, battery banks etc. With

- a. Conference room with conference table and chairs.
- b. SCADA Room with Work station with Desktop and Chairs.
- c. Battery room & Store Room with almirah.
- d. Pantry unit of sufficient size with sandwich type of platform with one sink (Reputed Make) plumbing fixture and exhaust fan
- e. Office room with chair and table.
- f. Toilet unit for Gents with urinals and Ladies having wash basins in each
- g. RCC cable trenches with covers and cable trays and all openings of cable entry shall have vermin proofing using spray foam or mortar.
- h. Furniture like conference table, chair and sofa etc.
- i. Lighting points and fixtures.
- j. Plumbing fixtures.
- k. Transformer yard with chain-link fencing and gate adjoining to building (outside).
- l. All other amenities for the operation & maintenance of Solar Photovoltaic Power Plant.
- m. All windows shall be equipped with sun film protection sheet and vista make vertical blind.

Facilities required for Conference cum Control Room: It shall also have adequate size SCADA cabin with necessary 2 numbers of work station with drawers of Godrej/ Durian/ Zuari make, 2 numbers Computers 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 2 nos. of 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 6 persons with Power Sockets with 6 chairs of Godrej/ Durian/ Zuari/ Usha/ Lexus and sofas of standard make. In Conference cum Control room, except control room (where panels are fixed) all other rooms like SCADA cabin, conference room, office room, store, pantry and passage shall have False ceiling that shall consist of 600 x 600 x 12 to 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 0.5 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 printer and scanner (Canon image Formula DR-C225 Document Scanner), landline phone, refrigerator (150 liter) of Voltas/Godrej/Whirlpool makes, projector of Epson/Hitachi Maxell, Gas connection for pantry and screen of 2m x 2m. All material, installations, and accessories to be provided shall be of best quality and of standard manufacture as approved by the EIC of the GGL. All units of the Conference cum Control Room

shall have marked signage of SS sheet of 1mm along with engraving words and filled with black color at all facilities within conference cum Control room. Proper nomenclature with words on all equipment shall also provide painting is accepted. 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 Philips/Syska/Havells make. MCR roof shall be accessed by RCC staircase.

Air Conditioner for Control Room: The control room shall be equipped with appropriate numbers of fans/AC for effective heat dissipation and cooling. The SCADA cabin and Conference room shall have split type air conditioning units.

Electrical requirements for Conference cum Control room:

- a. The Panels shall have adequate inputs to take in from the centralized Push Button Switching Unit having Suitable Mimic with Power flow Indicator & Status Indicator of different PCU's.
- b. The Panel shall be flooring mounted type. All the measuring instruments such as feeder voltmeter, ammeter, frequency meter, Electronic Energy Meter (for measuring the deliverable units (kWh) for sale), selector switches, Mimic etc. shall be in the front panel.
- c. All the Power cables shall be taken through backside of the Panel via sufficient /concrete cable trench and cable trays with cover at top.
- d. The Panel shall be fitted with suitable rating & size, HRC fuses/circuit breaker/isolator indicators for all incomer and outgoing terminals, voltmeter & ammeter with suitable selector switches to monitor & measure the power to be evacuated.
- e. Nuts & bolts including metallic cubicle shall have to be adequately protected against atmosphere and weather prevailing in the area.
- f. The overall dimension should be fitted with other Power Conditioning Units of the Power Plant. However, dimension, weight, sheet thickness, painting etc. should be indicated by the Bidder. The bill of material associated with the equipment should be clearly indicated while delivering the equipment.
- g. The Contractor shall provide to the Owner detailed civil, electrical, plumbing, etc. drawings and equipment specifications for the control room and take approval from client/consultant. The drawings of Panels with the make of components should be approved from the Owner.
- h. All the design & drawing related to switch yard / interconnection with grid should be as per requirement of GETCO and approved from GETCO.
- i. RCC structure shall have sufficient number of lighting point/ACDB/MCB board.

Landscaping: Landscaping in front area of MCR (25 sq. meters) is to be done using aesthetically pleasing and suitable varieties of flora, along with Sun dial of 1.5 mtr diameter,

2.15 Walls and Roof for RCC Super structure:

- i. RCC frame structure shall have adequate size of footing (suitable to the soil condition), columns, plinth beam, grade slab, lintel beam, roof slab, etc. Unless otherwise specified all RCC frame structure shall be of grade M25 with minimum 350 kg of cement per cubic metre.
- ii. Pre-construction anti-termite treatment shall be done in foundation as well as floor levels.
- iii. Walls constructed with red burnt clay brick having compressive strength more than 35 kg / cm². Peripheral wall shall be of min 230 mm thick except for the adjoining wall to Transformer. It should be 350 mm thick.
- iv. **Plastering:** Plastering shall be carried out over RCC, and brick works area mainly up to parapet wall top for Conference cum Control Room.
 - a. Plastering shall be applied to all internal, external walls as per IS 1542. Internal plaster shall be 12 mm thick (1:4) with mala finish, PoP punning, etc.
 - b. External plaster shall be 20 mm thick in CM (1:4) (Two layers of 12 mm and 8 mm thick layer) with mixing of waterproofing compound during second layer plaster of 8mm thick.
 - c. Ceiling plaster shall be 6mm thick using CM (1:3).
 - d. To avoid cracks all concrete /masonry joints shall be fixed with 200mm wide 24 g Chicken wire mesh before plastering.
- v. **Painting:**
 - a. Internal Paint: Oil Bound Distemper of approved make and as per recommendation of manufacturer. All internal plaster surfaces of wall & ceiling shall be painted using three coats of oil bound distemper over one coat primer of approved make and shade.
 - b. External Paint: Asian makes ACE Paint or equivalent Berger make as per recommendation of manufacturer. All external plaster surfaces shall be painted using two coats of Asian make ACE paint over one coat of primer.
 - c. Surface preparation including crack filling, Birla white putty filling etc. before painting on wall/ceiling shall be carried out as per manufacturer recommendation and as directed by the Owner.
- vi. **Doors, windows, ventilators:** It shall be made out from Aluminium sections. All sections shall be anodized with 20 microns thickness. Sections of Door frame and window frame shall be min 1.5mm thick and of approved make. Door shutters shall be made out from aluminium sections and combination of compact sheet and clear float / wired glass with sun film sheet on it. Room shall have required numbers and size of openable window with sun film sheet to provide adequate ventilation / fresh air circulations. All hardware / fixtures for doors and windows shall be of good quality and of top class (make: Dorma, Godrej and Kich) and shall be approved by the Owner. All the windows shall have MS Grill. Main door to switchgear room shall be steel door having adequate area to admit switchgear. There shall be minimum two doors to the switchgear room of flush welded steel type.

- vii. For Electrical panel room, there shall be provision of GI Rolling Shutter of adequate width and height to facilitate load / unloading of heavy electrical panels.
- viii. **Flooring:** The entire control room flooring shall be provided with 100mm thick M25 grade RCC slab on 75mm thick PCC (1:4:8) with sub-base below 230mm rubble soling over 600mm compacted CNS filling/available soil.
 - a. Final finishing over flooring:
 - Heavy duty approved quality vitrified tiles of 600mmX600mm X 8-10mm thick. Skirting shall be 150mm high from FFL over RCC floor in electrical MCC & Panels area & store area in proper line and level.
 - SCADA Room, Conference room, Pantry area, Lobby area, open area, entrance area: Heavy duty approved quality vitrified tiles of 600mmX600mm X 8-10mm thick. Skirting shall be 150mm high from FFL.
 - Battery room: Approved quality Acid/Alkali resistance tile flooring
 - Toilet: Heavy duty anti-skid 6mm thick ceramic Tiles shall be glazed tiles of 6 mm thickness up to lintel level.
 - Entrance Steps: Brickwork and plastering with antiskid tiles.
- ix. Roof shall be given a slope of minimum 1 in 100 towards the side opposite to auxiliary transformer yard. Water proofing of terrace by brick bat coba above China mosaic shall be provided.

2.16 Underground RCC water Tank/HDPE Water Tank:

The Contractor has to design as per relevant IS codes, submit and take approval from client / consultant and construct 1,50,000 liter underground RCC water tank or Sintex tank which shall be rested on RCC platform for 12 MW Project Contractor can also provide 3 layered Sintex water tank which shall be rested in RCC foundation with proper base of filling material. Design of water tank shall be done strictly based on Soil Investigation Report with complying all latest IS codes. As per IS 3370 part-1 2009 contractor shall design and execute the underground water tank with minimum concrete M-25 grade.

2.17 Water supply:

All necessary arrangement for wet cleaning of the solar panels shall be in the scope of the bidders and accordingly the agency has to provide all the necessary equipment, accessories, tool & tackles, pumps, and piping arrangement which are required for the same. The contractor should also arrange drinking water for labors and manpower working inside the premises. The Pipeline network shall be rested on proper RCC foundation with necessary height above the ground. The pipeline network shall be of HDPE pipe and



accessories. The Pipeline network shall be design in such way that water shall reach to each and every corner of the plant premises with sufficient pressure. It shall consist to proper electric panel with enclosure. Water softener plant is to be installed at plant premises if ground water is not suitable for cleaning purpose.

2.18 Water for Module Cleaning:

The Bidder shall estimate the water requirements for cleaning the photovoltaic modules at least once in every 10 Days in order to operate the plant at its guaranteed plant performance.

2.19 Toilet:

Toilet shall be constructed with following finish

- Floor: Vitrified tiles
 - Door and window made out of aluminium sections, 5mm float glass
 - Ventilators: Mechanical exhaust facility
 - Plumbing fixtures: Jaquar, Kohler and Crabtree 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.
- i. **Water Supply for Toilets:** All plumbing and sanitary shall be of GGL approved make. UPVC pipes of approved make & brand shall be laid down for water supply Two (02) Nos of three layered Sintex Water tank of 2000 Liter capacity shall be installed for Control room / Conference room & Toilet / Pantry.
- ii. **Drainage for Toilets:** Drainage pipes shall be of UPVC (6 kg/cm²) Supreme, Prince or equivalent make. Gully trap, inspection chambers, septic tank for 10 people and soak well to be constructed for abovementioned requirement.

2.20 Area Lighting

- i. Area lighting arrangement shall be made to illuminate the entire site at an appropriate lux level for night hours or bad light hours. Further, Road and Perimeter LUX level average 5 and rest area as per NBC 2016. Area lighting arrangement shall have adequate numbers of lights poles on the sides of roads, periphery, etc.
- ii. The connector box shall be made of stainless steel or FRP material complies with IP67 rating, Dust & Vermin Proof, which is to be recessed at the base of Yard Lighting system. The connector box shall have suitable brass or copper made connector terminal.



- iii. The lighting fixtures with control gear shall be mounted on tubular poles of approved height and mounting arrangement.
- iv. All the yard lighting towers and lighting fixtures shall be effectively grounded using adequate size of GI earthing wires / GI earthing strips.
- v. The light pole shall be fixed in separate foundation. The lighting poles shall be concreted with 600 mm coping above ground level for pole protection and 1 mtr below ground with minimum reinforcement
- vi. The control gear box (non-integral type) shall be encased in the coping.
- vii. Loop in – Loop out power cables shall be brought up to the control gear box through of adequate size for cable protection.
- viii. The cables shall be properly glanded to the control gear box gland plate.
- ix. XLPE / PVC insulated armored Cu/Al cables of adequate size shall be used for interconnection and supply of power to Yard lighting systems.
- x. Cable terminations shall be made with suitable cable lugs & sockets etc. crimped properly and passed through brass compression type cable glands at the entry & exit point of the connector box and at the entry point to MCB distribution Box for controlling the yard lighting system.
- xi. The height of the area lighting fixtures shall be per approval by GGL/GGLs Consultant. Lighting fixtures shall be installed close to fencing.

2.21 Quality Control Laboratory

- i. A fully equipped quality control laboratory shall be established at site with qualified personnel to conduct acceptance test on all construction materials, concrete cubes, compaction of soil testing samples etc. This laboratory shall be housed in a covered building. All testing equipment like Owen, electrically operated cube testing machine, Sieves for grading of sand & aggregates, flakiness and elongation index testing sieve, Density of Aggregate, electrically operated vibratory aggregate sieve, jars for sand testing, Abrasion testing equipment, Impact testing equipment, Bitumen testing equipment like thermometer, marshal test apparatus etc. If contractor is not establishing the laboratory on site, then contractor can send the samples to laboratory for testing in lab mentioned in lab mentioned in the tender or as instructed by the client. Vehicle shall be arranged by contractor to witness the consultant representative at lab. Cube testing machine should be mandatorily fixed at site.
- ii. Cube moulds, Slump cones, Vicat apparatus, Moisture meter, Soil testing equipment's shall be arranged for laboratory. Contractor shall arrange for design mix of concrete for each grade of concrete from NABL lab mentioned in the tender.

iii. All testing equipment shall be periodically calibrated to the satisfaction the Owner.

TEST SCHEDULE

SR.	Materials	Name of Laboratory Tests	Frequency of Test
1	2	3	4
1	SAND	1. Fineness Modular 2. Specific Gravity 3. Water absorption 4. Alkali reaction 5. Specific gravity 6. Gradation	One Test per working seasons or with change of source.
2	CRUSHED METAL KAPACHI FOR CONCRETE	1. Gradation 2. Water absorption 3. Impact value 4. Absorption. 5. Specific gravity 6. Soundness 7. Flakiness 8. Elongation	One Test for season or with change of source.
3	C.C. Cube Workability test.	1. Compressive Strength (7 Days & 28 Days)	As per IS 456 Standard.
4	T.M.T BAR	1. Yield Elongation Test IS:1608 1972 2. Bent Test IS: 1590 196 3. Released (In case of HYSD bars only) Chemical property test for Carbon, Phosphorous and Mn.	One sample for each lot.

2.22 Building Material

i. General Materials

Sr.	MATERIALS/ ITEMS	VENDOR / MANUFACTURERS
1.	CEMENT (OPC 53 GRADE)	ULTRATECH SANGHI SIDHHI ACC JAYPEE CEMENT Ambuja OPC JK Lakshmi Cement
2.	REINFORCEMENT STEEL HYSD/TMT BARS GRADE FE 500D	SAIL TISCO RINL THERMAX ELECTROTHREM
3.	ALUMINIUM SHEETS	HINDALCO INDAL JINDAL,
4.	CPVC/ UPVC pipes	FINOLEX SUPREME TRUEBORE
5.	VITRIFIED CERAMIC TILES	NITCO RAK BRAND OR AS SPECIFIED IN ITEM
6.	GLASS	FLOAT GLASS : SAINT GOBIN MODI GLASS
7.	ROLLING SHUTTERS	SURAJ ROLLING SHUTTERS BARODA OR APPROVED MAKE BY OWNER ,
8.	BRICKS	APPROVED MAKE BY OWNER
9.	FLUSH DOORS	GODREJ, FALCON PLYWOOD AND INDUS- GODHRA GREEN PLY KIT PLY



Sr.	MATERIALS/ ITEMS	VENDOR / MANUFACTURERS
10.	STAINLESS STEEL	SS – 304 GRADE FROM SALEM STEEL PLANT
11.	WATER PROOFING	APP SHEET OF TIKIDAN, FOSROC or PIDILITE
12.	PAINTS	ONLY BRAND NAMES GIVEN: BERGER ASIAN ICI
13.	SEALANTS	FOSROC SICA
14.	R.C MANHOLE COVER	PRECONS PRECAST CONCRETE PRODUCT CO. OR EQUIVALENT
15.	HARDENERS	FOSROC SICA
16.	PLYWOOD PRODUCTS	IPM, NOVOPAN PARTICLE BOARDS BHUTAN BOARDS NUWOOD PARTICLE BOARDS
17.	ALUMINIUM DOORS, WINDOWS, PARTITIONS	GODREJ INDAL JINDAL
18.	WATER PROOFING COMPOUNDS/ADMIXTURES/ EPOXY FLOORING	MATERIAL OF CONSTRUCTION FOSROC SICA PIDILITE
19.	PAINTS AND ACRYLIC DISTEMPERS, WEATHER PROOF PAINTS AND EXTERIOR EMULSION PAINTS	ASIAN PAINTS ICI BERGER.
20.	METAL CLADDING SYSTEM, SANDWICH PANEL	TATA BLUE SCOPE, LLOYD INSULATIONS (INDIA) LIMITED, KING SPAN TURKEY SINTEX

Sr.	MATERIALS/ ITEMS	VENDOR / MANUFACTURERS
21.	PUTTY	BIRLA ASIAN BERGER,
22.	PLASTICISER/ADMIXURE	FOSROC SIKA,
23.	ACID /ALKALI RESISTING PAINT	ASIAN BERGER
24.	NON-SHRINK GROUT MATERIAL	FOSROC
25.	GYPSUM FALSE CEILING (gyp board)	ARMSTRONG/GYPROC

ii. SANITARY AND WATER SUPPLY WORK (INTERNAL) (FIRST QUALITY TO BE-USED):

SR.	MATERIALS/ ITEMS	VENDOR / MANUFACTURERS
1.	RCC PIPES	APPROVED MANUFACTURER CONFORMING B.I.S. STANDARD
2.	G.I. PIPE	TATA MEDIUM CLASS.
3.	G.I. FITTINGS	“R” BRAND
4.	HDPE Pipes	FINOLEX, SUPREME, ASTRAL, DUKE AND ANY OTHER APPROVED BRAND BY GGL
5.	SLUICE VALVES, CHECK VALVES ETC.	LEADER ENGINEERING WORKS, JALANDHAR. KIRLOSKAR BROS. LIMITED, PUNE;
6.	BASS FITTINGS	LEADER ENGINEERING JALANDHAR. L & K MATHURA,
7.	C.P., FITTINGS	L & K make
8.	W.C. PAN WASH BASIN, URINALS SINK LOW DOWN FLUSHING CISTERN	EID, PARRYWARE, HINDUSTAN SANITARYWARE, CALCUTTA; KOHLER
9.	STAINLESS STEEL SINK WITH DRAIN BOARD	NIRALI
10.	MIRRORS	PHILCO, ATUL GLASS WORKS, VALLABH GLASS WORKS,

SR.	MATERIALS/ ITEMS	VENDOR / MANUFACTURERS
		GOLDENFISH
11.	WHITE GLAZED & COLOUR GLAZED CERAMIC TILES.	H&R JOHNSON TILES, SPARTEK, NITCO
12.	GLAZING GLASS.	MODI FLOAT SAINT GOBAIN.

iii. STRUCTURAL STEEL

SR.	MATERIALS/ ITEMS	VENDOR / MANUFACTURERS
1.	WELDING ELECTRODES	ADOR, D&H, ESSAB
2.	STRUCTURAL STEEL RAW MATERIALS	TISCO, SAIL, JINDAL, RINL
3.	ANCHOR BARS	BRIGHT BARS
4.	SHEETING AND SANDWICH PANELS FOR PRE_ENGINEERING WORK	TATA BLUE SCOPE, SINTEX JINDAL, KIRBY

NOTE:

1. Wherever the make is not specified for any other items, the Contractor shall submit credential for vendors for relevant items / equipment's, out of which the Owner shall decide acceptance of vendor based on review of credentials. This shall have no price implication. The Owner reserves the right to reject the proposed vendor without assigning any reason.
2. Bidder may suggest /request for approval of Additional vendor with credentials and details for review and approval of Owner. The Owner may consider the request in case proposed additional vendor is reputed and meets the tender specification requirements. The Owner reserves the right to reject the proposed vendor without assigning any reason.

2.23 Clean up of Work Site

After completion of all works, the Contractor shall have to demobilize all the equipment's, machinery and materials from plant premises. The Contractor shall have to clean the entire area by removing all unwanted construction materials, unwanted temporary structures, debris, excess earth, all type of scrape, wastage and unwanted materials from plant premises as directed by the Owner.

--- End of Section---

3. MODULE MOUNTING STRUCTURES (MMS)

- i. The MMS should be designed for an optimum tilt angle (fixed/seasonal/single axis/Dual axis tracking) so as to meet the NEEGG as per tender. The angle should be systematically optimized for maximum energy generation throughout the year based on location and local weather variables for each module technology.
- ii. The MMS should be safe and designed to allow easy replacement of any module and easy access to the O&M staff. It should be designed for simple mechanical and electrical installation, should support Solar PV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly and there should be no requirement of welding or complex machinery at site. Irrespective of design, none of the components shall be less than 1mm.
- iii. The array structure should 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 speed up to maximum 180 Kmph.
- iv. 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.
- v. 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 the Owner/ Consultant. Before final approval of drawing/design pile foundation for any type of structure i.e MMS, MCR, LCR etc pile load test shall be conducted, and result shall be submitted to GGL & GGL's Consultant.
- vi. The Contractor has to plan for pile load test like pull out, lateral and compression of minimum 9,9,3 are required to be conducted for site at strategic location, immediately after receiving Lol. Lateral test shall be conducted with the help of constructing anchor piles Based on the results of above-mentioned tests, final approval for design of pile shall be provided.
- vii. Modules shall be mounted on a non-corrosive support (bidder use star washer / serrated washer for module-to-module earthing). The frames and leg assemblies of the array structures shall be made of hot dip Galvanized steel per ASTM A123.
- viii. All members of module mounting structure shall be hot dip galvanized (HDGI) with minimum thickness of 2 mm for any members of MMS. For hot dip galvanization of structures, specific requirement for thickness of galvanization should be at least minimum 80 microns at any point of the galvanized structure. Galvanization shall be measured 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.



- ix. All nuts and bolts (fasteners) shall be made very good quality stainless steel of grade SS 304 required for module fixing and for other components of MMS, superstructure or switchyard, control room, etc. in the plant premises nuts and bolts (fasteners) shall be of MS material with minimum Grade HDG: 5.6.
- x. Modules shall be clamped / bolted with the structure properly. The material of construction shall be Al / Steel. Clamps / bolts shall be designed in such a way so as not to cast any shadow on the active part of a module.
- xi. Module mounting structures shall also be earthed through proper separate earthing.
- xii. The material of construction, structural design and workmanship shall be appropriate with a factor of safety of not less than 1.5.
- xiii. 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.
- xiv. The Contractor shall provide to the Owner the detailed design, specifications and calculations of the MMS and take approval from the Owner/Consultant.
- xv. The Contractor shall specify installation details of the Solar PV modules and the support structures with appropriate diagrams and drawings.
- xvi. The Module Mounting Structure design shall be certified by a Licensed structural engineer, and it is mandatory. certified structural engineer certificate to be submitted to GGL. In this certificate, wind withstand capacity should be mentioned as per tender.
- xvii. The minimum clearance between the lower edge of the module and the ground shall be the minimum 700 mm high at any array/module in the plant area.
- xviii. If pile foundation is adopted by Contractor, then min cage reinforcement is to be provided in the Pile even structural member is embedded in pile.
- xix. String Cables should be passes from Pipes and Cable-ties shall be used to hold and guide the Pipes (cables/wires) from the modules to inverters or junction boxes.
- xx. The Contractor shall provide to the Owner the detailed design, specifications and calculations of the MMS. Minimum height of foundation (Pile Cap) of Module Mounting Structure (MMS) shall be 300 mm from ground level. Pile cap height shall not be considered in design as integral part of load carrying length of pile. Pile caps shall be only provided to protect the structural member from the water.
- xxi. Curing of all piles shall be done thrice a day and be maintained for a period of seven days from the date of casting. If curing compound is to be used then it should be applied within 24 hrs. of concreting
- xxii. 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.



- xxiii. The Contractor shall specify installation details of the Solar PV modules and the support structures with appropriate diagrams and drawings.
- xxiv. 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. The design should be done by considering the life of the structure of 25 years.
- xxv. Civil foundation design for Module Mounting Structures (MMS) as well as control room shall be made in accordance with the Indian Standard Codes and soil conditions, with the help of licensed Structural Designer having substantial experience in similar work.
- xxvi. Module Mounting Structures Design is to be certified by licensed Structure Engineer and certificate to be produced along with the design details for approval by consultant / GGL.

3.1 Switchyard structures / transmission line structure designs

Switchyard structures / transmission line structure designs shall be strictly as per latest GETCO design of that region/district. The structural components of Switchyard shall be HDG of minimum 80 microns along with fasteners of HDG 5.6 grade. Foundation of the switchyards shall be minimum 450 mm high from the top level of laid metal/aggregate in the switchyard.

3.2 Structural Steel Work

- i. The structural steelwork required for termination incoming 66 kV line/ Cable, equipment supports, lighting masts and for shielding towers together with all foundation bolts shall be included by the Bidder in its scope of work. The steel work shall be fabricated from galvanized structural sections. The height of structures for incoming line shall be as per the design developed by the Bidder and drawings submitted.
- ii. The incoming line gantry shall be designed on the basis of ACSR conductor/Cable considered in the design and also considering that GETCO terminal tower will be located at a distance of not more than 100 meters from the incoming gantry at SPV power station switchyard. The Bidder shall take into account wind load, temperature variation etc. while designing the gantry structure. The column shall be provided with step bolts and anti-climbing devices.
- iii. The entire structural steel work shall conform to IS: 802. The Bidder shall furnish design calculations for approval by Owner before procuring the material.
- iv. The design of the switchyard towers, gantries and equipment structures shall also be designed in conformity with the standards followed by the Owner. Approval from the Owner also shall be obtained by the Bidder if required.

3.3 Hardware

- i. Metal fittings of specified material for string hardware meant for power conductor and earth wire shall have excellent mechanical properties such as strength, toughness and high corrosion resistance. The suspension and tension clamps shall be made from aluminum alloy having high mechanical strength. Suspension and tension clamps offered shall be suitable for ACSR / AAAC conductor as per design.
 - ii. All hooks, eyes, pins, bolts, suspension clamps and other fittings for attaching insulators to the tower or to the power conductor should be designed as to reduce (to a minimum) the damage to the conductor, insulator or the fitting arising from conductor vibration.
 - iii. All drop-forged parts shall be free-from flaws, cracks, or other defects and shall be smooth, close-grained and of true forms and dimensions. All machined surfaces shall be true, smooth and well-finished. The thickness of all structural steel of Switchyard shall be minimum 80 microns measured at all points of the structure member when measured. No averaging is allowed. The gap between base plate of structural members and concrete top foundation shall be filled with GP-2 grouting material of reputed make. The material of all J-bolts shall be of 8.8 Class.
 - iv. All ferrous parts of hardware shall be galvanized in accordance with IS 2629. Galvanization shall withstand four dips of 1-minute duration each in copper-sulphate solution as per the test procedure laid down in the relevant ISS.
 - v. The threads in nuts and tapped holes shall be cut after galvanizing and shall be well-lubricated/greased. All other threads shall be cut before galvanizing.
 - vi. Both the suspension and the tension hardware shall be of ball and socket type and shall be with 'R' and 'W' type security clip of stainless steel or phosphor Bronze conforming to IS 2486. The tension clamps of both compression type and bolted type as shown in the relevant drawings shall be offered. Arcing horns shall be provided on the line side for both the suspension type and compression type hardware.
 - a. Danger Plates: Size of each Danger Notice plates shall be 200 mm x 150 mm made of mild steel sheet and at least 2 mm thick, and vitreous enameled white on both sides and with inscription in signal red colours on front side as required. The inscriptions shall be in Gujarati and English.
 - b. 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 Signboards shall be made of steel plate of not less than 3 mm. Letters on the board shall be with appropriate illumination arrangements.
- **All Room:** The name boards shall be made of acrylic sheet of 300mm height and fixed at the entry of

all facilities.

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

--- End of Section---

4. DETAILED ELECTRICAL WORK

4.1 Photovoltaic Modules:

The Contractor shall employ solar PV Module of TOPCon Crystalline-Si 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 61730-2nd Edition and as tested by IEC / MNRE recognized test laboratory.

- i. The PV modules to be employed shall with rated power of module $\geq 580\text{Wp}$ 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. Contractor shall supply PV Modules as per ALMM orders published by MNRE time to time.
- iii. If Contractor fails to commission the project on or before 25th May 2026 then Contractor shall be liable to supply, erection and replacement of existing PV Module with List-2 of ALMM (List of Cell) published by MNRE time to time. This replacement of PV Module shall not relieve Contractor from its contractual obligations with time or cost.
- iv. All modules shall be certified with latest edition of IEC 61215 (Design qualification and type approval for **TOPCon Crystalline-Si solar technology**), latest edition of IEC 61730 (PV module safety qualification testing 1500V DC or higher). Latest edition of 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 85° C at 1500Volts or higher, IEC 62716, IEC 61701.
- v. 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.
- vi. Minimum certified module efficiency shall be 20% for crystalline with minimum fill factor of 0.75. The permissible maximum temperature coefficient of power (Pmpp) shall be -0.43%/ °C or better.
- vii. All photovoltaic modules should carry a performance warranty of > 90% during the first 10 years, and > 80% during the next 15 years. Further, module shall have performance warranty of > 97% during the first year of installation. Degradation of PV module for first year shall be limited to 3% and shall not be more than 0.7% in any subsequent year.
- viii. The module mismatch losses for modules connected to an inverter should be less than 1%.
- ix. SPV module should 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.
- xi. The SPV module shall be made up of high transmittivity glass & front surface shall give high encapsulation gain and the module shall consist 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 satisfactorily in relative humidity up to 85% with temperature between -40°C to +85°C and shall withstand adverse climatic conditions, such as high-speed wind, blow with dust, sand particles, saline climatic / soil conditions and for wind 180 km/hr on the surface of the panel as per IEC 61215.
- 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 the Owner 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. GGL or GGLs Consultant to inspect the modules at the manufacturer's site prior to dispatch.
- xviii. The Bidder is advised to check and ensure the availability of modules prior to submitting the Tender Document.
- xix. The Contractor would be required to maintain accessibility to the list of module IDs along with the above parametric data for each module.

Table 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

Sr.	Particulars
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

4.2 Junction Box / Combiner Box/String Monitoring Box:

- i. The Contractor shall provide sufficient no. of String Monitoring Box /Array Junction Boxes / PV combiner boxes / DCDBs.
- ii. All switch boards shall be provided with adequately rated copper busbar, 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 to receive suitable runs and size cables required for the Inverter/Transformer rating.
- iii. The degree of protection for following equipment shall be:

Outdoor Junction Box : IP 65 or above, with canopy
- 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 busbars for easy identification and cable ferrules will be fitted at the cable termination points for identification.
- vi. The Array Junction Box shall also have suitable type-II 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 disconnectors with shoes. All incoming & outgoing cables must be terminated in junction boxes with polyamide glands or PV connector receptacles. The rating of the Junction Boxes shall be suitable with adequate safety factor to inter connect the Solar PV array.
- vii. The Junction Boxes shall have suitable arrangement for the followings
 - a. Provide arrangement for string monitoring & disconnection for each of the string / input.
 - b. DC disconnector for group array isolation
 - c. The rating of the Junction Boxes shall be suitable with adequate safety factor to inter connect the Solar PV array.
- viii. The junction boxes shall be dust, vermin, and waterproof 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) and Protection Class II or higher. Junction box shall be designed for 1000V DC or 1500V DC system as applicable.

- ix. 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.
- x. The current carrying rating of the Junction Boxes shall be rated with standard safety factor to interconnect the Solar PV array.
- xi. Suitable markings shall be provided on the busbars for easy identification and cable ferrules will be fitted at the cable termination points for identification.
- xii. Adequate capacity solar DC fuses & isolating disconnectors should be provided. Fuses and monitoring facility for each string/ input including spare terminals shall be provided. The String Junction Box must have adequate space for maintenance and spare input terminals. For SJB with upto 25 inputs 2 inputs shall be kept in spare, for SJB with more than 25 inputs 3 inputs shall be kept in spare.
- xiii. Detailed junction box specifications and data sheet shall be provided in the Technical Bid document.
- xiv. Each Junction box shall have separate earthing.
- xv. 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 interim, the cables of 1100-1800 Volts DC for outdoor installations should comply with the draft EN 50618 for service life expectancy of 25 years.

4.3 Cables and Wires

- i. All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions for 25 years and voltages as per latest IEC standards. (Note: IEC standards for DC cables for PV systems is under development, the cables of 600- 1800 volts DC for outdoor installations should comply with the draft EN 50618 for service life expectancy of 25 years). DC Cable of Positive & Negative must be colour coded as per draft EN50618.
- ii. Wires with sufficient ampacity and parameters shall be designed and used so that average voltage-drop at full power from the PV modules to inverter should be maximum 2% (including diode voltage drop). All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions including High temperatures, UV radiation, rain, humidity, dirt, burial and attack by rodents, moss and microbes for 25 years and voltages as per latest IEC standards. (Note: DC cables for outdoor installations should comply with the EN50618 / TUV 2PfG 1169/09.07 or equivalent IS for service life expectancy of 25 years). Due consideration shall be made for the de-rating of the cables with respect to the laying pattern in buried trenches / on cable trays, while sizing the cables. The Contractor shall provide voltage drop calculations in excel sheet Wires



with sufficient ampacity and parameters shall be designed and used so that average voltage-drop at full power from the PV modules to inverter should be maximum 2% (including diode voltage drop). All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions including High temperatures, UV radiation, rain, humidity, dirt, burial and attack by rodents, moss and microbes for 25 years and voltages as per latest IEC standards. (Note: DC cables for outdoor installations should comply with the EN50618 / TUV 2PFG 1169/09.07 or equivalent IS for service life expectancy of 25 years). Due consideration shall be made for the de-rating of the cables with respect to the laying pattern in buried trenches / on cable trays, while sizing the cables. The Contractor shall provide voltage drop calculations in excel sheet

- iii. All cables shall be supplied in the single largest length to restrict the straight-through joints to the minimum number. Only terminal cable joints shall be accepted. No cable joint to join two cable ends shall be accepted. All wires used on the LT side shall conform to IS and should be of appropriate voltage grade. Copper conductor wires of reputed make shall be used.
- iv. All cables shall be armoured except Solar Cables. Solar cable shall be laid through MMS / DWC/HDPE Conduits.
- v. OFC cable shall be laid in DWC /HDPE conduits.
- vi. Ethernet cables shall be CAT-6.
- vii. All wires used for connecting the modules and array should conform to the NEC standards. Modules should be connected with USE-2/RHW-2 cables array to junction box conductors and junction box to photovoltaic disconnect with the THHN/THWN-2 sunlight resistant with 90°C wet rated insulation cable.
- viii. All high voltage cables connecting the main junction box/string inverters to the transformers should be XLPE insulated grade conforming to IS 7098-land cables shall also conform to IEC 60189 for test and measuring the methods.
- ix. Irrespective of utilization voltage and current rating all type of power cables shall be minimum of 1100 V/1500V grade XLPE insulated conforming to IS 7098& IS 1554/ IS 694 for working voltage less than 150 V control cable shall be of minimum 500 V grade, the control and power cable has to be laid separately. All LT XLPE cables shall confirm to IS: 7098 Part I & II. All HT XLPE Cables (up to 33kV) Shall confirm IS: 7098 PART-3 & IEC -60287, IEC-60332 and the Contractor to submit technical data sheet, Voltage drop calculation, Power Loss Calculation and type test report for the approval of client / consultants.
- x. The cables shall be adequately insulated for the voltage required and shall be suitably colour coded for the required service. Bending radius for cables shall be as per manufacturer's recommendations and IS: 1255.

Table 2: Relevant Codes & Standards for Cable

Sr.	Item	Relevant IS	Relevant IEC
1	Conductors of Insulated Cables	IS: 8130 - 1984	IEC: 228
2	Impulse tests on cables and their accessories		IEC: 230
3	Extruded solid dielectric-insulated power cables for rated voltage from 1 KV up to 30 KV.		IEC: 502
4	Test methods for insulations and sheaths of electric cables and chords.		IEC: 540
5	Test on cable over a sheath which has special protective functions and are applied by extrusion.		IEC: 229
6	Calculations of continuous current rating of cables (100% load factor).		IEC: 287
7	Cross-linked polyethylene insulated PVC sheathed cable for voltage from 3.3 KV up to 33 KV.		IS: 7098 (Part II& III)
8	PVC insulation & sheath of electrical cables.		IS: 5831 - 1984
9	Mild steel wires, formed wires and tapes for armouring of cables.		IS: 3975
10	Electrical test methods for electric cables Partial discharge test.		IEC: 885(2) - 1987 (Part II)
11	Methods of test for cables.		IS: 10810
12	Common test methods for insulating and sheathing materials of electric cables.		IEC: 811

Sr.	Item	Relevant IS	Relevant IEC
13	Impulse test on cables & other accessories		IEC: 230
14	Cable termination for gas insulated switchgear.		IEC: 859

4.4 Technical Specification of LT XLPE Cables

i. General Constructional Features

The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in original drums with manufacturer's name, size, and type, clearly written on the drums.

- a. **Material:** Medium voltage cable shall be XLPE insulated. PVC sheathed, aluminium or copper conductor, armoured conforming to IS: 7098 Part I.
- b. **Type:** The cables shall be circular, multi core, annealed copper or aluminium conductor, XLPE insulated, and PVC sheathed, armoured.
- c. **Conductor:** Uncoated, annealed copper, of high conductivity up to 4 mm² size, the conductor shall be solid and above 4 mm², conductors shall be concentrically stranded as per IEC: 228.
- d. **Insulation:** XLPE rated 90° C. extruded insulation.
- e. **Core Identification:**

Two cores	:	Red and Black
Three cores	:	Red, Yellow and Blue
Four cores	:	Red, Yellow, Blue and Black
Single core	:	Green cable with yellow strips for earthing

Black shall always be used for neutral.
- f. **Assembly:** Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.
- g. **Armour:** Galvanized steel flat strip / round wires applied helically in single layers complete with covering the assembly of cores
 - For cable size up to 25 Sq. mm.: Armour of 1.4 mm Dia G.I. round wire
 - For cable size above 25 Sq. mm. Armour of 4 mm wide 0.8 mm thick G.I strip
- h. **Sheath:** The cable shall be rated extruded for XLPE 90 deg.c. Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables.



- i. Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp 50 deg. C and operating temperature of cables. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black. Sequential length marking required at every 1.0-meter interval on outer sheath shall be available. The contractor has to furnish resistance / reactance / capacitances of the cable in the technical datasheet.
- j. **Rating:** 1100 Volts or higher.

4.5 Technical Specification of HT XLPE Cables

i. General Constructional Features

- a. **Conductors:** The conductor shall be of circular stranded Aluminium conforming to IS: 8130 & IEC: 228. It shall be clean, reasonably uniform in size & shape smooth & free from harmful defects. Any other form of conductor may also be accepted if in line with modern trends.
- b. **Semi-Conductor Barrier Tape/Tapes:** The semi-conducting barrier tape/tapes shall be provided over the conductors.
- c. **Conductor Screen:** The conductor screen shall consist of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.
- d. **Insulation:** The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogenous body.
- e. **Insulation Screen:**
 - Each insulation has an insulation screen in two parts consisting of:
 - A water barrier tape/Non-metallic semi-conducting swellable tape part and a metallic screen part.
 - The non-metallic part shall be directly applied upon the insulation of each core and may consist of an impregnated but nylon/PVC tape or a similar approved material or, an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion).
 - The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove.
 - The metallic part shall consist of a copper tape helical overlap over the water barrier tape/blocking tape as per IS 7098. A binder tape of copper shall be applied over the copper wire metallic screen.

f. Laying Up:



- The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape.
- The cores shall be laid up with a right-hand direction of lay.
- Binder tape/Moisture barrier:
 - During layup, a suitable open spiral binder may be applied, at the manufacturer's discretion, before the application of an extruded inner covering.
- g. **Fillers:** Fillers shall be polypropylene.
- h. **Inner Covering/Sheath:** The inner covering shall be extruded over the laid-up cores to form compact and circular bedding for the metallic layer.
- i. **Metallic Layer:** The metallic layer shall be galvanised steel wire.
- j. **Outer Sheath:** The tough outer sheath, black coloured best resisting PVC polyethylene compound type ST-2 as per IS: 5831 for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.
- k. **Cable Marking:**

Embossing on outer sheath: The following particulars shall be properly legible embossed on the cable sheath at intervals of not exceeding one meter throughout the length of the cable. The cables with poor and illegible embossing shall be liable for rejection.

 - GGL SPVPP
 - Voltage grade
 - Year of manufacture
 - Manufactures name
 - Successive Length
 - Size of cable
 - ISI mark
- l. Packing and marking shall be as per clause No. 18 of IS 7098 (part I)/1988 amended up to date.
- m. Cables inside the control room and in the switchyard shall be laid in Galvanized Cable Trays mounted on mild steel supports duly painted, in constructed trenches with RCC raft and brick sidewalls and provided with removable RCC covers.
- n. Cable terminations shall be made with suitable cable lugs & sockets etc, crimped properly and passed through brass compression type cable glands at the entry & exit point of the cubicles.

- o. All cable/wires shall be provided with Punched Aluminium tags only. The marking on tags shall be done with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.
- p. The wiring for modules interconnection shall be in the GI pipe /HDPE/ DWC Pipe of approved make.
- q. Data sheets of individual cable sizes (HT & LT) shall be submitted for approval by the Owner. Drum numbers and drum length details shall be submitted with each consignment.
- r. Cable end terminations and joint kits shall comply with the latest version of the relevant IS standard.
- s. The cable ends shall be terminated with adequate size copper/ Aluminum/ Bimetallic lugs and sockets etc, single/double compression cable glands. Cable glands shall be of robust construction capable of clamping cable and cable armor (for armored cables) firmly without injury to insulation. The metallic glands shall be earthed at min one location. Suitable lock type crimping lugs shall be used for cable end terminations. Where cables are raising from ground, suitable PVC pipe guarding shall be provided for cable raising with sealing of the guarding PVC pipe including a suitable clamp.
- t. HT cable termination kits and straight through joints shall be selected as per the cable specifications. Installation shall be as per the instructions given in the manufacturer's manual. Heat shrinkable type kits only shall be used for HT and LT cables.
- u. Data sheets of the joints and kits shall be submitted for approval by GGL.

4.6 Clamps and Connectors

- i. The bus-support clamps, spacers, T-connectors and various equipment connectors shall be supplied as per the enclosed drawings. The material to be used for these items shall be generally as per Table 4.
- ii. The materials shall be of the best workmanship, and all the sharp edges and corners shall be rounded off. The thickness of tinning, wherever applicable, shall be not less than 10 microns. The minimum thickness of pads made of copper shall be 10 mm and those made out of Aluminium/Aluminium Alloy, shall be 12 mm, unless otherwise indicated in the specifications.
- iii. All the clamps and connectors shall be designed to carry a continuous current not less than 125% of the rated current of the conductor (twin/single as the case may be)/equipment terminal to which these are to be connected. Temperature rise of the connector under the above condition shall not be more than 50% of the temperature of the main conductor/equipment terminal.

Table 3: Clamps & Connectors

Sr.	Application	Material
1.	Bolted type connection	
2.	For connection to ACSR/AAAC/ Aluminum terminal	Aluminum Alloy conforming to designate A6 as per IS 617
3.	For connection to copper terminals, with crimping facility to connect ACSR/AAAC jumper	Electrolytic grade copper, forged and tinned
4.	Crimping type connection	
5.	For connection to ACSR/AAAC jumper	Electrolytic grade aluminum

- iv. All the fasteners (i.e. nut-bolts, washers, check-nuts, etc.) used in the clamps and connectors shall be non-magnetic stainless steel. The straight bolts shall be fully threaded, and the U-bolts shall be threaded up to 30 mm from the ends. For connectors made out of Aluminium/Aluminium Alloy, the bolts shall be of 12 mm diameter, and for copper connectors the bolts shall be of 10 mm diameter.
- v. The clamps and connectors meant for ACSR and AAAC shall have the same crimping dimensions. It shall be possible to use the same clamp/connector for ACSR or AAAC, as would be required, without any modification/change at site.
- vi. The length of bolt shall be chosen such that after fully tightening the nut and check-nut, minimum 5 (five) threads of the bolt shall project outside the nut/check-nut.
- vii. As an alternative to the various types of clamps and connectors detailed under 2.0 above, the Contractors may offer connectors of Power Fired Wedge Pressure Technology (PFWPT). However, the same needs to be specified in the Bid.
- viii. Connectors of PFWPT type shall meet the general requirements for various connections/joints as indicated in the relevant drawings.
- ix. PFWPT type connectors shall comprise of:
 - a. Tapered 'C' - shaped spring member
 - b. Wedge for connecting solid/stranded conductor along with handle, suitable for connection between:
 - Aluminium & Aluminium
 - Copper & Copper
 - Aluminium & Copper
 - Aluminium & Al. Alloy
 - Copper & Al. Alloy
 - Al. Alloy & Al. Alloy



- x. Components of the PFWPT type connectors shall be made of Aluminium Alloy suitably heat-treated to ensure that the required Mechanical & Electrical parameters are in line with ANS 1 specification no. C 119.4-1991. The connectors shall have 'self-cleaning' capability during application. The connector shall ensure stable and low contact resistance under varying load conditions and the thermal cycling effects.
- xi. The special tools and tackles required for installation of the PFWPT type connectors shall be identified in the offer. One set of these bolts and tackles shall be included in the scope of supply.
- xii. The Contractor shall furnish the following information in their bill of material:
 - a. Availability of the PGWT connectors indigenously.
 - b. Unit rate of each item.
 - c. Notwithstanding anything stated above, the final decision regarding acceptance of the type of clamps and connectors (conventional/PFWPT type) shall rest with GGL.

4.7 Lightning protection for PV Array

- i. The source of over voltage can be lightning or other atmospheric disturbance. Main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other sub-system components as per IS: 2309 – 1989 (Reaffirmed – 2005), Edition 3.1 (2006-01).
- ii. Necessary foundation / anchoring for holding the lightning conductor in position to be made after giving due consideration to shadow on PV array, maximum wind speed and maintenance requirement at site in future. Lightning arresters shall be equipped with lightning counters.
- iii. The lightning conductor shall be earthed through flats and connected to the earth mats as per applicable Indian Standards with earth pits. Minimum two earth pits shall be provided for each lightning arrestor. Each lightning conductor shall be fitted with individual earth pit as per required Standards including accessories and providing masonry enclosure with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as required as per provisions of IS & Earth Resistance of Lightning System must be less than one (1) Ohm.
 - a) If necessary, more numbers of lightning conductors may be provided. The Contractor is also free to provide franklin rod / Early Streamer type of lightning arrestors on the MMS structure designed in such a way not to cast shadow on the next row of solar PV modules. The Contractor to submit necessary calculations based upon rolling sphere method for the Lightning protection system.
- iv. The Contractor shall submit the drawings and detailed specifications of the PV array lightning protection equipment to GGL for approval before installation of system.
- v. Lightning Protection shall be provided with digital counter with an individual Lightning arrestor.

4.8 Earthing for PV array

- i. The photovoltaic modules, BOS and other components of power plant require adequate earthing for protecting against any serious faults as guided by IEC 60364.
- ii. The earthing system shall be designed with consideration of the earth resistivity of the project area. The earth resistivity values shall be measured prior to designing the earthing system. Unless otherwise specified, earthing system shall be in accordance with IS: 3043 and IEEE 80, Indian Electricity Rules, Codes of practice and regulations existing in the location where the system is being installed.
- iii. The permissible system fault power level at all the voltage shall be kept in consideration while designing the earthing system. Each array structure of the PV yard, LT power system, earthing grid for switchyard, all electrical equipment, control room, PCU, all junction boxes, ACDB& DCDB, all motors and pumps etc. shall be grounded properly as per IS 3043 - 1987. All metal casing / shielding of the plant shall be thoroughly grounded in accordance with Indian electricity act / IE Rules.
- iv. The earthing for array and LT power system shall be made of 3 meter long 16 mm² (16 mm) Copper rod with chemical compound filled, double walled earthing electrodes including accessories, and providing masonry/ precast enclosure with cast iron cover plate/ Precast, chemical compound mix as required as per provisions of IS: 3043.
- v. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.
- vi. Each string/ array and MMS of the plant shall be grounded properly. The array structures are to be connected to earth pits as per IS standards. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.
- vii. The complete earthing system shall be mechanically & electrically connected to provide independent return to earth.
- viii. For each earth pit, a necessary test point shall be provided.
- ix. In compliance to Rule 11 and 61 of Indian Electricity Rules, 1956 (as amended up to date), all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.
- x. The Contractor should submit the earthing system design calculations along with the system layout for the Owner's approval prior to the installation of the system
- xi. Unless otherwise specified, the earthing system primary and secondary grid conductors, equipment connections shall be constructed with galvanized iron flat. However, the earthing of transformer neutrals, plc and inverter terminals and electronic earthing shall be provided using copper earthing conductor only.
- xii. Earthing Mesh is to be prepared and installed in entire power plant.

4.9 Inverter and Power Conditioning Unit (PCU) (String/central Inverter):

- i. Only those PCUs/ Inverters which are commissioned for more than 25 MW capacity (1500V DC) in other solar PV projects till date (Date of NOA) shall be considered for this project. The Contractor has to provide sufficient information to the satisfaction of GGL 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 String/Central inverter shall be min. 200 kW/KVA.
- 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.
- 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 in between 0.80 lag to 0.80 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 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 or Equivalent International standard.
- xii. DC input terminals must be in enough numbers so as each terminal is connected to dedicated single input. Two DC inputs shall not be connected on the single input DC terminal of the inverter.
- 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 of 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 minimum protection to IP 65(Outdoor) and Protection Class II or higher.



- 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 should 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 of 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 confirm to IEC 62093 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 is 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 followed 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 Control Room.
- 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. For Drawl of KVARH (Reactive energy) Contractor shall be responsible for the same and charges shall be borne by contractor only. The reactive charges will be settled in the O & M Bills of the contractor.
- 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 phases 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
 - g. Dedicated Prefab compartment required for Ethernet for networking
 - h. PCU shall have protection against over current, sync loss, over temperature, DC bus over voltage, cooling fan failure (if provided), short circuit, lightening, earth fault, surge voltage

induced at output due to external source, power regulation in the event of thermal overloading,

- xxxi. It should have bus communication via interface for integration, remote control via telephone model or mini web server, integrated protection in the DC and three phase system, insulation monitoring of PV array with sequential fault location. Alternatively, the same can be provided through SCADA.
- xxxii. Ground fault detector which is essential for large PV generators in view of appreciable discharge current with respect to ground.
- xxxiii. The power conditioner must be entirely self-managing and stable in operation. A self-diagnostic system check should occur on startup. Functions should include a test of key parameters on startup.
- xxxiv. Over voltage protection against atmospheric lightning discharge to the PV array is required. Proper earthing shall be provided to inverter as per Manufacturer guideline and as per IS 3043
- xxxv. The power conditioner must be entirely self-managing and stable in operation. A self-diagnostic system check should occur on startup. Functions should include a test of key parameters on startup.
- xxxvi. **Standards and Compliances:**

The Bidder also has to confirm the PCU specifications in the Bid.

Table 4: Detailed Specifications of PCU (String/Central Inverter)

Sr.	Particulars	Details
1	PCU Mounting	As per the design/Manufacturer Guideline
2	Nominal AC Output Power	≥ 200 kW/KVA
3	Nominal AC Output Voltage	800 Volts +15%/-10% AC / 270 V / As per design
4	Maximum Input Voltage	1500 V DC
5	Wave Form	Pure Sine wave
6	DC voltage range, MPPT	As per design
7	Minimum Efficiency at 100% load The rated European efficiency (Euro Eta Efficiency) and peak efficiency	≥ 98%, measured as per IEC 61683 standard for measuring efficiency. * Inverter No Load / Full Load Loss Calculation must be submitted by the Bidder.
8	Output frequency	50 Hz +3% to - 3% Hz
9	Power Factor	0.80 lag- 0.80 lead
10	Max. THD at rated power	Less than 3 %
11	Operating ambient temperature range	-25 to 60° deg C

Sr.	Particulars	Details
12	Humidity	15% to 95 % non- condensing
13	Enclosure	IP 65 (Outdoor rated) IEC-60068-2 (environmental)
14	Protection rating (as per IEC-60721-3-3)	Classification of chemically active substances: 3C2 Classification of chemically active substances: 3S2
15	Grid Specifications	IEC 61727, VDE 0126
16	Nominal Voltage & Frequency	800 Volts & 50 Hz
17	Voltage Tolerance	+ 10% and -10% or better than that

- PCU shall confirm IEC 60068-2 standards for Environmental Testing.
- All inverters shall be IEC 61000 compliant for electromagnetic compatibility, harmonics, etc.
- All inverters shall be safety rated as per IEC 62109 (1 & 2), EN 50178 or equivalent DIN or UL standard.
- Each PCU shall be compliant with IEEE standard 929 – 200 or equivalent.

xxxvii. PCU must be provided with necessary features for SCADA monitoring & controlling desk installed in Main Control Room through Universal Open Protocol of Communication-

Documentary Requirements & Inspection.

1. The bill of materials associated with PCUs should be clearly indicated while delivering the equipment.
2. The Contractor shall provide a data sheet containing detailed technical specifications of all the inverters and PCUs. Operation & Maintenance manual should be furnished by the Bidder before dispatch of PCUs.

Note: The Owner or its authorized representative reserves the right to inspect the PCUs/ Inverters at the manufacturer's site prior to dispatch.

4.10 AC Network

- i. AC converted by the inverter is transmitted through the appropriate cables from the Inverter to appropriately sized Inverter transformer via AC combiner box. In case of more than one Inverter transformer in a block, RMU shall be provided. RMU panel should consist of adequate size indoor AC bus/ cable, which can handle the current and the voltage safely as per the relevant, IS standards. RMU panel should be equipped with adequate protection relays, fuses, annunciations and remote



operating and controlling facility from the Main Control Room. Relevant national & international codes to be follows:-

Table 5: Relevant National & International Code

Sr.	Item	Relevant IS	Relevant IEC
1	Power transformer	IS 2026	IEC 76
2	Fittings & Accessories	IS 3639	
3	Climate Proofing	IS 3202	IEC 354
4	Loading of Transformer	IS 6600	IEC 296
5	Oil	IS 335	IEC 137
6	Bushings	IS 20650	IEC 144
7	Degree of Protection	IS 2147	IEC 76
8	Testing, Tolerances on guaranteed Particulars	IS 2026	IEC 76
9	Buchholz Relay	IS 3637	
10	Electrical Insulation	IS 1271	IEC 85

- ii. RMU panel or radial scheme through VCB panel is acceptable but RMU is to be used for connecting control room. It shall have circuit breaker of suitable rating for connection and disconnection of PCU from grid. The busbar shall connect the AC distribution board to the transformer. It shall have provision to measure bus voltage, current and power of the transformer. Outdoor inverter & RMU panel with IP65 or above are acceptable. Inverter station should be properly provided with canopy structure and working platform.
- iii. Busbars shall be of high conductivity Aluminium alloy or Copper of adequate size. The busbars shall be adequately supported by non-hygroscopic, non-combustible track resistant and high strength type polyester fiber glass moulded insulators. Separate supports shall be provided for each phase and neutral busbar. The bus-bars joints shall be provided with high tensile steel bolts, Belleville washers and nuts, so as to ensure good contacts at the joints. The busbars shall be colour coded as per IS 375.
- iv. The Bidder shall submit the detailed specifications of the AC bus and panel in the Bid.
- v. The RMU panel with thermal over current and earth fault releases. The incomer shall be selected one size higher than the required rating as per Type 2 selection chart. RMU shall be provided with metering facility i.e., ampere meter and volt meter irrespective of voltage presence indications.
- vi. Removable gland plates with gaskets shall be provided in the cable alleys for glanding the power and control cables. The distance between the gland plate and the incomer terminals shall not be less than 450 mm.

- vii. The Contractor should submit theoretical design calculations and detailed explanations along with drawings shall be provided and approved by the Owner.

4.11 HV Substation Block:

i. Step-Up Transformer

- a. The Contractor shall provide the complete turnkey design, supply, erection, testing and commissioning of transformers and transformer substation to first step-up the output of the inverter to HV at the location of the inverter. Inverter Transformer must be protected with HV VCB Panel. Hence, total 12 MW capacity of the solar plant with provision of rated 11kV or 33 kV HV Vacuum Circuit Breaker panel shall be connected up to 66 kV substation of the plant.”
- b. 3 phase, Oil Filled, 11 or 33 kV, 50 Hz, Inverter Transformers of the selected inverter rating and associated Switchgear of approved make should be utilized as per IS 6600. Inverter transformers can be off-load tap change type. The transformers shall be suitable for outdoor installation in which the neutral can be kept floated and they should be suitable for service under fluctuations in supply voltage up to plus 5% to minus 10% in step of 2.5% for inverter transformer.
- c. 12 MW (AC) plant shall have cumulative capacity of Minimum 8 MVA X 2 Nos of 800 V to 11 kV/33 kV Inverter duty power transformer of ONAN/ONAF and for 12 MW capacity minimum capacity of power transformer of 15 MVA of 11kV/33 kV to 66kV ONAN cooling for temperature rise of 55 Degree Celsius / 65 Degree Celsius as a temperature rise units.
- d. Cumulative loss shall be as per IGBC / CBIP guidelines. All electrical equipment and installation shall confirm to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified for installation and operation of electrical plants.
- e. Relevant national and international standards in this connection are mentioned in Table 6 General Standards for Transformers.
- f. All working parts, insofar as possible, are to be arranged for convenience of operation, inspection, lubrication and ease of replacement with minimum downtime. All parts of equipment or of duplicate equipment offered shall be interchangeable.
- g. The quality of materials of construction and the workmanship of the finished products/ components shall be in accordance with the highest standard and practices adopted for the equipment covered by the specification.

Table 6: General Standards for Transformers

IS: 2026 (Part 1 to 4)	Specifications for Power Transformer
IS: 2099	Bushings for alternating voltage above 1000 V
IS: 3639	Fittings and accessories for power transformer
IEC: 60076 (Part 1 to 5)	Specifications for Power Transformer



IS: 2026 (Part 1 to 4)	Specifications for Power Transformer
IS: 9921 Part 1 to 5	Alternating currents disconnectors (isolators) and earthing switches rating, design, construction, tests etc.
IS: 2705 Part 1 to 4 & IEC: 185	Current transformer
IS: 3156 Part 1 to 4	Voltage Transformer
IS: 3070 part 1 to 3	Lightning arrestors
IS: 2544	Porcelain insulators for system above 1000 V
IS: 5350	Part III – post insulator units for systems greater than 1000 V
IS: 5621	Hollow Insulators for use in electrical equipment
IS: 5556	Serrated lock washers – specification
IEC: 186	Voltage transformer

- h. All items of equipment and materials shall be thoroughly cleaned and painted in accordance with relevant Indian Standards. The finish paint shall be done with two coats of epoxy based final paint of colour Shade RAL 7032 of IS:5 for indoor equipment
- i. Any fitting or accessories which may not have been specifically mentioned in the specification, but which are usual or necessary in the equipment of similar plant or for efficient working of the plant shall be deemed to be included in the contract and shall be provided by the Contractor without extra charges. All plant and apparatus shall be complete in all details whether such details are mentioned in the specifications or not.
- j. All equipment shall be designed for operation in tropical humid climate at the required capacity in an ambient air temperature of 50°C. Equipment shall be suitable for an ambient temperature of 50°C. Maximum relative humidity of 100% shall also be taken into consideration for design of equipment.
- k. The reference ambient temperatures for which the transformers are to be designed are as mentioned in Table 7.
- l. The rating and electrical characteristics of the Outdoor type inverter transformer (typical) shall be as mentioned in Table 8.

Table 7: Reference Weather Conditions for Transformer Design

Sr.	Particulars	Specifications
1.	Maximum ambient temperature	50 degree C
2.	Maximum daily average ambient temp	45 degree C



3.	Maximum yearly weighted average ambient temp	40 degree C
4.	Minimum ambient air temperature: (Cooling medium shall be Air)	Minus 5 degree C
5.	Climatic Conditions:	
5.1	Maximum relative humidity	100%
5.2	Yearly average number of thunder storms	As per site
5.3	Average no. of rainy days per annum	As per site
5.4	Fog	As per site
5.5	Number of months during which tropical monsoon conditions prevail	As per site
5.6	Dust storms	As per site
5.7	Average annual rainfall	As per site
5.8	Maximum wind speed	180 kmph

ii. **Technical Data of Inverter Transformer**

- a. The rating and electrical characteristics of the outdoor type inverter transformer (typical) shall be as under:

Table 8: Rating and electrical characteristics of Inverter Transformer

Sr.	Particulars	Inverter Transformer (Outdoor type)
1	Continuous kVA ratings	As per design (2 Nos. X Min. 8 MVA)
2	Winding Material	Copper Only
3	Type	Oil immersed
4	Frequency	50 Hz
5	Type of cooling	ONAN
6	No. of phases	Three
7	Rating voltage H.V. side	11 / 33 kV
8	Highest System voltage on H.V. side	12 kV/ 36 kV
9	Rated voltage on L.V. side	Output of solar inverter
10	Vector Group	Dy5/ Dy11 (As per Design of Solar String Inverter)
11	Connections a) H.V. Winding b) L.V. winding	Delta Star



Sr.	Particulars	Inverter Transformer (Outdoor type)
12	On load taps on H.V. Side (for H.V. Variation)	Inverter transformer shall be provided with OLTC & taps Range of +5 to -5% in steps of 2.5% as these taps are not required to be changed on line.
13	Impedance voltage (%) as per IS 2026	4%
14	Minimum Creepage distance	31 mm/ kV
15	Transformer connections	LV side – Bus Duct/ Busbar with weather proof enclosure, HV Side – Bushing with enclosure

iii. **Technical Data of 66/11 or 33kV Step-Up Power Transformer**

Sr.	Particulars	66/11 or 33 kV Step UP Power Transformer
1.	Type of transformer	Min. 15 MVA, ONAN cooled, three phase, 66/11or 33KV Step Up Power Transformer, Double Limb wound, Core type for OUT DOOR application. Mounted on Rails with wheels.
2.	Three phase types of windings for HV	Interleaved type / Disc type with static end rings at both ends with uniformly insulated,
3.	Three phase types of windings for LV	Continuous disc type / layer type with uniformly insulated.
4.	Vector Grouping	D-Y n 11 / YNyn0 (as per IS: 2026 part-IV) or as per Design
5.	Type of insulation	Uniformly insulated as per IS: 2026 Part III
6.	Winding Material	Electrolytic grade copper
7.	Winding Insulation	Class-A
8.	System frequency	50Hz \pm 3%



Sr.	Particulars	66/11 or 33 kV Step UP Power Transformer
9.	Rated Capacity	As per IS 6600 for Power Transformer
10.	Rated Primary Voltage	11kV or 33 kV
11.	Rated Secondary Voltage	66 kV
12.	Maximum value of percentage Impedance at the (Normal working) principle tap position	11.76% or as per IS without positive tolerance

Non-cumulative over load capacity after the transformer has reached steady temperature on continuous operation at rated load i.e. At rated power) 110% for continuous, 125% for 15 minutes, 140% for 5 min Tapings (On load Tap Changer) OLTC shall be of minimum 72 KV Voltage class and shall have maximum rated through current not less than 300 Amps at normal tap, short circuit withstand current not less than 8kA for 3 Seconds and shall be of High-Speed Resistor type, housed in a separate tank outside the main tank.: Min.17 Taps in step of 1.25%. The maximum losses during ONAF condition to be considered for the evaluation and the same must be as per latest IS.

Transformer Losses : As per IS

Insulating medium Transformer oil as per IS: 12463

Nitrogen Injection Fire Protection System (NIFPS): NIFPS to be provided for all power transformer rating more than 10 MVA (As per CEA guidelines). NIFP system shall be provided with automatic control for fire prevention and fire extinction. The system shall be tested by UL, FM, LPCB or national testing body of BIS accredited laboratory's Test Report required.

iv. Instrument Transformer (66 kV Switchyard)

- The instrument transformers, i.e., current and voltage transformers shall be single phase transformer units and shall be supplied with a common marshaling box for a set of three single phase units. The tank as well as top metalics shall be hot dip galvanized or painted grey color as per RAL 9002.
- The instrument transformers shall be oil filled hermetically sealed units. The instrument transformers shall be provided with filling and drain plugs.



- c. Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block. The insulators shall have cantilever strength of more than 500 kg.
- d. Current Transformer, Voltage Transformer, Circuit Breaker and Relays should match –Local distribution GGL requirements.

v. **Current Transformer (66 kV Switchyard)**

- a. Current transformers may be either of the bushing type or wound type. The bushing types are normally accommodated within the transformer bushings and the wound types are invariably separately mounted. The location of the current transformer with respect to associated circuit breaker has an important bearing upon the protection scheme as well as layout of, substation. Current transformer class and ratio is determined by electrical protection, metering consideration.
- b. Technical specifications – Current ratings, design, Temperature rise and testing etc. should be in accordance with IS: 2705 (part I to IV).

Type and Rating:

- The current transformer should be of outdoor/ indoor type, single phase, oil immersed, self-cooled and suitable for operation in 3 phase solidly grounded system.
- Each current transformer should have the following particulars under the site conditions for the system under design (typical values for 66 kV systems are given).
- General Parameters: 66 kV CT.
- Each current transformer should have the following particulars under the site conditions for the system under design (typical values for 66 kV system are given).

Table 9: General parameters for 66 kV CT

Sr.	Particulars	Details
1	Highest system Voltage (Um)	72 kV rms
2	Rated frequency	50 Hz
3	System Neutral Earthing	Effective earthed
4	Installation	Outdoor/indoor (IP 65)
5	Rated short time thermal current	25 kA for 3 sec or appropriate thermal current as per design calculations
6	Rated dynamic current	63 kA (Peak) appropriate dynamic current as per design calculations
7	Rated min power frequency withstands voltage (rms value)	140 kV
8	Rated lightning impulse withstand	340 kV



Sr.	Particulars	Details
	voltage (peak value)	
10	Minimum Creepage distance	31mm/kV
11	Temperature rise	As per -IS 2705/1992
12	Type of insulation	Class A
13	Number of cores	For Transformer: Three (3) with One (1) protection core and One (1) metering core (1) Diff. Protection of Transformer For ABT Meter Line Side: Three (3) with One (1) protection core and One (2) ABT metering core Main & Check
14	CT secondary current	Protection cores – 1 Amp. Metering Core – 1 Amp (With Highest Accuracy Class)
15	Number of terminals in marshalling box	All terminals of control circuits wired up to marshalling box plus 20 terminals spare
16	CT ratio & Rated VA Burden, short time thermal rating, class of accuracy	Minimum burden required (As per GETCO requirement): 1. Metering core – 5VA min. 2. Protection core – 10VA min.

vi. **General Parameters of 66 kV VT**

The Bidder has to furnish the specifications of 66 kV VT with the Bid.

Table 10: General parameters for 66 kV VT

Sr.	Particulars	Details
1	Highest system voltage (Um)	72 kV
2	System neutral earthing	effective earthed
3	Installation	Outdoor (IP 65)
4	System fault level	Appropriate
5	Rated min power frequency withstand voltage (rms value)	140 kV
6	Rated lightning impulse withstand voltage (peak value)	340 kV



Sr.	Particulars	Details
7	Standard reference range of frequencies for which the accuracy is valid	96% to 102% for protection and 99% to 101% for measurement
8	Rated voltage factor	1.2 continuous & 1.9 for 30 sec
9	Class of Accuracy	0.5 / 3P, IS3156/1992
10	Minimum Creepage distance	31 mm/kV
11	Stray capacitance and stray conductance of LV terminal over entire carrier frequency range	As per IEC:358
12	One Minute Power Frequency Withstand voltage for secondary winding	3 kV rms
13	Temp. rise over an ambient temp. of 50 deg. C	As per IS 3156/1992
14	Number of terminals in control spare.	All terminals of control circuits wired Cabinet up to marshalling box plus 10 terminals
15	Rated total thermal burden	300 VA min.
16	Number of cores	2 (two) – 1 for protection and one for metering with 0.5 class accuracy.
17	Rated Output, insulation level, transformation ratio, rated voltage factor	should be provided as per GETCO standards and requirements.

vii. **Circuit Breaker (66 kV)**

- a. The circuit breakers shall be capable of rapid and smooth interruption of currents under all conditions completely suppressing all undesirable phenomena even under the most severe and persistent short circuit conditions or when interrupting small currents or leading or lagging reactive currents. The circuit breakers shall be 'Restrike-Free' under all operating conditions. The details of any device incorporated to limit or control the rate of rise of restriking voltage across, the circuit breaker contacts shall be stated. The over voltage across, the circuit breaker contacts shall be stated. The over voltage caused by circuit breaker while switching inductive or capacitive loads shall not exceed 2.5 times the highest phase to neutral voltage. The actual makes and break times for the

circuit breakers throughout the ranges of their operating duties shall be stated in the offer and guaranteed.

- b. The arc quenching chambers shall have devices to ensure almost uniform distribution of voltage across the interrupters.
- c. Appropriate & adequate Capacity AC& DC power supply shall be provided as per the IEC 60898 / IEC 62271 – 100 or equivalent Indian Standards for control circuit and protection relay circuit, fuses, annunciations and remote operating and controlling facility from the Main Control Room.
- d. Circuit breaker shall be C2/MI class under all duty conditions and shall be capable of performing their duties without opening resistor. The circuit breaker shall meet the duty requirement of any type of fault or fault location and shall be suitable for line charging and dropping when used on 6 kV effectively grounded or ungrounded systems and perform make and break operations as per the stipulated duty cycles satisfactorily.
- e. The circuit breaker shall be capable for breaking the steady & transient magnetizing current corresponding to 66 kV transformers. It shall also be capable of breaking line charging currents as per IEC- 62271-100 with a voltage factor of 1.4.
- f. The rated transient recovery voltage for terminal fault and short line faults shall be as per IEC: 62271-100.
- g. The Bidder shall indicate in the Bid, the noise level of breaker at distance of 50 to 150 m from base of the breaker.
- h. The Bidder may note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, pneumatic pressure etc. While furnishing the proof of the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between same pole and poles and show how it is covered in the guaranteed total break time.
- i. While furnishing particulars regarding the D.C. component of the circuit breaker, the Bidder shall note that IEC-62271-100 requires that this value should correspond to the guaranteed minimum opening time under any condition of operation.
- j. The critical current which gives the longest arc duration at lock out pressure of extinguishing medium and the duration shall be indicated.
- k. All the duty requirements specified above shall be provided with the support of adequate test reports.
- l. Circuit breaker shall be SF6 with electrically charged spring mechanism. The operating mechanism shall be anti-pumping and trip free (as per IEC definition) electrically under every method of closing. The mechanism of the breaker shall be such that the position of the breaker is maintained even after the leakage of operating media and / or gas. The circuit breaker shall be able to perform the duty cycle without any interruption.



- m. Electrical tripping shall be performed by shunt trip coil. Provision shall also be made for local electrical control. 'Local / remote' selector switch and close & trip push buttons shall be provided in the breaker central control cabinet. Remote located push buttons and indicating lamps shall also be provided. The SF6 coil DC supply through appropriately rated battery bank and charger to be supplied by the Contractor.
- n. Operating mechanisms and all accessories shall be in local control cabinet. A central control cabinet for the three poles of the breaker shall be provided along with supply of necessary tubing, cables, etc.
- o. Mounting and supporting structure for Circuit Breaker. The circuit breakers should be self-supporting type. However, if necessary for the purpose of minimum ground clearance the circuit breakers should be mounted on raised steel structures which should be included in the scope of supply of circuit breaker.
- p. Following information and data for design of foundations from the supplier of the circuit breaker be obtained.
- Dead weight per pole for complete circuit breaker
 - Static bending moments above the feet of each pole and for complete circuit breaker.
 - Static shear force at the foot of each pole and for complete circuit breaker
 - Maximum height of the steel supporting structure
 - Maximum diameter of the pole
 - Maximum horizontal force acting at upper terminal of each pole due to impact of closing/opening of the circuit breaker
 - Max. Impact loading in terms of equivalent static load both compression and upward due to opening/closing of the breakers. It shall be clearly stated whether these forces shall act simultaneously or at different timing.
 - No. of steel supporting columns provided for mounting the equipment.
 - The above data should represent static reactions for the worst windage or operation conditions. Circuit breakers whether of self-supporting type or on raised steel structure should ensure minimum sectional clearance (say 3500 mm for 66 kV)
 - Necessary connecting materials such as clamps, bolts, nuts, washers etc. and fixing bolts for mounting the equipment on the supporting structures wherever required should be obtained from the circuit breaker supplier.
- q. **Applicable Standards:** The materials shall conform in all respects to the relevant Indian Standard Specifications/ IEC Standards, with latest amendments indicated below in Table 11.

Table 11: Applicable Standards for Circuit Breakers



Indian Standard	Title	International & international recognized standard
ISS-13118/1991	General requirements for Circuit breakers for voltage above 1000 V	IEC 62271-100-1/2001
ISS-2705/1992	Current Transformers	
ISS-2099/1986	Bushings for alternating voltages above 1000 V	
ISS-2633/1964	Methods of testing uniformity of coating of zinc coated articles	
ISS-3231/1986	Electrical relays for power system protection	
ISS-1248/1983	Specification for Ammeters & Voltmeters	
ISS-335/1983	New insulating oils Electrical Clearances	IEC 71 (For oils in CTs)
ISS-2147/1962	Degree of protection provided by enclosures for low voltage switchgear & control gear	

viii. **General Parameters of Circuit Breaker:**

General parameters: Outdoor/ Indoor Vacuum type Circuit Breaker.

Table 12: General Parameters for 66 kV Circuit Breakers

Sr.	Particulars	Details
1	Type of circuit breaker	SF6 type
2	Highest System Voltage	72 kV
3	Rated operating voltage	66 kV
4	Rated frequency	50 Hz (+3% to -5%)
5	Number of poles	Three (3)
6	Rated/minimum power frequency Withstand voltage	140 kV
7	Rated lightning impulse Withstand voltage	340 kV
8	Minimum Creepage distance	31 mm/kV
9	Rated operating duty cycle	0 - 0.3 sec. - CO – 3 min. – CO
10	Rated line charging breaking	As per IEC
11	Reclosing	Single and three phase high speed auto reclosing



12	Maximum fault level	25 kA (rms) for 3 sec.
13	Auxiliary contacts	As required plus 6NO and 6NC contacts per pole as spare.
14	Noise level	Maximum 140dB at 50m distance from base of circuit breaker
15	Seismic acceleration	0.4g horizontal

ix. **General Parameters of SF6 Insulated Ring Main Unit (RMU):**

Table 13: General Parameters for SF6 Type RMU

Sr.	Particulars	Details
1	Type of Ring Main Unit	Metal enclosed, compact module, panel type, IEC 62271-200. Transformer Breaker must be VCB.
2	Highest System Voltage	11/33 kV
3	Rated operating voltage	12/36 kV
4	Rated frequency	50 Hz (+3% to -5%)
5	Number of poles	Three (3)
6	Rated/minimum power frequency Withstand voltage	28/70kV
7	Rated lightning impulse Withstand voltage	170 kV
8	Rated Current Busbar	630A
9.	Insulation Gas	SF6
10	Minimum Creepage distance	31mm/kV
11	Rated operating duty cycle	0 - 0.3 sec. - CO – 3 min. – CO
12	Rated line charging breaking	As per IEC
13	Reclosing	Single and three phase high speed auto reclosing
14	Maximum fault level	21 kA (rms) for 1 sec. Or appropriate as per design
15	Rated Making Capacity	52 kA
16	Rated Breaking Capacity	21 kA
17	Auxiliary contacts	As required plus 6NO and 6NC contacts per pole as spare.



18	Noise level	Maximum 140dB at 50m distance from base of circuit breaker
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x. **Circuit Breaker protection against**

- Over Current
- Earth fault
- Restricted earth fault relay
- Under voltage & over voltage protection
- Under frequency & over frequency
- SF6 gas pressure low (where applicable)
- DC supply failure

xi. **Protective Relays**

- a. The Solar PV system and the associated power evacuation system interconnections should be protected as per IEC 61727 Ed.2, norms. Over current relays, reverse power relays, differential protection relays and earth fault relays have to be essentially provided. All relay should be numerical type & should be remote operating and controlling facility from the control room.
- b. The numerical relays shall have RS 485 port for communication.
- c. The operating voltage of the relays shall be 110 V DC/220 V DC as per battery bank rating.
- d. Detailed Design calculations shall be provided on fault power computations and the philosophy of protective relaying with respect to short circuit kA calculations. Design, drawing and model of protection relay shall be approved by the Owner/Electricity Authority (GETCO).

4.12 Isolators cum Earthing Switches, Contacts, Insulators, Busbars

- i. This specification covers design, manufacture, testing and supply of. Manually operated 66 KV, 800 Amps Upright mounting type with manually operated with earth switch Isolators. The Isolators and Isolator-cum-Earthing Switched shall comply with the requirements of the IS: 9921 and IEC: 129 (latest edition) except specified herein. The Insulators shall comply with the requirements of IS : 2544 and IEC: 168-1988 (latest edition) for 66 kV pole mounted structure wherever required. 66 kV pole mounted structure would be supplied, installed and commissioned by the Contractor wherever required.



- ii. The isolator shall be of the manual operated type with earthing switches and shall complete with all parts and accessories including insulator operating rods, mounting attachments, necessary for their efficient operation. The equipment shall confirm in all respect to high standards of engineering Equipment shall be capable of performing in continuous commercial operation up to the suppliers guarantee in a manner acceptable to the client, The equipment offered shall be complete with all components necessary for its effective and trouble-free operation along with associated equipment's interlock, protection schemes, etc. Such components shall be deemed to be within the scope of the Contractor's supply irrespective of whether those are specifically brought out in this specification or not. All similar parts particularly removable ones shall be interchangeable.
- iii. Each pole shall have three Pedestal type of Insulator's stacks. Necessary arrangements shall be provided for proper alignment of the contacts. Ganged operated links shall be so designed that all phases shall make and break simultaneously. The design of Isolators and Isolator-cum-Earthing Switches shall be provided for positive control of blades in all positions with minimum mechanical stress on the Insulators. Fixed guides shall be provided so that proper setting of contacts shall be obtained, when a blade is out of alignment even by 25mm in either direction. All movable parts which may be in current path shall be shunted by flexible copper conductor of adequate cross-section and capacity, which shall be furnished under bill of material.
- iv. **Service Condition:**

The 66 kV triple pole air break isolators are intended to be used primarily for sectionalizing 66 kV UG cable portion of the line with 66 kV overhead portion of the line.

Isolator shall confirm IS: 9921(Part 1 to 4) & IEC 600 - 129 "alternating current disconnects (Isolators) and earthing switches", and IS 9921 (Part-I to IV) "Specification for alternating current disconnects (isolators) and earthing switches for voltages above 1000V"

- a. The moving & fixed contacts shall be made of hard drawn electrolytic grade copper strips and shall be heavy duty self-aligning & high-pressure type preferably which applies pressure to the contact surfaces after the blades are fully closed and release the pressure before they start to open. High pressure type contacts shall wipe the contact surfaces, while opening and closing. The contacts shall be so designed that wiping, action shall not cause securing or abrasion on the contact surfaces. The wiping action shall be sufficient to remove oxide film, formed during the operation of the switches. The pressure shall be developed by rotation of the entire blade.
- b. The temperature rise of contacts due to the flow of rated short circuit current for a period of 3 seconds shall not cause any annealing or welding of contacts.
- c. The moving contacts, if provided, shall close first and open last so that no damage is caused due to arcing whatever to the main contacts. The Successful Bidder shall give full details of such contacts with necessary drawings.



- d. The arcing contacts, if provided, shall close first and open last so that no damage is caused due to arcing whatever to the main contacts. The Contractor shall give full details of such contacts with necessary drawings.
- e. The female contact and its tensioning by spring shall be such that there will, always, be a positive contact with adequate pressure to give enough contact surface for the passing of current. The springs provided should not go out of alignment or get entangled with the male contact during operation. The details of springs shall be furnished on the G.A. drawing.

4.13 Insulators:

The isolator shall be provided with solid core insulators

- i. These shall be of stacking type to be used. The dimensions and other parameters unless otherwise specified shall generally conform to IS - 5350-Part-11 & IEC 273.
 - ii. The cylindrical type post insulators shall be of solid core type. Insulators of similar type shall be interchangeable. The mechanical strength class for outdoor cylindrical post insulators shall be of strength class 6, corresponding mechanical strength in tension, compression and torsional shall be as per IS: 53550 Part - II. When operated at maximum system voltage, there shall be no electrical discharge. Shielding rings, if necessary, shall be provided.
 - iii. The parameters of the insulators required shall conform to IS: 0350 - Part - II - 1973 or IEC 273.
 - iv. The cylindrical post insulators shall consist of single unit only.
 - v. The insulator shall be provided with a completely galvanized steel base designed for mounting on the support. The base and mounting arrangement shall be such that the insulator shall be rigid and self-supporting and no guying or cross bracing between phase shall be necessary.
- i. Porcelain of the insulator:**
- a. The porcelain used for the manufacture of the insulators shall be homogenous, free from laminations and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be uniform brown colour, with a smooth surface arranged to shade away rain water and free from blisters, burns and other similar defects. Insulators shall be inter-changeable.
 - b. The porcelain and metal parts shall be assembled in such a manner and with such materials that any differential thermal expansion between the metal and porcelain parts throughout the operating temperature range will not loosen the parts or electrical strength or rigidity. The assembly shall not have excessive concentration of electrical stress in any section or across leakage surfaces. The cement used shall not give rise to chemical reaction with metal fittings. The insulator shall be suitable for water washing by rains or artificial means in service conditions. Further the insulators to be supplied with shall be of high- quality and should not result in mismatch and misalignment of stacks during erection and operation.



- c. Each cap shall be of a high-grade cast iron or malleable steel casting or steel forging. Cap and base insulators shall be interchangeable with each other. The insulator shall conform to the requirement of the latest edition of IS: 2544, or any other equivalent standard. The Bidder should furnish the characteristics of insulators in the Bid.

4.14 Busbars:

- i. The outdoor busbars and equipment connections shall be with ACSR conductor (Panther /suitable size as per design).
- ii. The busbars and the connection jumpers shall be supported on post insulators wherever required.
- iii. The ACSR bus bars are an underground system of wires strung between two supporting structures and supported by strain type insulators. The stringing tension may be limited to 500-900 kg. depending upon the size of the conductor used. These types of bus bars are suitable for earthquake prone areas.
- iv. Bus bar Material – The materials in common use for bus bars and connections of the strain type are ACSR conductor.
- v. Since aluminum oxides rapidly great care is necessary in making connections. In the case of long spans expansion joints should be provided to avoid strain on the supporting insulators due to thermal expansion or contraction of pipe.
- vi. The bus bar sizes should meet the electrical and mechanical requirements of the specific application for which they are chosen.
- vii. The isolator shall be provided with padlocking device to permit locking of the isolator in both fully open and fully closed positions.

4.15 Control & Relay Panel Specifications

- i. The control & relay panel shall be free standing, simplex type, floor mounting type, fabricated from 2 mm thick MS sheet for main enclosure and 1.6 mm thick MS sheet for internals and partitions. The main enclosure shall be mounted on a base frame fabricated out of 100x50 IGGL mild steel section.
- ii. The enclosure external finish color shade shall be decided by the Owner, The internal surface shall have a glossy white finish all over.
- iii. The control & relay panel shall contain the following metering and protection devices:
 - Metering, Indications & Controls
 - Ammeter – 0 – A
 - Ammeter selector switch
 - Voltmeter – 0 – 12/36 kV
 - Voltmeter selector switch

- Load manager to display the following parameters: MW, MVA, MVA_{rh}, MVA_r Cos ϕ , Hz,
- Indication lamps for R, Y, B phases, Breaker 'ON' (R), Breaker 'OFF' (G), Breaker 'TRIP' (A), Spring charged (W), Trip Circuit Healthy (B)
- TNC switch, spring return to neutral position shall be provided for circuit breaker operation.
- Local / Remote selection switch for circuit breaker operation
- Semaphore indicators (LED type) for CB and Isolator 'Open' & 'Close' positions
- Mimic diagram for the 66 kV systems with aluminum strips and 'ON' 'OFF' indications for isolators

4.16 Low Voltage Switchgear

- i. This specification is for the 415V TP&N Power Control Centre (PCC).
- ii. The PCC shall be rated for the maximum output of the supply transformer feeding the system.
- iii. The short circuit withstand rating (1 sec) at rated voltage of the switchgear shall be minimum of 20 kA (rms) and corresponding dynamic rating shall be 50 kA (peak).
- iv. The configuration of the PCCs shall be as per the Single Line Diagram of the system.
- v. In case contractor opts for the string inverter, then output of the string inverters shall be connected to suitable rating of MCCB's and input side of inverter duty transformer's (IDT) shall be connected through air circuit breaker (ACB) of suitable rating only.
- vi. Execution
 - Single front / compartmentalized, modular design, degree of protection IP52 with provision of extension on both sides.
 - Incomer feeders: mains incomer - Electrically operated draw out type Air Circuit Breakers (ACBs).
 - Outgoing feeders: Electrically operated draw out type Air Circuit Breakers (ACBs) / Moulded Case Circuit Breakers (MCCBs)
 - The finish-colored shade of switchgear enclosure for interior should be glossy white & for exterior it shall be light grey, semi glossy shade 631 of IS: 5. If a different exterior shade is desired by the PURCHASER, the same shall be intimated to the supplier.
 - The PCC shall be fabricated out of CRGO sheet steel; 2 mm thick for the outer shall all-round. The internal walls and separators shall be of 1.6 mm thick CRGO sheet steel.
 - The gland plates shall be 3 mm thick.

4.17 Control & Relay Panel Specifications for 415 V TP&N Power Control Centre (PCC)

- i. This specification is for the 415V TP&N Power Control Centre (PCC).
- ii. The PCC shall be rated for the maximum output of the supply transformer feeding the system. The short circuit withstand rating (1 sec) at rated voltage of the switchgear shall be minimum of 20 kA (rms) and corresponding dynamic rating shall be 50 kA (peak)

- iii. The configuration of the PCCs shall be as per the Single Line Diagram of the system.
- iv. Execution: Power Control Centres (Construction)
 - a. Single front / compartmentalized, modular design, degree of protection IP52 with provision of extension on both sides.
 - b. Incomer feeders: mains incomer - Electrically operated draw out type Air Circuit Breakers (ACBs).
 - c. Outgoing feeders: Electrically operated draw out type Air Circuit Breakers (ACBs) / Moulded Case Circuit Breakers (MCCBs)
 - d. The colour finish shade of switchgear enclosure for interior shall be glossy white & for exterior it shall be light grey, RAL 7032 of IS: 5. If a different exterior shade is desired by the PURCHASER, the same shall be intimated to the supplier.
 - e. The PCC shall be fabricated out of CRGO sheet steel; 2 mm thick for the outer shall all-round. The internal walls and separators shall be of 1.6 mm thick CRGO sheet steel
 - f. The gland plates shall be 3 mm thick
- v. Control Circuit
 - a. Control supply for breaker closing / tripping - 110V DC
 - b. Air Circuit Breaker Spring charge motor – 240 V AC, 1 phase
 - c. Moulded Case Circuit Breakers – 240 V AC, 1 phase
 - d. Indications, annunciation – 110V DC
 - e. Space heater, sockets, etc. – 240 V AC, 1 phase
- vi. Busbar and Cable Cavity
 - a. The material for main bus bars and tap off bus bars shall be electrolytic grade aluminum with HR PVC sleeved insulation
 - b. Bus bars shall be suitable for short circuit rating and current suitable for all connected loads.
 - c. Bottom cable entry for incoming and outgoing cables
 - d. A suitable gland plate shall be supplied for termination of power, control and instrumentation cables.
 - e. Whenever feeders are housed in multi-tier configuration, these tiers shall be segregated by sheet metal barriers

4.18 Control Room Electrical Wiring

- i. Electrification of building shall be carried out as per IS 732-1989, IS 46481968 and other relevant standards. Suitable AC Distribution Board should be designed to Supply AC power in Control room.



- ii. Control room AC distribution Board theoretical design, calculations and detailed explanations along with drawing shall be provided and approved by GGL.

4.19 Auxiliary Power Supply

- i. The Contractor shall install a separate minimum 100 kVA, 11 kV or 33 kV / 415 V step down transformer to supply power for internal equipment such as power for control equipment, area lighting, water pumps, oil filtration and conference room fixtures, control room lighting and air-condition, etc.
- ii. This auxiliary power should be utilized directly from the grid through a separate meter and should not interfere with accounting of solar electricity fed into the grid.

4.20 DC Battery & Charger

- i. Adequate capacity DC battery Bank should be provided for emergency control supply of inverters, control / protection system & emergency lighting. A appropriate capacity battery charger with relevant IS/IEC standards & protection and automatic change over system should be provided to charge the battery bank along with relay circuit, fuses, annunciations and remote operating and controlling facility from the Main Control Room.
- ii. A DC power supply Distribution panel/board should be supplied along with the Charger as per relevant IS standards. Control room DC Battery Bank & DC supply system theoretical design, calculations and detailed explanations along with drawing shall be provided and approved by GGL / GETCO. For designing of battery, 20% design margin shall be considered.
- iii. All DC batteries shall have the following specifications.

a.	Type	:	Tubular Lead Acid type,
b.	Rating	:	110 V D.C., Minimum 80 Ah at 8 Hour rate of discharge
c.	Standard	:	IS 1651 – 1979; performance as per IS 8702
d.	Container	:	Plastic Resin, ABS
e.	Terminal Post	:	Designed suitably to accommodate external bolted connections

- iv. The battery shall be provided with epoxy paint coated exhaust fan for removal of gases released from the battery cells.
- v. The data sheet for the battery shall be submitted along with the Bid for evaluation.

4.21 Earthing (General Plant):

- i. Earthing bus bar shall be terminated at both ends of the switchgear to suit the connections to outside Earthing conductor. All components inside the module are required to be earthed individually and are to be looped and connected to the horizontal earth bus.

ii. Terminals

- a. CT circuit 0074 - Isolating link type terminals with shorting facility
- b. PT circuit – clip on type terminals
- c. Spare contacts shall be wired up to terminal block. 10% spare terminals shall be provided for each module

iii. Specific Requirements

- a. All ACBs shall be 4 pole, electrically operated, draw-out type, with closing coil, spring charge motor, trip coil, TNC switch for close and trip, manual closing and tripping push buttons, door I/L, test and service position micro switches, emergency P.B., safety shutters, etc. The circuit breaker shall be provided with anti-pumping feature.
- b. ACBs shall be complete with microprocessor release and shall be provided with over current, short circuit and earth fault protection.
- c. Minimum 10% spare feeders of each rating shall be provided in the switchgear. No spare feeder is required for 11kV VCB panel and SMB.
- d. All current transformers shall have 5/1A secondary and all meters shall be suitable for 5/1 A operation.
- e. All indicating lamps shall be of LED cluster type. ACB feeders shall be provided with ON, OFF, AUTOTRIP, SPRING CHARGED, TEST, SERVICE, TRIP CIRCUIT HEALTHY indications
- f. All indicating instruments shall be flush mounting, Digital, 96 sq.mm size.
- g. Window annunciator with hooter and accept, test, reset button shall be provided. Necessary auxiliary relays for contact multiplication shall be provided in the panel.
- h. The maximum temperature of the bus bars, droppers and contacts at continuous current rating under site reference ambient temperature of 50° C shall not exceed 105° C.
- i. Instrumentation: Switchgear instrumentation shall be provided as follows:
 - Mains Incomer – Voltmeter with selector switch
 - Ammeter with selector switch
 - Power Factor meter
 - Frequency meter
 - TVM + MD meter
 - Potential indicating lamps
 - Outgoing Feeders
 - Ammeter with selector switch on all feeders

4.22 Lightning Protection for PV plant & Earthing (General Plant):

- i. The source of over voltage can be lightning or other atmospheric disturbance. Main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other sub-system components as per IEC 60099 / IS: 2309 – 1989 (Reaffirmed – 2005), Edition 3.1 (2006-01). Lightning Protection System required for Solar PV Plant, Substation Structure & Control Room within the EPC scope of work. The intent of specification can be conventional as per IS : 2309 or can be Early Streamer Emission Type depending upon Area, Protected Equipment & Technical feasibility. Necessary concrete foundation for holding the lightning conductor in position to be made after giving due consideration to shadow on PV array, maximum wind speed and maintenance requirement at site in future. We recommended going with Early Stream Emission Air Terminal Technology as per NFC 17-102 / IEC 62305-2. Level of Protection must be defined as per Rolling Sphere Method LPL-I, LPL-II, LPL-III & LPL-IV where the radius shall be of 20mtr, 30mtr, 45mtr & 60mtr respectively.
- ii. $R_p(h)$: Protection radius at a given height (h) $R_p(h) = \sqrt{2rh - h^2} + \Delta(2r + \Delta)$ (for $h \geq 5$ m) For $h < 5$ m, refer to the figure : Height of the OPR tip above the surface(s) to be protected $r(m)$: Standardized striking distance $\Delta(m) = 106 .\Delta T$ (OPR efficiency)

OPR radius of protection												
Protection level	I (r = 20 m)			II (r = 30 m)			III (r = 45 m)			IV (r = 60 m)		
OPR	OPR 30	OPR 45	OPR 60	OPR 30	OPR 45	OPR 60	OPR 30	OPR 45	OPR 60	OPR 30	OPR 45	OPR 60
h (m)	Radius of protection R_p (m)											
2	19	25	31	22	28	35	25	32	39	28	36	43
3	29	38	47	33	42	52	38	48	58	43	57	64
4	38	51	63	44	57	69	51	65	78	57	72	85
5	48	63	79	55	71	86	63	81	97	71	89	107
6	48	63	79	55	71	87	64	81	97	72	90	107
8	49	64	79	56	72	87	65	82	98	73	91	108
10	49	64	79	57	72	88	66	83	99	75	92	109
15	50	65	80	58	73	89	69	85	101	78	95	111
20	50	65	80	59	74	89	71	86	102	81	97	113
45	43	65	76	58	75	89	75	90	105	89	104	119
50	40	65	74	57	75	88	75	90	105	89	104	120
55	36	65	72	55	75	86	74	90	105	90	105	120
60	30	65	69	52	75	85	73	90	104	90	105	120

- iii. The lightning conductor shall be earthed through flats and connected to the earth mats as per applicable Indian Standards with earth pits. Each lightning conductor shall be fitted with individual LA counter and earth pit as per required Standards including accessories, and providing masonry enclosure with cast iron cover plate having locking arrangement, chemical compound as per provisions of IS.
- iv. If necessary, more numbers of lightning conductors may be provided as per design calculation
- v. The Contractor shall submit the drawings and detailed specifications of the PV array lightning protection equipment.
- vi. The design, manufacture, inspection, testing and performance of Lightning Arrester shall comply with all currently applicable statutes, safety codes, provision of latest Indian Electricity Act, Indian Electricity Rules and Regulations of Statutory Authorities.
- vii. Contractor shall provide dedicated two earth pits for Lightning Arrestor as per relevant IS standard.

4.23 General Technical Specifications of Control Panel

- i. The panel shall be self-supporting, free standing, floor mounted, modular type with construction having degree of protection of IP 54 as per IS 2147.
- ii. The panel shall be fabricated from 14 SWG CRCA sheet steel for frame & load bearing surfaces. Partitions may be fabricated from 16 SWG CRCA if no components are mounted on them.
- iii. The panel shall be painted with 2 coats of primer after pre-treatment and 2 coats of Polyurethane / epoxy paint with shade as decided by the Owner.
- iv. Stiffeners shall be provided at corners & between modules to make panel rugged. The stiffeners will necessarily be required for relay compartments or doors where heavy components are mounted.
- v. The openable covers shall be provided with lift-off type hinges, quarter turn door locks and flexible copper wire for earth connection.
- vi. The panel shall be dust and vermin proof. Synthetic or neoprene gaskets shall be provided at all openings.
- vii. The panel shall be of dead front construction suitable for front operated and back maintained functioning.
- viii. Panel shall be provided with fl. lamp of 20 w capacity operated by door operated limit switch. Panel shall also have space heaters and thermostat arrangement.
- ix. Panel shall be provided with 5pin switch socket combined unit of 5/15 Amp capacity.
- x. Lifting hooks shall be provided at the top of the panel.
- xi. The hardware components used in the panel shall be hot dipped galvanized.
- xii. The control components shall be fixed on mounting plate by drilling & tapping.
- xiii. Aluminum anodized legend plates shall be provided for all the components. For components mounted on front face, legend plate from inside shall also be provided.
- xiv. Pretreatment by 7 tank process shall be done before painting / powder coating the panel.
- xv. Panel shall have provision of drawing pocket.
- xvi. The panel should be designed to ensure maximum safety during operation inspection, connection of cables and maintenance. Inside panel, checking and removal of components shall be possible without disturbing other units.
- xvii. Cable entries will be from bottom. The opening of cable entry shall be covered by 3 mm thick gland plates.
- xviii. The panel shall be provided with all necessary components / devices and instruments as per the enclosed schematic diagram and functional requirements.
- xix. Components such as protective relays, auxiliary relays, push buttons, switches, instruments shall be flush mounted on the front side of a panel.
- xx. The control wiring shall be done with PVC insulated flexible copper wire. For CT secondary circuits 2.5 sq.mm. wire shall be used. For control wiring 1.5 sq.mm. wire shall be used.

- xxi. Earthing busbar of suitable cross section shall be provided throughout the length of panel.
- xxii. The panel shall be fully wired all the terminals shall be brought out for cable connections. 10% spare terminals shall be provided. Separate terminal block shall be provided for different voltages. All wire shall have P.V.C. ferrules as per wiring diagram.
- xxiii. Proper shrouding to incoming and outgoing terminals shall be provided to ensure safety during operation, inspection and maintenance.
- xxiv. Indicating lamps shall be with multiple LEDs & shall be suitable for the specified voltage.
- xxv. All the components in the panel shall be properly labeled. The labels shall be made of non-rusting metal or engraved PVC material properly fixed by screws.
- xxvi. The panel layout shall be made in such a way that it will always facilitate easy removal and reconnection of control cables without disturbing other wiring.
- xxvii. Centre lines of control switches, push buttons and indicating lamps shall be matched so as to give neat appearance. Similarly top lines of indicating instruments and relays shall also be matched.
- xxviii. The panel shall be provided with electrolytic grade aluminum busbar of suitable cross section so as to maintain max current density of 0.8 AMP/ Sq.mm.
- xxix. Bus bars shall be provided with color coded heat shrinkable sleeves.
- xxx. Bus bars shall be supported by high quality epoxy insulators provided at specified distances so as to withstand the given fault level.
- xxxi. The busbar chambers shall be provided with suitable ventilation arrangements so as to limit the maximum temperature of 85°C while carrying rated current.
- xxxii. Proper clearance of minimum 25 mm shall be maintained between phase bus bars and between bus bars.
- xxxiii. The panel shall be inspected at manufactures' works before dispatching to site at the discretion of GGL.
- xxxiv. All routine tests shall be carried out on the panel in presence of the Owner / its representative. These tests shall include following:
 - a. Verification of components ratings and operation.
 - b. High voltage measurement test.
 - c. Insulation Resistance Measurement.
- xxxv. Control testing.
- xxxvi. Approval of the following drawings shall be obtained before manufacturing the panels
 - a. General arrangement drawing.
 - b. Wiring Diagram.

xxxvii. Detail bill of material.

xxxviii. **66 kV Under Ground Cable:**

The Contractor shall provide 66 kV Under Ground Cable along with bay and metering on Turnkey basis as per client's requirement at GETCO substation. The Bidder shall confirm the same in the Bid. The Underground cable shall also be approved as a registered supplier in GETCO.

4.24 Metering System

(At Solar Plant End as per GETCO/ DISCOM)

- i. ABT energy meter shall be provided as approved by GETCO/DISCOM to measure the quantum of energy delivered to the grid for sale. The responsibility of arranging for the meter, its inspection/calibration/testing charges etc. rests with the Contractor. All charges incurred on Meter testing, shall be borne by the Contractor. ABT energy metering system is to be approved by GETCO.
- ii. Meter must be provided with the necessary data cables.
- iii. Separate metering system has to be provided for L.T. (incoming) and H.T. (outgoing) supply.
- iv. The Bidder shall provide ABT compliant meters at the interface points. Interface metering shall conform to the Central Electricity Authority (Installation and Operation Meters) Regulation 2006 and amendment thereof Commercial settlement of solar Photovoltaic Grid Interactive based power project shall be in accordance with the GERC relevant order. Meter shall be suitable for interfacing for synchronizing the built-in clock of the meter by GPS time synchronization equipment existing at the station either through a synchronization pulse received from the time synchronization equipment or through a remote PC synchronized to GPS clock shall also be in the scope of Bidder.
- v. All charges for testing and passing of the meter with relevant government agency shall be borne by bidder; GGL will assist Bidder with the necessary document as and when required.
- vi. ABT compliant Energy Meters shall have technical specification as given below (not limited to specified requirement, Bidder can provide Meter with latest facilities):
- vii. Shall be microprocessor-based conforming to IEC 60687 / IEC 6205211/ IEC 62053-22 / IS 14697
- viii. Shall carry out measurement of active energy (both import and export) and reactive energy (import) by 3-phase, 4 wire principle suitable for balanced/ unbalanced 3 phase loads.
- ix. Shall have an accuracy of energy measurement of at least Class 0.2 for active energy and at least Class 0.5 for reactive energy according to IEC 60687 and shall be connected to Class 0.2S CT cores and Class 0.2S VT windings.
- x. The active and reactive energy should be directly computed in CT & VT primary ratings.
- xi. Shall compute the net MWh and MVARh during each successive 15-minute block metering interval along with a plus/minus sign, instantaneous net MWh, instantaneous net MVARh, average frequency of each 15 minutes, net active energy at midnight, net reactive energy for voltage low and high conditions at each midnight.



- xii. Each energy meter shall have a display unit with a seven-digit display unit. It shall display the net MWh and MVARh with a plus/minus sign and average frequency during the previous metering interval; peak MW demand since the last demand reset; accumulated total (instantaneous) MWh and MVARh with a plus/minus sign, date and time; and instantaneous current and voltage on each phase.
- xiii. All the registers shall be stored in a non-volatile memory. Meter registers for each metering interval, as well as accumulated totals, shall be downloadable. All the net active/reactive energy values displayed or stored shall be with a plus /minus sign for export/import.
- xiv. At least the following data shall be stored before being over-written for the following parameters:

Table 14: Co-ordination Parameters

Sr.	Parameters	Details	Min No of Days.
1	Net MWh	15 min Block	90 days in meter
2	Average Frequency	15 min Block	90 days in meter
3	Net MVARh for > 103 %	15 min Block	90 days in meter
4	Cumulative Net MWh	At every Mid-night	30 days in meter / 90 days in PC
5	Cumulative Net MVARh for $v > 103\%$	At every Mid-night	30 days in meter / 90 days in PC
6	Date and time blocks of VT failure on any phase		

- xv. Shall have a built-in clock and calendar with an accuracy of less than 15 seconds per month drift without assistance of external time synchronizing pulse.
- xvi. Date/time shall be displayed on demand. The clock shall be synchronized by GPS time synchronization equipment existing at the station provided by Contractor.
- xvii. The meter shall be suitable to operate with power drawn from the VT supplies. The burden of the meters shall be less than maximum 2 VA.
- xviii. The power supply to the meter shall be healthy even with a single-phase VT supply. An automatic backup, in the event of non-availability of voltage in all the phases, shall be provided by a built-in long-life battery and shall not need replacement for at least 10 years with a continuous VT interruption of at least 2 years. Date and time of VT interruption and restoration shall be automatically stored in a non-volatile memory.
- xix. Even under the absence of VT input, energy meter display shall be available, and it shall be possible to download data from the energy meters.



- xx. Shall have an optical port on the front of the meter for data collection from either a hand-held meter reading instrument (MRI) having a display for energy readings or from a notebook computer with suitable software.
- xxi. The meter shall have means to test MWh and MVARh accuracy and calibration at site in-situ and test terminal blocks shall be provided for the same.
- xxii. The meter shall have a unique identification code provided by the Company and shall be permanently marked on the front of the meter and stored in the non-volatile memory of the meter.
- xxiii. The Owner shall have the right to carry out surprise inspections of the Metering Systems from time to time to check their accuracy. (Metering at Receiving End as Per Gujarat Solar Power Policy 2023 and amended time to time or GERC Regulation & its amendment time to time)
- xxiv. Changes at receiving end various locations of GGL shall be in the scope of EPC Contractor.
- xxv. The electricity generated by the SPGs, shall be metered on 15-minute time block basis by STU/DisCom/SLDC/ ALDC at the receiving end of the STU substation / 11 kV system of DisCom. For the purpose of energy accounting, solar generating projects shall provide ABT-Compliant meters at the interface points. Interface metering shall confirm to the Central Electricity Authority (Installation and Operation of Meters) Regulations as amended from time to time. STU/Discom shall stipulate specification in this regard.
- xxvi. In case of contracted load/ sanctioned demand not exceeding 1MW, DISCOM may allow installation of non-ABT meters at consumer level reprogrammed as per the energy accounting requirement.

4.25 SCADA and Remote Monitoring System

Scope of work for 12 MW(AC) SCADA system shall cover:

- i. Design & Engineering, submission of drawings/documents, manufacture, Factory Acceptance Test (FAT), packing & forwarding, loading, Insurance, transportation, delivery of the SCADA system with and associated items, supply of mandatory spares, Erection, testing, commissioning of SCADA system and acquisition of solar plant data as well as to provide data in open protocol to central PC / Server for viewing of 12 MW(AC) solar Plant data at each Control Room, Stabilization of SCADA system, providing data to GUVNL as per requirements, training to GGL engineers, Warranty/Defect Liability Period services, submission of As-built documents.
- ii. The plant shall be automatically operated and shall be controlled by microprocessor-based control system SCADA. There shall be simultaneous data logging, recording and display system for continuous monitoring of data for different parameters of different sub systems, power supply of the power plant at DC side and AC side.
- iii. An integrated SCADA shall be supplied which should be capable of communicating with all inverters and provide information of the entire Solar PV Grid interactive power plant.



- iv. Computer-aided data acquisition unit shall be a separate & individual system comprising of different transducers to read the different variable parameters, A/D converter, multiplexer, de multiplexer, interfacing hardware & software, which will be robust & rugged suitable to operate in the control room Environment.
- v. Reliable sensors for solar insolation, temperature, and other weather and electrical parameters are to be supplied with the data logger unit.
- vi. The data acquisition system shall measure and continuously record electrical parameters at inverter output, 11kV/33 kV terminal, 66 KV terminal, 66 kV ABT meter at evacuation point, ambient temperature near array field, control room temperature, AC and DC side electrical parameters of each inverter, power characteristics of the HT side.
- vii. All data shall be recorded chronologically date wise. The data file should be MS Excel compatible. The data logger shall have internal reliable battery backup and data storage capacity to record all sorts of data simultaneously round the clock. All data shall be stored in a common work sheet chronologically and representation of monitored data shall be in graphics mode or in tabulation form. All instantaneous data can be shown in the Computer Screen. Provision should be available for Remote Monitoring.
- viii. The Bill of Materials associated with the equipment must clearly indicate especially the details about the PC and Printers, etc.
- ix. The Data Acquisition System should be housed in a desk made of steel sheet.
- x. SCADA shall provide following data at a 5–15-minute interval.
 - a. Power at 66 kV ABT meter at switchyard
 - b. Ambient temperature near array field.
 - c. Wind Speed
 - d. AC and DC side Power of each inverter
 - e. Solar irradiation/isolation
 - f. Voltage of the HT Side
 - g. Any other parameter considered necessary by supplier based on current prudent practice.
- xi. Minimum I/O Consideration as per below table. Any other parameter not mentioned in the list but required as per current prudent practice to be considered & provided.

Minimum Requirements of SCADA System for I/O Consideration

Sr. No.	Equipment Details	Location	SCADA Requirements			
			Monitoring / Status	Control / Operation	Data Logging	Specific Remarks
1	ABT Meter	66kV Switchyard	Yes		Yes	
2	Isolators	66kV Switchyard	Yes			
3	C & R	66kV Switchyard	Yes		Yes	Relay Log
4	Power Transformer	66kV Switchyard	Yes		Yes	Marshalling Box
5	Breakers	66kV Switchyard	Yes	Yes		
6	11kV / 33 kV VCB Panel	MCR	Yes	Yes	Yes	MFM Meters with RS485
7	DC Battery Charger	MCR	Yes			Battery Back Up Status
8	UPS	MCR / LCR	Yes			UPS Data Log
9	Aux. Transformer	66kv Switchyard	Yes			Marshalling Box
10	Fire Alarm Panel	MCR / LCR	Yes			
11	Inverter	LCR	Yes	Yes	Yes	Inverter Data Log
12	11kV /33 kV RMU	LCR	Yes	Yes	Yes	MFM Meters with RS485
13	Weather Monitoring Status	MCR	Yes		Yes	
15	CCTV	LCR / MCR / Plant / Switchyard	Yes		Yes	NVR based recording & data transmission

- xii. SCADA system Panel hardware shall be with Hot-Redundant CPU, Redundant Communication Module & cables and redundant Power Supply Module with necessary non redundant I/O modules i.e. Digital Inputs, Digital Output, and Analog Inputs hardwired modules. Each channel in each type of I/O modules shall be isolated. Minimum 5 % Spare each type I/Os shall be provided and the same shall be wired up to TBs. Time synchronization through Master Clock shall be provided for PLC /SCADA system. Alarm and hooter shall be provided with HMI.
- xiii. SCADA shall provide 15 minutes daily, monthly and annual average of following parameters:

- Exported Energy to grid at 66 kV
- Energy of each inverter
- Solar Radiation
- Temperature

- xiv. The SCADA server PC shall be of Industrial type, rugged & robust in nature to operate in a hostile environment. The PC should have minimum Intel Core i5 processor having 2 x 500 GB HDD with 8 GB RAM + 2GB RAM with Graphics Card. The PC shall also have 42" LED Color monitor, DVD Drive with Writer, USB drive, Scroll Mouse and UPS for 4 hours Power back up.
- xv. SCADA system shall be integrated for 12 MW (AC) Solar Project at Control Room.
- xvi. The PLC/SCADA system shall work satisfactorily without air conditioning in control room without affecting performance of the system.
- xvii. Spares and service support letter for SCADA system for 15 Years from date of COD shall be taken from OEM of SCADA system and shall be submitted to GGL.
- xviii. Minimum 2 (Two) nos. Operator cum Engineering stations with highest configuration i.e. 256 GB SSD, 2 X 4 TB HDD, 2 X 16 GB RAM, i9 processor or better & one dedicated laptop shall be supplied for SCADA System for 12 MW (AC) Solar Project. Laptop shall work as EWS. Laptop shall be with minimum 256 GB SSD & 2 TB HDD, 16 GB RAM, Processor- i7 or better with graphics card. Details of PC & Laptop configuration shall be submitted for approval.
- xix. Hard ware as well as software-based Fire wall shall be considered for providing data over internet for proper data security.
- xx. The SCADA system shall also have the capability of daily/monthly/yearly reports, trends, alarms, Time based & Event based Reports, events. The minimum data storage shall be of 3 years for SCADA System. Report shall be generated as per the Owner's requirement and also in the format i.e., Excel or PDF of text as per requirements.
- xxi. Contractor shall provide the licensed System software, PC Operating System and System specific software, if any. Minimum 5 % Spare points / tags shall be considered for future provision.
- xxii. All Key (s), passwords & License(s) shall be handed over to GGL.
- xxiii. PLC Supplier shall develop the Logics/Program, required logic modifications as per System / Plant and the Owner's requirement at site, without any cost implication to GGL.
- xxiv. The printer shall be of industrial type, rugged & robust in nature and of reputed make. The printer shall be equipped for printing, scanning, copying and fax.
- xxv. **String/MPPT Monitoring System:** String/MPPT Monitoring System designed exclusively for parallel connection of the photovoltaic field strings, allowing for protection in the case of breakdown & monitoring the entire photovoltaic field, by means of the following checks.
 - Reading the string currents

- Reading the total voltage of the field
 - Checking the fuses positioned in the system, to protect the photovoltaic panels.
 - Checking the state of the internal protection against over-voltages.
 - Should be very low power consumption.
- a. Monitoring of various parameters at string level should be made possible in the main control room at site by installing the suitable string monitoring system any fault at string level could be recognizable by that system.
 - b. A provision should be present for remote monitoring of the power plant at string detail over the web.
 - c. The Contractor shall provide to GGL the detailed specifications, and all administrative rights/ privileges/ passwords to the string monitoring system.
 - d. In addition to the string performance, various performance and operating parameters of the inverters, transformers and various switchyard equipment including power, energy, efficiency, outages, etc. shall be monitored and logged. Further, all necessary formulas shall be developed in logic like efficiency, performance ratio, expected generation etc.
 - e. For SJB data acquisition at PLC/SCADA system, maximum 10 SJBs shall be looped in one loop for SCADA system.
 - f. Individual and overall screen, 500V/600V minimum 2pair 0.5 Sq.mm armored cable shall be provided.
 - g. Fiber optical cables shall be provided based on layout for SCADA system. Minimum 2 spare core with termination shall be provided.
 - h. Fiber Optical cable shall be armored type. Ring / Star network shall be provided for SCADA system.

xxvi. **Weather Station and Data Logger**

- a. Contractor shall provide the data over remote webserver with rights to control or modify the same through appropriate arrangements.
- b. Contractor shall provide necessary licensed software and hardware solution to offer monitoring of electrical parameters of grid and solar generator monitored at individual string level over remote web server. The Contractor shall provide all necessary accessories like power supply, connection cords, sensors, active SIM card with appropriate data plan etc. so as to make the system complete in all respect.
- c. The cost of data plan during the project and O&M shall be borne by the Contractor. At the end of the O&M, the same shall be transferred to GGL at no extra cost.
- d. It shall also have local data logging and communication through Bluetooth / Wi Fi and Ethernet port.



- e. The Remote Monitoring System shall be capable of sustaining maximum – minimum temperature, rainfall, wind gusts and UV radiation. The enclosure shall be IP65 for outdoor installation / IP32 for indoor installation.
- f. The Remote Monitoring System shall have capability to log and send data from weather sensors.
- g. The data shall be available for every minimum 15 minutes interval.
- h. The system shall have sufficient internal memory storage to retain data for one complete year and shall have provision of expanding memory through external memory card / USB drive.
- i. The system shall be able to communicate wirelessly in a close proximity
- j. The Contractor shall provide to the Owner the detailed specifications, and all administrative rights/ privileges / passwords to the string monitoring system.
- k. The Contractor shall provide following measuring instruments with all necessary software & hardware compatible with the Data logging and web-based monitoring system.
 - **Pyranometer:** For 12 MW (AC) project, the Contractor shall provide total three nos. of pyranometers (Two nos. GHI and One no GTI / Plane Irradiance). The pyranometers shall have following specifications mentioned in Table 15

Table 15: Specification of Pyranometers

Sr.	Particulars	Specification
1	Class	Class A as per IEC 61724-1
2	Spectral Response	0.31 to 2.8 micron
3	Sensitivity	Approx. 9 micro - volt/w/m2
4	Time response (95%)	Max 15 sec.
5	Non linearity	±0.5%
6	Temperature Response	±2%
7	Temperature Response	Max ±2%
8	Tilt error	±0.5%.
9	Zero offset thermal radiation	±7 w/m2
10	Zero offset temperature change	±2 w/m2
11	Operating temperature range	- 40 deg. to +80 deg.
12	Uncertainty (95% confidence Level)	Hourly- Max-3%
13	Daily-	Max -2%
14	Non stability	Max ±0.8%
15	Resolution	Min + / - 1 W/m2

Sr.	Particulars	Specification
16	Input Power for Instrument & Peripherals	230 VACS (If required)
17	Output Signal	Analogue form which is compatible with the data

- **Temperature Sensor:** The Contractor shall provide suitable nos. of RTD type temperature sensors with required weather shield as per Indian Standards, so as to individually and simultaneously measure both, ambient temperature, and module temperature. To measure module temperature, the temperature sensors shall be located on the back of representative modules. Care must be taken to ensure that the temperature of the cell in front of the sensor is not substantially altered due to the presence of the sensor. Instrument shall have a range of -5°C to 60°C.
- **Anemometer and Wind Vane:** The Contractor shall provide double cup anemometer on tubular type made up of hot dipped Galvanized Iron. Velocity range up to 65 m/s, accuracy limit of 0.1 m/s. the anemometer shall have valid calibration certificates which should be produced during one month of the installation.
- Each instrument shall be supplied with necessary cables. Calibration certificate with calibration traceability to World Radiation Reference (WRR) or World Radiation Centre (WRC) shall be furnished along with the equipment. The signal cable length shall not exceed 20m. Bidder shall provide Instrument manual in hard and soft form.
- The data acquisition system shall measure, continuously record power at PV module ambient temperature near array field, cell temperature, wind velocity, AC and DC (string level) side power of each inverter, power characteristics of the HT side, fault messages, alarms etc. in Indian Standard Time.
- Reliable sensors for solar insolation, temperature & other weather & electrical parameters are to be supplied with data logger unit.
- All data shall be recorded chronologically date wise. The data file should be MS Excel compatible. The data logger shall have internal reliable battery backup and data storage capacity to record all sorts of data simultaneously round the clock. All data shall be stored in a common work sheet chronologically. Representation of monitored data in graphics mode or in tabulation form. All instantaneous data can be shown in the Computer Screen.



- Provision should be available for Remote Monitoring and Data Retrieval over web server. Moreover, Successful Bidder shall also provide minimum 3 (three) nos. Operator cum Engineering stations & one laptop with required hardware and licensed copies of software to make it fully functional for normal operation and data logging through Bluetooth / Wi Fi / RS port from the site.
- The Bill of Materials associated with the equipment must clearly indicate especially the details about the PC and other accessories.
- The Data Acquisition System should be housed in appropriate enclosure to sustain outdoor environment as per generation design guidelines laid for enclosures. The same shall have provision of locking the same to prevent unauthorized operation. Remote Monitoring System (RMS) shall provide following data at a 15-minute interval.
 - Power, Current and Voltage at individual solar PV strings (Instantaneous)
 - Ambient temperature near array field, cell temperature measured at module front and back surface
 - Wind Speed
 - Cumulative AC and DC side Power of each inverter
 - Cumulative AC and DC energy of each inverter
- l. Solar irradiation/isolation over horizontal and in-plane of the module
- m. Voltage, frequency and other important electrical parameters etc. in the local grid.
- n. Any other parameter considered necessary by supplier based on current prudent practice
- o. RMS shall have feature to be integrated with the local system as well remotely via the web using either a standard modem or a GSM/WIFI modem. The Bidder shall provide compatible software and hardware so that data can be transmitted via Standard modem.
- p. RMS shall be provided with independent solar PV based power supply along with maintenance free battery having 3 days autonomy.
- q. The RMS shall be compatible to the requirements for measuring and reporting the performance ratio of the power plant.
- r. The contractor shall provide all administrative rights/ privileges/ passwords of the RMS system to GGL.
- s. The Bidder shall submit the data sheet with technical specifications of the RMS system in the Bid.

4.26 Management Information System (MIS) for 12 MW (AC) Project:

- i. Web based monitoring shall be machine independent. The web-based monitoring shall provide same screen as available in the plant. All reports shall also be downloaded from remote web client in PDF / Excel format.
- ii. The Bidder shall provide web based Real Time Remote monitoring system such that the data from 12 MW project shall be available to remote location(s) for viewing data by GGL officials at GGL Offices in existing PCs and also outside the offices and to other Government agencies through internet/web-based link for real time monitoring of complete system.
- iii. Complete 12 MW Plant data shall be available to remote locations.
- iv. Minimum 4 Nos. of concurrent remote logins/user are envisaged for web-based monitoring/view. Remote monitoring data for MIS shall be viewed at existing the Owner's PC / mobile. Separate PC / work station for MIS System is not envisaged. All data shall be accessible through internet with password protected login. Further, facility shall be provided for data view from mobile devices also. Samsung make SIM Card supported Tab / pad with for remote monitoring of solar plant to be provided by bidder.

4.27 Testing Instrument for Electrical & Electronic:

The Contractor shall also provide required set of onsite testing instruments/equipment viz. earth resistance tester, insulation tester, millimetres, clamp meters, Transformer oil BDV kit, infra-red thermal imaging hand held temperature meter, etc.

4.28 Electronic LED Display Board:

The Contractor shall provide an electronic LED Display board that can display the Solar PV plant parameters like total generation till date, daily generation, instantaneous generation, instantaneous frequency, etc. The LED display board has to be erected at a height of 8 feet above ground level and should be large enough to be read from a distance. The LED display board is to be placed between the Control Room and the main gate, the exact location of which will be provided by the Owner/ Consultant after award of the project.

Pixel pitch	16.0 mm
Brightness	6,500 nits
LED configuration	DIP / Equivalent
Pixel density	3,906/sqm 363/sqft
Viewing angle	H: 140 degrees V: -45/+15 degrees

Contrast ratio	2,000:1
Lifetime	80,000 hrs.
Power consumption	Typical: 220W/sqm; 20W/sqft Max: 480W/sqm; 45W/sqft
Processing	16 bit/color
Refresh rate	4,800 Hz
Operating temperature	-20/+50 degrees Celsius; -4/+122 degrees Fahrenheit
IP rating	IP 65/54
Tile size (WxHxD) in mm	1,024 x 1,024 x 212 mm / 40.3 x 40.3 x 8.3 inches
Serviceability	Front or back
Certifications	CE, UL/ETL, FCC, CB/CEBEC, TUV GS, CCC, RoHS, WEEE

4.29 **CCTV Camera System:**

The Contractor shall provide IP Based CCTV Camera for the Monitoring of Control Room, Plant Perimeter, Boundary, Entry & Exit Gates complete in all respect including necessary Camera, NVR, Switch, Active & Passive Components, Software, minimum 43" inch monitor etc. For the capacity of 12 MW land parcel, minimum 40 Nos. of CCTV Camera of various Indoor / Outdoor with Night Vision Camera to install at Project Site or as per actual site condition to cover the entire area prior approval of GGL/GGLs consultant needed in this regard. Min.

2 Nos. of PTZ camera shall be provided around the Main Control Room with min. height of 12 Meters.



i. **Camera Specification (Outdoor):**



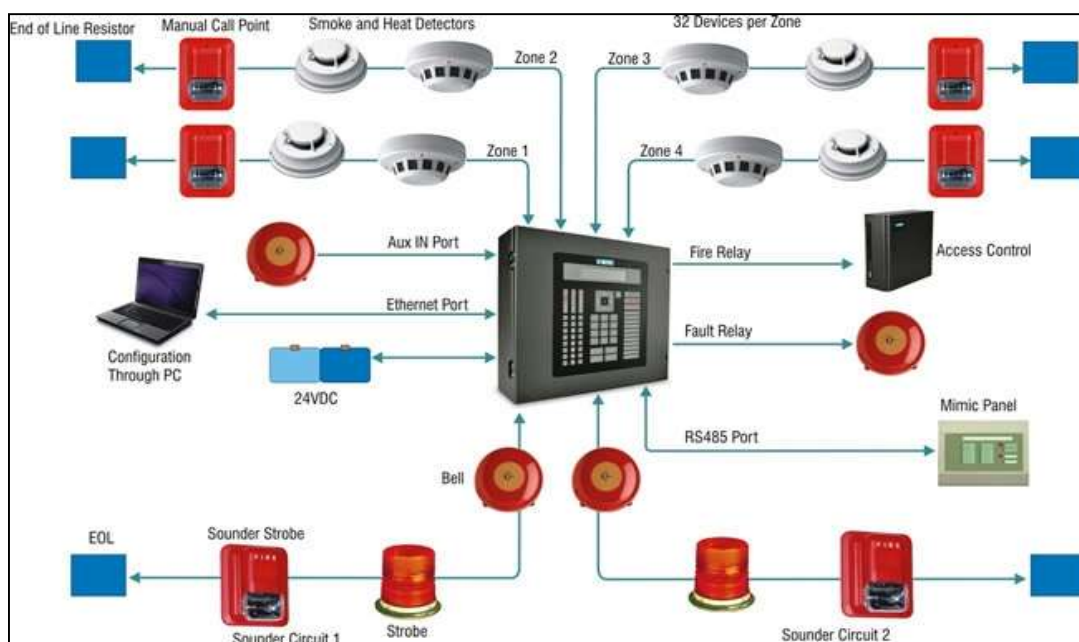
1/3" CMOS HD sensor, Out Door Bullet H.264 Compression, 2 mega Pixels CMOS, 3DNR, The highest resolution can be up to 1920×1080 Low Lux, DWDR, Support Voice talk, 1CH Audio in/1CH Audio Out, Mobile P2P Viewing, Support Protocol: TCP, UDP, IP, HTTP, FTP, SMTP, DHCP, DNS, ARP, ICMP, POP3, NTP and RTSP, Support ONVIF 2.0, Lens : 2.8-12mm Megapixel lens (4-9mm lens optional), IR Distance: 20-30m, POE (802.3af). Support ROI function, Built-in Micro SD/SDHC/SDXC card slot, Ingress Protection level: IP66, Video Bit Rate 32 Kbps – 8 Mbps, Audio Compression G.711/G.722.1/G.726/MP2L2, Dual Stream, BLC, ROI STANDARD: ONVIF, PSIA, CGI, ISAPI, Operating Conditions -30°C – -60°C (-22°F – -140°F).

ii. **Camera Specification (Indoor):**

1/3" CMOS HD sensor, Indoor Dome fix Lens H.264 Compression, 1.3 mega Pixels CMOS, 3DNR, The highest resolution can be up to 1280×960 , Shutter Speed: $1/3$ s to $1/100,000$ s, Min. Illumination: 0.01Lux @ ($F1.2$, AGC ON), 0Lux with IR 0.028Lux @ ($F2.0$, AGC ON), 0Lux with IR, Video Bit Rate 32 Kbps – 8 Mbps, Support Protocol: TCP, UDP, IP, HTTP, FTP, SMTP, DHCP, DNS, ARP, ICMP, POP3, NTP and RTSP, Support ONVIF 2.0, Lens : 3.6mm 1.3Mega Pixel Lens SD, 3DNR, D-WDR, Motion Detection, Privacy Mask, 24pcs LED, 20m IR distance, POE(802.3af), Support Dual stream, Impact protection : IK10, operating condition, Support ROI, BLC, Standard : ONVIF, PSIA, CGI, ISAPI, Image Settings: Rotate mode, Saturation, Brightness, Contrast adjustable by client software or web browser, H.264 Type: Baseline Profile / Main Profile.

4.30 **Fire Alarm System**

The contractor shall provide Fire Alarm System for LCT, MCR & Control Room as per local CFO's guideline.



- i. **Fire Alarm Panel:** Integrated Fire Detection, Alarm and Control System with Voice Evacuation (EVAC) of UL listed Microprocessor based networkable analogue addressable Main Fire Alarm Control having

required loop capacity, each loop having capacity of appropriate addressable detectors and addressable devices. Panel capacity can be expanded to additional loops by addition of modules or integrating multiple panels. Panel costs to include power supply, 24VDC power supply automatic battery charger, 24 volts sealed lead acid batteries sufficient for 24 hours normal working and then be capable of operating the system for 2 hours during emergency conditions. The system should be complete with user-friendly programming and configuration tools, front panel operating with a full QWERTY keypad and alphanumeric 640-character LCD display. The Panel as well as detectors and devices shall be UL 9th edition Approved/Listed and in conformance with international standards such as NFPA 72 2010 edition National Fire Alarm and Signaling Code for Human Life Safety. The complete system as a solution must be supplied from the same make/OEM manufacturer components conforming to these standards. The panel shall have the capability to integrate with SCADA on open protocol.

- ii. **Smoke Detector:** Analog Addressable Multi-Criteria Sensing Type Detector or Heat Detector as per application must be with mounting based LED, Address Switch inclusive of detector base and complete as required. All Detectors must be UL Listed & FM Approved.
- iii. **Sounder:** UL Listed Directional Sounders with 20 hz to 20 khz operating frequency with minimum 8 distinct sound patterns to indicate corridors, exit doors, move upward, move down ward etc. to direct Occupants for fast & safe Evacuation as specified in NFPA 72 - 2007 edition complete as per all requirements of technical specifications & contracts works.
- iv. **Manual Call Point / Glass Break Device:** UL listed, Flush or surface mounted Manual Call Point in manufacturers prescribed matching red enamel outlet box complete. All components must be of same manufacturing origin.
- v. **Monitor, Control Modules & Fault Isolators:** UL listed, modules complete with mounting arrangement on North American junction box as per requirements of contract works.

4.31 Fire Extinguishing System

- i. The installation shall meet all applicable statutory requirements, safety regulations in terms of fire protection.
- ii. Liquefied CO2 fire extinguisher shall be upright type of capacity 9 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 portable fire extinguisher as given below:
- iii. Fire extinguishers shall be required for conference cum control room as per CEA and safety guidelines required numbers of fire extinguisher shall be kept at switchyard and control room. For outdoor installations type AB fire extinguishers can be used and for all indoor applications type ABC fire extinguishers shall be used.



- iv. Sand buckets should be wall mounted made from at least 24 SWG sheet with bracket fixing on wall conforming to IS 2546.
- v. The Contractor shall provide at each location (Control Room cum Conference Room, Switchgear Room, Transformer Yard, Substation and other relevant areas) one number each of DCP Type (9 Kg), Foam Type (9 Kg) and CO₂ Type (9 Kg) fire extinguishers in accordance with applicable safety regulations, and shall further provide any additional fire extinguishers as may be required by statutory provisions or site safety regulations.

Note: The Contractor shall be responsible for ensuring all compliance with all applicable fire safety norms of Gujarat State or any other statutory approvals and for obtaining necessary approvals for the entire plant, including all equipment and buildings, from the respective statutory authorities.

4.32 Clean up of Work Site

After completion of all works, the Contractor shall have to demobilize all the equipment's, machinery and materials from plant premises. The Contractor shall have to clean the entire area by removing all unwanted construction and electrical materials, unwanted temporary structures, debris, excess earth, all type of scrape, wastage and unwanted materials from plant premises as directed by the Owner.

--- End of Section---

5. INTENT OF LAND ON LEASE:

The purpose of Intent is to acquire or take land on long term lease (27 years) for setting up Solar Project.

5.1 Criteria for Selection of Land:

The following criteria, with or without modifications, shall be adopted for selecting the site(s)/location(s) for further negotiations for purchase of land:

- i. **The Location:** Within periphery of 4 kms from the GETCO substation in any of the districts, preferably, Banaskantha, Patan, Sabarkantha, Surendranagar, Kutch districts in the state of Gujarat. Due weightage shall be given to the sites with high solar radiation. Rate quoted by EPC contractor shall include charges of ROW for HT/LT line power evacuation infrastructure for 27 years. Charges of ROW shall not be claimed by EPC contractor separately to GGL.
- ii. **Size of the Land:** About Approx. 60-65 acres (Land requirement May Vary Based on the module wattage offered by EPC Contractor). All Survey Numbers shall be adjoining each other and preferably land shall be in single piece. (Offered land shall not be Gaucher, Gam tal and simtal).
- iii. **Current land Status:** The land use of the offered land shall not be either agricultural or forest land. The land should be Free Hold/ NA and legally fit for use for Institutional activities including Solar Project. If Agriculture land is offered, then responsibility of conversion to non-Agriculture shall be in the scope of EPC contractor. GGL will give maximum 2 months' time for conversion of Agriculture land to non-Agriculture and transfer with clear title in all respect from date of Lease Agreement in the name of GGL for 27 years of lease. For entire lease period lease amount (as per agreement) to be paid by GGL to EPC contractor. EPC contractor has to prepare/offer agreement such that GGL does not have to face any issue related to land lease and renewal of land lease during entire period of land lease i.e., 27 years. In the lease agreement all terms related to transfer of land on lease to GGL, renewal of land lease agreement at regular interval as per statutory requirement if any, long term lease agreement up to 27 years, renewal of land lease amount after agreed period, undertaking of providing land on lease to GGL up to 27 years by EPC contractor, and taxes & duties on land use during lease period shall be payable by EPC contractor. The stamp duty and registration charges payable on the Instrument of Transfer / Transfer Deed / Deed of Conveyance and any other documents towards the Long-Term lease of plot of land shall be borne by EPC contractor. However, preference shall be given to Freehold/ NA land suitable for Solar Project/ Industrial use.
- iv. **Accessibility:** The location of site offered should draw its access from road.
- v. **Shape:** The shape of the land should be preferably square. Narrow /uneven strip of land will not be given preference.
- vi. **Topography:** It should be preferably even land other than Low-lying with water bodies/ hillocks.
- vii. **Infrastructure:** The availability of Basic Infrastructure, i.e., Water supply, from nearby water canal shall be given preference.



- viii. **Existence of permanent structures:** There should be no such permanent structures like HT Transmission towers, mobile towers etc on the land offered for sale.
- ix. **Type of land:** Status of land whether Freehold or Agriculture, Lease hold, Industrial etc. Transfer of land shall be preferably under section as Per Appropriate govt laws and regulation.
- x. GGL reserves the right to have negotiations with any or all, accept or reject any or all the Tender or annul this process at any time without assigning any reason whatsoever.
- xi. The applicants/ bidders may submit a brief write-up in support of their offers along with the Tender on the above lines

NOTE: The Contractor shall arrange land on lease for the project for a period of 27 (twenty-seven) years from the date of commencement of the lease agreement, on terms and conditions acceptable to the GGL. The lease shall be valid for the entire operational life of the solar plant and shall be free from any encumbrances or legal disputes for the duration of the lease period.

5.2 General Terms & Conditions

Procedure for Selection of Land

- i. GGL shall open & scrutinize the details submitted by the intending Developers/Land owners taking into consideration the selection criterion.
- ii. The application(s) not accompanied by the documents as per the Document Checklist of ITB, is/are liable to be rejected.
- iii. GGL is not bound to give reasons for rejection of proposed land.
- iv. The decision of GGL in this matter shall be final & binding on the applicant.
- v. GGL shall issue LOI in the name of EPC contractor on approval of proposal by GGL Management.
- vi. GGL shall enter into an Agreement to long term lease on receipt of clear due diligence report and settlement of all terms & conditions.
- vii. Subsequently a sale deed/ lease deed shall be executed on fulfillment of other conditions of the Agreement to long term lease. The Contractor shall ensure that the lease deed is not terminated by the lessor/land owner for any reason during the validity of the full term of 27 years, except in the case any instance of non-payment of due and payable lease rental by GGL not remedied within the available cure period
- viii. Final measurement of area shall be done by DLR or Govt. Authorized Surveyor and same shall be acceptable to all the parties. Payment shall be made based on above certified measurement only.
- ix. The stamp duty and registration charges payable on the Instrument of Transfer / Transfer Deed / Deed of Conveyance and any other documents towards the Long-Term lease of plot of land shall be borne by EPC contractor.



- x. All the pending dues of offered land prior to purchase/ Long Term Lease will be borne by the EPC contractor GGL may prefer/select/accept the proposal for any land in single to suit total requirement based on its own internal assessment. It will be entirely GGL's prerogative to access the land suitability from overall project feasibility aspects and its associated risk with respect to Solar Radiation, power evacuation, genuineness of proposal, likely issues of ROW etc. during Project execution phase, expected time for obtaining clearances etc. to complete the project in stipulated time frame. GGL's decision in this regard shall be final and binding to all the bidders. Further GGL will not be under any obligation to disclose, intimate or justify its selection of land or any other matter submitted / received.
- xi. In the case of long-term lease, land will be returned to the EPC Contractor/ Legal heirs at the end of 27 years in the same situation of the land at that time after removing necessary electrical, mechanical & Solar equipment above the ground in case lease is not extended beyond 27 years
- xii. GGL is free to take legal action upon Breach of terms and conditions of lease agreement by EPC contractor.

If the breach of lease agreement by EPC contractor in between of the lease tenure of 27 years, GGL has right to recover the total project investment cost including EPC cost, land lease cost, administrative cost of GGL, taxes and duties paid, loss of revenue for balance lease period and any other losses which is not mentioned in tender but actual incurred along with interest prevailing at that time from the submitted bank guarantees and balance amount shall be recovered by available other modes.

5.3 Terms & Conditions of Payment

- i. Quarterly payment of the lease amount (lease amount as per agreement) will be released, On compliance of all other terms & conditions of this document.
- ii. Applicable Stamp duties/ Registration charges shall be paid by EPC Contractor during transfer of land to GGL

GGL shall make payment of total consideration as per above mentioned stages subject to applicable tax deducted at source and GGL will issue TDS certificate within a reasonable time.

- a. GGL shall release payment by Cheque/RTGS, directly to the EPC contractor.
- b. GGL will not pay any brokerage to any person/Agent/Real Estate consultant for the proposed transaction/deal.
- c. The EPC contractor shall provide the dimensional plan of the site showing/duly marked the permanent structures with dimensions, HT/LT lines sectoral /other roads etc.
- d. In case the land parcel is not fenced, the EPC contractor shall fix the demarcation pillars of at least 2 feet height above ground level at the interval of 300 feet centre to centre along the



- boundary for only identification of land parcel. The cost of the fencing/ fixing of pillars will be borne by the EPC contractor.
- e. The EPC contractor (s) shall obtain requisite permission from the respective local bodies of the state in respect of transfer of land/license in favor of GGL before signing of Agreement to Sell/lease, if applicable.
 - f. The Agreement to lease shall be signed only if the due diligence report is positive or on compliance of the anomalies, if any, to the satisfaction of the law firm appointed by GGL.
 - g. EPC contractor shall irrevocably and exclusively grant and transfer to GGL all the Development Rights in respect of Project.
 - h. GGL shall not be under any obligation for providing direct or indirect employment to the EPC Contractor/ land owner, who leased the land to GGL, including their family members at any time.

5.4 Arbitration:

In case of any dispute or difference arising in relation to meaning or interpretation or arising out of this order/tender, the authorized official/representative of the GGL and the Contractor will resolve the disputes/ differences amicably through for mutual consultation process and in a time bound manner. In case the said dispute/difference is not resolved, the same shall be referred to arbitral tribunal consisting of sole arbitrator who shall be jointly appointed by the parties in writing. The provisions of the Arbitration and Conciliation Act, 1996 will be applicable to the arbitration proceedings. The arbitral proceedings shall be conducted in English language and seat, and venue of the arbitration shall be at Gandhinagar. The cost of the Arbitration proceedings shall be shared equally by both the parties. The decision / award of the arbitrator shall be final and binding.

Notwithstanding anything contained herein, the Contractor agrees that the subsistence of any dispute/difference or ongoing arbitration shall not affect the execution of the Project and the Contractor shall not be relieved of its obligation to timely execute the Project in its entirety.

--- End of Section---

6. VENDOR LIST

The list of acceptable makes for equipment / system are as listed below:

Sr.	Description	Vendor Name
1	PCU / Inverter	ABB-Fimer, SMA, DELTA/Hitachi
		GoodWe, HUAWEI, SUNGROW
		SOLAREEDGE, Havells, Polycab, Solis, Sofar
2	PV Modules	As per ALMM List published by MNRE Time to time.
3	HT Panel /HT Breaker (OEM or Authorized System House of OEM)	Siemens
		L & T
		ABB
		CGL
4	Control and relay panel (OEM or Authorized System House of OEM)	ABB
		L & T
		Siemens
		CTR
		Popular Switchgear
5	LT Switchgear component (LT switchgear panel shall be CPRI approved vendor) (OEM or Authorized System House of OEM)	L & T
		Siemens
		ABB
		Schneider
6	Power Transformer	Voltamp
		T&R
		Areva
		CGL
		Atlanta
		Electrotherm
		ABB
		BHEL
7	Inverter Transformer	Electrotherm
		Areva
		Atlanta
		Voltamp
		ABB
		CGL



Sr.	Description	Vendor Name
		T & R
8	Auxiliary Transformer (Dry Type)	Voltamp
		Kotson
		Expert Engineers
		Electrotherm
		T&R
		Danish
		Melcon
9	Solar Cable and DC Cable (UV Protected)	M/s LAPP
		M/s Siechem
		M/s KEI
		M/s Avocab
		M/s Apar
		M/s Polycab
10	AC Cable (Up to 66 kV)	M/s LAPP
		M/s Torrent
		M/s Gloster
		M/s Avocab
		M/s Polycab
		M/s Apar
		M/s KEI
		M/s Havells
		M/s Universal
		M/s CCI/Finolex
11	HT termination kits	Raychem
		3M
12	Optical Fiber Cable	Finolex
		Havells
		D-Link
13	Earthing Pit Materials	Ashlok
		ERICO
		Powertrac
14	SJB	M/s Hensel Electric Pvt Ltd
		M/s Trinity Solar



Sr.	Description	Vendor Name
		M/s Statcon
		M/s Eaton
		M/s ABB
15	Lugs	Dowell
		Comet
		3D
16	Cable Glands	Comet / 3D
17	SCADA System	M/s Rockwell
		M/s Siemens
		M/s ABB
		M/s Schneider
18	Weather Sensors	a. Pyranometer: i) Keep & Zonen ii) Ingenieurbüro Mencke & Tegtmeier GmbH b. Wind Sensor: ADOLF THIES GmbH & Co c. Temperature Measurement: i) Met One Inc ii) Climatronics d. Wind Speed & direction: i) Met One Inc e. Tripod Stand: i) Met One Inc ii) Climatronics For other reputed make – GGL EIC approval is required.
19	Batteries	Exide, Luminous, Vguard, Amaron
20	UPS	Hitachi HI-REL
		Fuji
		Eaton
		Emerson
21	Battery Charger	M/s Chhabi Electrical
		M/s. Caldyne
		M/s. HBL Niap power system Ltd
		M/s Servilink
22	Lightning Arrestor (ESE type)	Erico
		Nimbus
		Hex
		Ingesco
		Indelec
23	ABT Energy Meter (subject to approval of GETCO / GUVNL)	SECURE
		L&T



Sr.	Description	Vendor Name
24	HT Isolator (Upto 66 kV Outdoor Type)	As per GETCO's approved Vendors
25	HT CT & PT (Upto 66 kV Oil Filled Type)	As per GETCO's approved Vendors
26	LA (Up to 66 kV Outdoor Type)	As per GETCO's approved Vendors
27	66kV Cable (Subject to approval of GETCO)	As per GETCO's approved Vendors
28	Disc and post insulator	As per GETCO's approved Vendors
29	GI structure for the switchyard	Sujana Towers
		Kalpataru Power transmission
		OR Any other Approved vendors of GETCO
30	Insulator hardware	3M
		IT IPL
		Approved vendors of GETCO
31	Clamps and connectors	Klemenn engineering corporation
		Approved vendors of GETCO
32	Numerical Relay	Siemens
		Areva
33	Switch fuse unit	Siemens
		L & T
34	PLCC equipment's	ABB
35	Lighting fixture / system	Philips /Bajaj/Havells
36	CSS (Compact Sub-station) (OEM or Authorized System House of OEM)	ABB
		CGL
		Siemens
		Alstom
		Schneider
37	LED Chips	Philips
		GREE
		Nishia
38	MCCB	SIEMENS
		ABB



Sr.	Description	Vendor Name
		Schneider
		L & T
39	RMU (Ring Main Unit) (OEM or Authorized System House of OEM)	ABB
		Schneider
		Siemens
		CGL
		L & T
40	Steel Structure for MMS	TISCO
		SAIL
		JINDAL
		RINL
		ESSAR
41	Submersible/Sump Pump	Kirloskar
		Lubi Pumps
		CGL
		CRI
		Jyoti
42	CCTV Camera & Monitoring System	Sony /Honeywell/Milestone or approved by GGL

NOTES:

- (1) The final make selected out of the recommended makes listed above shall be subject to the Owner's approval during detailed Engineering.
- (2) Wherever the make is not specified for any other items, the contractor shall submit credential for vendors for relevant items / equipment's, out of which Owner shall decide acceptance of vendor based on review of credentials. This shall have no price implication. Owner reserves the right to reject the proposed vendor without assigning any reason.
- (3) Bidder may suggest /request for approval of Additional vendor with credentials and details for review and approval of Owner. Owner may consider the request in case proposed additional vendor is reputed and meeting the tender specification requirements. Owner reserves the right to reject the proposed vendor without assigning any reason.
- (4) For SCADA system common make of PLC / SCADA system is envisaged for GGL 12 MW.

Mandatory Spares List for 12 MW (AC)

Sr.	Description	Quantity
PV Module		
1	SPV Module	500 Nos.
2	Connector Set	1000 Nos.
Cable		
	DC Cable	2000 Meter
	AC Cable LT and HT each type	750 Meter
	HT& LT Cable Jointing Kit each type	10 Nos.
PCU		
1	Complete inverter (String Inverter)	5 Nos.
INVERTER TRANSFORMER & POWER TRANSFORMER		
1	Buchholz relay	1 Set
2	OTI & WTI complete	1 Set.
3	MOG	1 Set.
4	Valve (each type)	1 No.
5	Silica gel breather	1 Set.
6	Bushing & Support insulator (each type)	1 No.
7	Pressure relief device	1 Set.
Structure		
1	Complete Structure assembly for One Array / String	1 Set
AC / DC Distribution Boards		
1	Indicating Lamps of each type used	06 Nos.
2	Contactor of each type used	03 Nos.
3	Relay of each type used	01 No.
4	Indicating instruments of each type used	01 No.
5	Circuit Breaker of each type used	01 No.
Battery Charger		
1	Indicating instruments of each type used	03 Nos.
2	Shunt Resistor of each type used	03 Nos.
3	Complete Thyristor Bridge/Module of each type used	06 Nos.
4	Printed Circuit Cards of each type used	03 Nos.
5	Semi Conducting Type Fast Fuse of each type	09 Nos.
6	Auxiliary Fuse of each type used	07 Nos.
7	Auto Transformer of each type used	01 No.



Sr.	Description	Quantity
8	Control transformers of each type and rating	01 No.
DC Inverter /UPS		
1	Circuit Breaker of each type used	03 Nos.
2	Complete Thyristor Bridge/Module	03 Nos.
3	Printed Circuit Cards – Inverter Control Card and Data Logger Card	03 Nos.
4	Cooling Fan	03 Nos.
HT Panel		
1	Protection relays of each type used	01 No.
2	Test plugs	01 No.
3	Auxiliary relays of each type used	07 Nos.
4	Circuit breaker trip and closing coils each type	03 Nos.
5	Breaker Position Switch each type and rating	03 Nos
LT Panel / switchgear		
1	MCCB	01 No.
2	Current transformer each used type	01 No.
3	Coils for tripping and closing	03 Nos
4	Breaker Position Switch each type and rating	03 Nos
66 kV Switchyard		
1	Surge arrester for 66 KV	3 Nos.
2	Disc Insulators string 66 kV (Each type)	3 Sets
3	Conductor of each type used each type	75 mtr
4	Stringing hardware	01 Set
5	Terminal Connectors on high voltage conductors and equipment's each type	01 Set
6	Complete drive mechanism including motor for disconnect switches	01 No.
7	Trip coils for circuit breakers	01 No.
8	Closing coils for circuit breakers	01 No.
9	Complete set of rupture disc	1 Sets
10	66kV Current transformer of each rating	02 Nos.
11	66kV Voltage transformer of each rating	1 Nos.
12	66kV Post insulator	01 Set
13	66kV Isolator contacts set (Male+Female)	01 Set



Sr.	Description	Quantity
14	Maintenance earthing rod for 66kV	01 Set
15	Breaker operating mechanism	01 Set
16	SF6 bottle (To fill SF6 in one complete Circuit breaker)	01 No.
17	Contactors and relays of each type and rating used in circuit breaker and isolator control cubicle / Mechanism box	01 set.
18	Limit switch for the isolator	01 Set
19	66kV Earth switch contact assy.	01 Set (For three pole)
SCADA System		
1	Each type of electronic module including CPU	1 No. each type
2	Any type of converter like RS 485 to Ethernet, Serial link converter, MODBUS converter etc	1 No. each type
3	Network Switch	1 No each type
4	Any other recommended spares by OEM List shall be submitted	

Notes:

- (1) The suggested spares are the minimum requirement of GGL. The EPC Contractor shall ensure sufficient spares beyond the suggested spares list to maintain its contractual obligations.
- (2) Bidder shall furnish recommended spare list as a part of design/drawing approval stage.
- (3) Wherever % indicated in Mandatory spares list, Total installed quantity of each type shall be considered for calculation of % of spare of each type.
- (4) For rounding of upper side number shall be considered for quantity of item.
- (5) All the mandatory spares may be kept at site with record of use by Contractor during O&M. Used items shall be replenished by Contractor time to time. All mandatory spares items shall be handed over to GGL after completion of O&M period.

--- End of Section---

7. OPERATION AND MAINTENANCE (O&M)

7.1 Operation & Maintenance period

The Operation & Maintenance period shall be as mentioned in NIT (i.e. 10 Years). The start of O&M and first year operation shall be considered after successful completion of Operation Acceptance Test (OAT).

7.2 Guideline for Operation and Maintenance (O&M) after O&M Period:

O&M Contract shall cover complete Solar PV Power plant and power evacuation system up to GETCO S/S connection point as specified in the Tender. The Contractor shall Comply NEEGG in respective O&M year.

Further, it is the responsibility of the Contractor to liaison with the following authorities:

- a. Liaison with Central Electricity Authority.
- b. Liaison with State Renewable Agency.
- c. Any other department / agency as may be required.
- d. GGL shall provide required documents.

i. **O&M of the Solar PV Power Plant**

Comprehensive operation & maintenance of the Solar PV plant including supply of spare parts, consumables, repairs/replacement of any defective equipment etc. shall be performed by the Contractor for a period of 10 (Ten) years. During O&M period, employer personnel shall have unrestricted entry to the solar plant at any time. GGL may depute its personals to associate with O&M activities. The Contractor shall assist them in developing expertise through their day-to-day O&M activities and all records of maintenance must be maintained by the contractor which can be accessed by employer on demand. These recordings are to be handed over to employer after the O&M period of contract. During the O&M period, the Contactor shall be responsible for any defect in the work due to faulty workmanship or due to use of substandard material in the work. Any defects in the work during the warrantee period shall there be rectified/replaced by the contractor without any extra cost to the employer within a reasonable time as may be considered from the date of receipt of such intimation from employer failing which employer shall take up rectification work at the risk and cost of contractor. The Contractor shall be responsible for supply of all spare parts, repairs / replacement of any defective equipment(s) including civil works at his own cost as required from time to time during the O&M period. During O & M period the Contractor shall be responsible for all the activities required for the successful running, optimum energy generation etc. This shall include but not necessarily be limited to following:

- a. Deputation of adequate number of O&M, engineering and supporting personnel, security etc.
- b. The Contractor shall deploy, as a minimum, 1 Site In-Charge (Day Shift only) (Degree or Diploma with 8 Years Experience), 1 Engineer day shift (Diploma with 5 Years Experience), 2 Technicians round the

clock (Diploma with 2 Years Experience), and 5 Security Personnel round the clock, Contractor may increase the manpower as required to meet site conditions or as per owner requisite.

- c. Operation part consists of deputing necessary manpower necessary to operate the Solar Photovoltaic Power Plant at the optimum capacity. Operation procedures such as preparation to start, routine operations with safety precautions, monitoring of Solar Power Plant etc. shall be carried out as per the manufacturer's instructions to have trouble free operation of the complete system.
- d. The Contractor shall demonstrate guaranteed generation as quoted in respective O&M year. In case the contractor fails to achieve the guaranteed generation, then penalties shall be recovered as defined in this Tender.
- e. Reporting the energy generation data to GGL.
- f. Monitoring, controlling, troubleshooting, maintaining records, registers etc.
- g. Recording/logging of all the operational parameters (e.g. voltage, current, power factor, energy output, temperature etc.) and preparation of daily/weekly/monthly reports etc. including submission of periodical consolidate plant performance reports to the Owner / GGL.
- h. Conducting periodical checking, testing, over hauling and preventive action of all equipment in systematic method including regular cleaning of PV modules of the solar PV plant as per OEM guidelines.
- i. The Contractor shall carry out the periodical/plant maintenance as given in the manufacturer's service manual and requirement.
- j. Cleaning include cutting/removing of bushes/vegetation & anti-weeding treatment etc. of the complete plant on regular basis and as and when required.
- k. Particular care shall be taken for outdoor equipment to prevent corrosion. Cleaning of the junction boxes, cable joints, insulators etc. shall also be carried out at every month interval.
- l. Resistance of the earthing system as well as individual earthing is to be measured and recorded every month. If the earth resistance is more than 3-ohm, suitable action is to be taken to bring down the same.
- m. According to the recommendations stock of special tools and tackles shall be maintained for Modules, PCU's and other major electrical equipment.
- n. Breakdown / Corrective Maintenance: Whenever a fault has occurred, the contractor has to attend to rectify the fault & the fault must be rectified at the earliest time from the time of occurrence of fault.
- o. A maintenance record is to be maintained by the contractor to record the regular maintenance work carried out as well as any breakdown maintenance along with the date of maintenance reasons for the breakdown's steps have taken to attend the breakdown duration of the breakdown etc.



- p. The Schedules will be drawn such that some of the jobs other than breakdown, which may require comparatively long stoppage of the Power Plant, shall be carried out preferably during the non-sun period.
- q. The Contractor shall ensure that all safety measures are taken at the site to avoid accidents to his employees or his co-contractor's employees as per prevailing safety rules.
- r. In order to ensure longevity, safety of the core equipment and optimum performance of the system the contractor should use only genuine spares of high-quality standards.
- s. Supply of all spares, consumables and fixing / installation of the same including proper storage of tool, tackles & spares.
- t. The Contractor shall at his own expense provide all amenities to his workmen as per applicable laws and rules.
- u. The Contractor shall immediately report the accidents, if any, to the Engineer-In-charge & to all the concerned authorities as per prevailing laws of the state.
- v. The Contractor shall comply with the provision of all relevant Acts of Central or State Governments including payment of Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938, Workmen's Compensation Act 1923, Industrial Dispute Act 1947, Maturity Benefit Act 1961, Employees State Insurance Act 1948, Contract Labour (Regulations & Abolishment) Act 1970 or any modification thereof or any other law relating where to and rules made there under from time to time.
- w. Coordinating, on behalf of GGL, and obtaining renewal of statutory licenses, clearances and approvals from state departments such as GEDA/ CEA etc.
- x. Contractor shall keep updating the spares inventory at the site every time there is consumption of spare items towards replacement.
- y. Coordinating with sub-station upon grid failures, line problems etc. and implementing the needful steps to restore the plant to normal operation
- z. Theft incidents: immediate reporting to GGL, filing FIRs with police stations on behalf of GGL, coordination for site inspection by insurance companies and clearance of insurance claims, logging of events (date, time) and maintaining records
- aa. Proper housekeeping shall be maintained during O&M period by the Contractor.

All the civil defects, rectification, repairing, replacement related to civil works shall be in the scope of the 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:

- a. Buildings, Underground Water Tank includes:

- Water tightness of roof and walls.
- Painting to the structure PEB/ RCC Framed structure at regular interval (not more than three years). Painting of building every 02 years.
- Plumbing & Sanitation related defects/replacement.
- Chalking / overflow of septic tank and soak pit.
- Replacement / repairing of water tank if major/minor leakage observed.
- Leakage of water to be attended by suitable crack filler.
- Repairing/replacement of doors, windows, ventilators & rolling shutter.

b. Storm Water Drainage:

- Before and after the monsoon season the storm, water drainage shall be maintained & cleaned for smoother flow of storm water.

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 is including supply of all required materials, mobilization of labour, and arrangement of required tools tackles and equipment to carry out all above civil maintenance works.

ii. **Handing Over the Facilities**

After expiry of O&M period, the Contractor shall hand over the Facilities to Employer in good operating condition along with requisite tools & tackles and spares etc. The Contractor shall demonstrate functional operations of all the major & critical Plant & Equipment. The spare if consumed during O&M period then same shall be replenished at the time of handing over of facilities.

--- End of Section---

8. PROJECT TIMELINE

8.1 Proposed Schedule

- i. The Contractor shall provide full programme of the supply in detail and delivery schedule along with work schedule thereto. Strict adherence and guaranteed delivery schedule mentioned in terms and conditions shall be the essence of the Contract and delivery schedule must be maintained.
- ii. The work must be completed as per the Timeline below from the date of handing over of site.

Proposed Schedule

Sr. No.	Stage	Reference from Zero Date ("D")
1.	Issue of Letter of Intent	D
2.	Completion of land lease work and site development work	D+60
3.	Commencement of civil work	D+75
4.	Approval of major drawings	D+90
5.	Completion of supply of major balance of system	D+150
6.	Completion of Civil work & erection of MMS in phased manner, as per agreed schedule	D+225
7.	Completion of supply of PV modules, in phased manner, as per agreed schedule	D+195
8.	Completion of Civil work for conference cum Control room, General Civil works, in phased manner, as per agreed schedule	D+240
9.	Installation and interconnection of all DC circuit	D+240
10.	Installation and interconnection of all AC circuit	D+255
11.	Interconnection and testing of entire plant	D+315
12.	Commissioning of entire plant	D+345
13.	COD with GUVNL/GEDA (full capacity)	D+360
14.	Operational Acceptance Test & Completion of Facilities	D+390
15.	Plant Stabilisation and Operation by EPC Contractor	D + 395
16.	Performance Guarantee Test-cum-Final Acceptance Test (Tentative) after completion of first year of operation after COD with GGL/GEDA/GUVNL/GETCO	D+720



- iii. The Contractor shall also provide a Bar/ PERT Chart indicating completion schedule for various items involved in the work within the stipulated completion period and the Contractor should strictly adhere to that schedule.
- iv. The issue of Lol shall be considered as the Zero Date.
- v. The Bar/ PERT Chart provided by the Contractor shall submitted to GGL for approval prior to commencement of the execution of the Project. All comments and modifications provided by GGL shall be incorporated and adhered to by the Contractor in the Timeline, Bar/ PERT Chart, detailed execution plan, etc. for execution of the Project.
- vi. Based on above timeline, Contractor to submit detailed schedule/timeline for 12 MW (AC).
- vii. The GGL/GGL's Consultant/GEDA/DisCOM authorized representative will witness and validate the commissioning procedure at site. Commissioning certificate shall be issued by State Nodal Agency GEDA after successful commissioning.
- viii. "Commissioning" word indicated in this tender shall mean commissioning certificate issued by State Nodal Agency (GEDA).
- ix. Partial commissioning of project shall not be allowed. Full fledge commissioning shall be considered by GGL subject to consideration and acceptance by GEDA/GGL.

8.2 Delay in Execution or Failure to Supply

- i. Any delay in completion of the work shall attract liquidated damage/ penalty for late completion as per Liquidated Damage (Clause 8.3) of this Tender.
- ii. If the Contractor fails to deliver the plant or fails to start the work within specified time frame after issue of Lol or fails to carry out the work as per agreed schedule or leaves the work site after partial execution of the work, GGL shall have the right to get the work done through any other agency at the risk and cost of the Contractor. Further to this, GGL may, without prejudice to the right of the Contractor to recover damages for breach of trust of the Contract, may impose penalties.
- iii. Notwithstanding anything contained in this tender document, bidder to note that Completion time of Project activities as per the prescribed timeline/schedule is the essence of the Contract. It is envisaged that EPC Contractor shall plan and achieve progress of the Project on or before the prescribed timeline/schedule without fail.
- iv. If, at any time, the CONTRACTOR's actual progress falls behind or is likely to fall behind the agreed schedule of the break-up/detailed Project activities, the CONTRACTOR shall submit to the GGL, a revised programme with catch up schedule, taking into account the prevailing circumstances and delay in the respective activities / milestones. The CONTRACTOR shall, at the same time/forthwith notify promptly to GGL of the steps being taken to expedite progress of the Project activities, so as to achieve completion of such activities within the agreed Time schedule for Completion. The Contractor shall in order to overcome the situation, forthwith mobilise required additional resources



like manpower, materials, machineries etc. to achieve the prescribed timeline/schedule at his risk and cost.

- v. In case further slippage is observed in the progress of Project activities, as per agreed time schedule or failure by EPC Contractor, at any stage of the Contract, to perform the Contract diligently to fulfil his obligations as per the EPC Contract, GGL reserves the right to engage any other Contractor(s)/sub-contractor(s) at any time, at the risk and cost of the EPC Contractor to ensure completion of the Project activities in line with the agreed time schedule. Further, GGL will also deduct Liquidated Damages (LD) arising out of any such delay, if any, as per the terms of this tender document or recover the costs, expenses, losses, damages incurred or suffered by GGL as per the recourse available under this tender document or any other law for the time being in force.

8.3 Liquidated Damages for Delay and Underperformance

- i. Delay in Commissioning and COD with GEDA/ GUVNL
 - a. In case the EPC Contractor fails to achieve successful Commissioning/ COD of 12 MW (AC) with GUVNL/GETCO/GEDA within 12 months from the date of LoI (Zero date), then GGL shall levy the Liquidated Damages on the EPC Contractor.
 - b. Completion time is the essence of the Contract and the same shall be firm and binding. The Bidder shall complete “COD with GEDA/DISCOM” of 12 MW (AC) Solar PV Projects within 12 months on best effort basis. For calculation of Liquidated Damages (LD), Project schedule shall be considered as 360 Days from LoI date. i.e., project shall be completed (COD with GEDA/GUVNL, with full capacity) within 360 Days from the “Zero Date”.
 - c. In case the EPC Works of solar PV project (COD with GEDA/GUVNL, with full capacity) is not completed within the stipulated time period (i.e., 360 days from zero date) and the delay is not due to Force Majeure or due to GGL’s default then the Contractor shall pay to the GGL compensation for delay subject to following:
- ii. Delay up to 30 days: Amount of Rs. 15,000/MW/Day shall be deducted as penalty for the first 30 days of delay calculated on per day basis and proportionate to the capacity not commissioned as COD with GEDA/DISCOM.
- iii. Delay of more than 30 days and up to 60 days: Amount of Rs. 25,000 /MW/day shall be deducted on per day basis and proportionate to the capacity not commissioned as COD with GEDA/DISCOM.
- iv. Delay of more than 60 days: Amount of Rs. 35,000 /MW/day shall be deducted on per day basis and proportionate to the capacity not commissioned as COD with GEDA/DISCOM.

Maximum applicable Liquidated Damages: The upper ceiling for total liquidated damages for delay shall be maximum 10% of the EPC Contract Price.



- v. The said right of the GGL to levy damages on account of delay shall be without prejudice to and in addition to the right of the Company to get the concerned work done from a third party at the complete risk and cost of the Contractor.
- vi. The Contractor shall indicate duration of all the activities in activity chart in conformity with the overall schedule of the completion of project. The Contractor shall submit the activity chart in form of Bar Chart which shall be discussed and finalized and shall be a part of Contract.
- vii. Any strike / lockouts at works or site of the Contractor or his sub-supplier/sub-contractor shall not be considered as force majeure condition.
- viii. For calculation of penalty, date of issue of LOI shall be the reference date.
- ix. Underperformance
 - a. At the time of the Operational Acceptance Test, any shortfall in the Performance Ratio (PR) as determined through the Test Procedure in the Annexure G: Procedure for Performance Testing of section V, will attract imposition of Liquidated Damages after one (1) unsuccessful chance. For any shortfall in PR below 0.75 by the Bidder for the second (2) time, a penalty of 1% of the EPC Contract Price (including taxes & duties) shall be levied. In case the first the Test is unsuccessful then penalty shall not be charged but the Contractor has to make the necessary corrections to conduct the test again within the stipulated maximum 30 days, so as to demonstrate the PR equal to or more than 0.75. In the second (2nd) time, a penalty at the rate specified above shall be levied on the Contractor. The penalty shall be deducted from the pending payment and Performance Bank Guarantee. However, if Contractor feels that NEEGG may not be achieved and want to carry out further correction, the same will be allowed for the one more time i.e., 3rd time but PG Test and O&M period shall start from such later date as mentioned in Point no. A (xi) in NIT; Table Pg. 5. In case the Contractor is successful in 3rd attempt then 1% of the EPC Contract Price (including taxes & duties) deducted after unsuccessful 2nd attempt shall be returned. However, if the Contractor fails in the 3rd attempt as well then, the penalty deducted at the time of 2nd unsuccessful attempt shall not be returned.
- x. Performance Guarantee Test / Final Acceptance Test
 - a. If the "Actual Delivered Energy" at the metering point (Plant end 66 kV sub-station) is less than the NEEGG (corresponding to NEEGG for 1st year of O&M as per tender), based on the procedure mentioned in Annexure-G, then a penalty shall be charged at the rate of the tariff applicable to GGL from the DISCOM at that time per kWh for the shortfall (for example, if the applicable rate is ₹8.0/kWh, the penalty shall be at ₹8.0/kWh; if the applicable rate is ₹9.2/kWh, the penalty shall be at ₹9.2/kWh). The Bidder/Contractor shall make necessary correction to meet NEEGG. In case the Contractor fails to pay the penalty as above within 30 days, then the entire Performance Bank Guarantee shall be encashed by GGL and all remaining payments yet to be made by GGL to the Contractor shall also be forfeited.

8.4 Penalty for Generation during Operation & Maintenance (O&M)

- i. Penalty for loss of Generation during O & M.
 - a. For each Contract Year, the Contractor shall demonstrate “Actual Delivered Energy” at the Metering Point (Plant end 66 kV sub-station) as compared to the ‘NEEGG’ for the particular year (calculated as per the methodology given in Annexure – G (Part C) for section V.
 - b. If for any Contract Year, it is found that the “Actual Delivered Energy” is less than ‘NEEGG’ for the particular year, the Contractor shall pay compensation to GGL equivalent to the rate applicable to GGL from the Discom during that particular Contract Year (for example, if the applicable rate is ₹8.0/kWh, the compensation shall be at ₹8.0/kWh; if the applicable rate is ₹9.2/kWh, the compensation shall be at ₹9.2/kWh). The same shall be recovered from payments yet to be made by GGL to the Contractor and/or from the Bank Guarantees available with GGL.
 - c. In In case of any defect in the system after Commissioning, the Contractor shall initiate action for repair within forty-eight (48) hours. After 48 hours, penalty shall be charged and the same shall be deducted/recovered from payments yet to be made by GGL to the Contractor and/or from the Bank Guarantee submitted to GGL. A penalty at the rate applicable to GGL from the DISCOM at that time shall be charged by GGL for the loss of generation due to that effect post 48 hours (for example, if the applicable rate is ₹8.0/kWh, the penalty shall be at ₹8.0/kWh; if the applicable rate is ₹9.2/kWh, the penalty shall be at ₹9.2/kWh). The loss of generation shall be calculated with respect to the NEEGG of that particular year, based on the actual radiation.
 - d. However, in case the Contractor fulfils the NEEGG at the end of the year then the amount deducted as a penalty for loss of generation as per this Clause shall be adjusted in the Contractor’s bill or reimbursed. In case the Contractor fails to meet the NEEGG at the end of the year then above-mentioned penalty shall be adjusted from the penalty calculated at the end of the year for the shortfall in the generation so that there is no duplication of penalty for the same loss of generation. The first 48 hours shall not be considered for the penalty in case of any defect.
 - e. In case the Project fails to generate any power continuously for 6 months any time during the O&M period, it shall be considered as an “Event of Default”.
 - f. Upon occurrence of any Event of Default mentioned in Clause 8.4 (d) herein above, GGL shall have the right to encash the entire amount of O&M Bank Guarantee submitted by the Contractor and withheld any other pending payment.
 - g. The GGL reserves the right to perform random audits of weather monitoring system of the plant anytime during the entire O&M period. If any discrepancy is found between the measured parameters, the difference between the measured parameters by GGL from secondary sources and the weather monitoring system installed by the Contractor at the site will be factored in calculating the adjusted NEEGG during the entire year. However, GGL will have the final authority to decide on this matter.

8.5 Important Timelines and Dates

i. Performance Guarantee (PG) Test Period

Performance Guarantee (PG) Test Period shall start as under:

- a. If the Contractor successfully completes Operational Acceptance Test (OAT) in first attempt within 30 days from date of commissioning then PG Test Period and O&M Period will start from the date when the OAT was started.

(OR)

- b. In case the Contractor fails the OAT in the first attempt; the Contractor shall be allowed additional 30 days for corrective actions and next OAT shall start on completion of 30 days period or earlier as desired by the Contractor.

The PG Test and the O&M period shall start from the date when of second OAT period is started. In case the Contractor fails in the second attempt as well, a penalty will be imposed at 1% of EPC Contract Price (i.e. Supply + Work Price). In this case, irrespective of the result (whether pass or fail) of the OAT, the PG Test and O&M Period shall start at the beginning of the second OAT. The start of O&M and first year operation shall be considered after successful completion of operational acceptance test or 60 days from date of commissioning of 12 MW (AC) whichever is earlier. Further all the guarantees related to NEEGG / Incentive shall also be applicable.

(OR)

- c. However, in case of failure of the second OAT, if the Contractor needs more time to further take corrective action at its own discretion, then the same may be allowed by GGL without imposing any further penalty on the Contractor towards such subsequent OATs. However, if the Contractor is successful in third attempt, then the penalty deducted at the time of unsuccessful 2nd attempt of OAT shall be returned but if the Contractor fails in third attempt of OAT, then penalty charged at the time of second unsuccessful attempt of OAT shall not be returned to the Contractor.

ii. Operation and Maintenance (O&M) Period

Upon start of PG Test Period as per Clause No. 8.5 (i) above for 10 Years. The maintenance contract shall be renewable for another 10 years on the same terms & conditions except for the price which shall be discussed and mutually agreed upon at that point of the times.

iii. Bank Guarantee Against PV Module Warranty (if applicable)

Bank Guarantee Against PV Module Warranty validity shall be 90 days beyond the 25 Years from the date of Commissioning of the entire Project.

iv. **Bank Guarantee for shortfall at the time of PG test (if applicable)**

Bank Guarantee for shortfall at the time of PG test validity shall be 9 Years from the completion of PG Test.

9. PAYMENT TERMS (12 MW PROJECT)

Supply, Works and 10 years of O&M: The GGL shall pay the Contractor in the following manner for supply of material and at the following time for achieving the respective milestones for the Supply. The Tender is a comprehensive EPC Contract of Supply, Works and O&M, there shall be three (3) different contracts signed for supply, works and O&M. However, a single LoI shall be provided to the Successful Bidder. The payment terms for Supply, Works and O&M are given below.

9.1 Terms of payment for Supply

Terms of payment for Supply

Sr.	Payment Milestones	Amount
1.	Advance Payment (10% of Supply Price excluding taxes & duties) against (i) Acceptance of LOI (ii) Submission of Advance Bank Guarantee of equivalent amount (iii) Submission of Performance Bank Guarantee (validity of minimum 27 months/ as per Tender)	10% of Supply Price excluding taxes & duties
2.	Completion of Erection of MMS Column Post including civil Foundation of 12 MW (AC)	10% of Supply Price
3.	Supply of PV Modules & Inverter on pro rata basis (Supply of PV Modules shall be as per mutually agreed schedule on sequential basis only) payment upon receipt of PV Modules at site for Modules.	45% of Supply Price
4.	Supply of BOS for 12 MW (AC) on Pro rata basis except Sr. No. 3	10% of Supply Price
5.	Completion of Erection & installation of 12 MW (AC) Plant	10% of Supply Price
6.	Upon achieving Commissioning / COD of the Plant with GEDA / GUVNL	10% of Supply Price
7.	Upon Completion of the Facilities and Successful Performance and Operational Acceptance Test	5% of Supply Price

Note:

1. “Supply Price” is equal to the price of Supply of all equipment portion under “EPC Supply-Contract Price” (including taxes) quoted by the Contractor in its Financial Proposal.
2. Supply payment is subject to receipt of goods at site.



3. Payment against supply of PV modules shall be on sequential basis after readiness of module mounting structure as indicated in best effort schedule.

9.2 Terms of payment for Work

Payment Terms for the Works shall be as per the following table. The GGL shall pay the Contractor in the following manner for all the erection, testing, commissioning.

Terms of payment for Works

Sr.	Milestone for Works	Amount
1.	Mobilization Advance Payment: Against mobilization at site and submission of BG of equivalent amount	10 % of Contract Value of Works
2.	Against monthly RA bills for the Works executed at site a. Against Module mounting structure installation b. Panel Erection, DC & AC Cabling c. Erection and Commissioning	60 % of Contract Value of Works a. 30% b. 20% c. 10%
3.	Pro-rata upon part Commissioning Maximum three slots	10 % of Contract Value of Works
4.	Upon Successful Commissioning of the entire Project Against PV Module Bank Guarantee (if PV Module insurance is not available)	10 % of Contract Value of Works
5.	Upon Successful OAT	10 % of Contract Value of Works

Note: “Erection, Testing and Commissioning Works Price” is equal to the price of Works (all the erection, testing and commissioning works) portion of “EPC Contract Price” (including taxes) quoted by the Contractor in its Financial Proposal.

9.3 Terms of payment for O&M

Terms of payment for Operation and Maintenance (O&M)

Sr. No.	Milestone for Works	Amount
1.	On Successful Operation and Maintenance of the Solar PV Power Plant on quarterly basis for each year till 10 years and extendable for further period of 10 years as per discretion of GGL on mutual consent.	Year 1: OM-1 Year 2: OM-2 Year 3: OM-3 Year 4: OM-4



Sr. No.	Milestone for Works	Amount
		Year 5: OM-5
		Year 6: OM-6
		Year 7: OM-7
		Year 8: OM-8
		Year 9: OM-9
		Year 10: OM-10

9.4 Terms of payment for Land Lease

Terms of payment for Land Lease

Sr. No.	Milestone for Works	Amount
1.	Land Lease of the Solar PV Power Plant on yearly basis for each year till 27 years	Year 1: Land Lease -1 Year 2: Land Lease -2 Year 3: Land Lease -3 Year 4: Land Lease -4 Year 5: Land Lease -5 Year 6: Land Lease -6 Year 7: Land Lease -7 Year 8: Land Lease -8 Year 9: Land Lease -9 Year 10: Land Lease -10 Year 11: Land Lease -11 Year 12: Land Lease -12 Year 13: Land Lease -13 Year 14: Land Lease -14 Year 15: Land Lease -15 Year 16: Land Lease -16 Year 17: Land Lease -17 Year 18: Land Lease -18 Year 19: Land Lease -19 Year 20: Land Lease -20 Year 21: Land Lease -21 Year 22: Land Lease -22 Year 23: Land Lease -23 Year 24: Land Lease -24



Sr. No.	Milestone for Works	Amount
		Year 25: Land Lease -25
		Year 26: Land Lease -26
		Year 27: Land Lease -27

9.5 Payments Procedure

- i. Subject to any deduction which the GGL may be authorized to make under this Contract, and or to any additions or deductions provided for in this Contract, the Contractor shall be entitled to payment as follows:
 - a. All payments shall be made in Indian Rupees (INR), unless otherwise specified in the Lol/Contract Agreement. All payment shall be made on the basis of actual measurement for the quantified items as per schedule of works.
 - b. The Contractor shall submit the bill for claim in three copies with all supporting documents as per the Contract condition to GGL. After due verification and recommendation, GGL shall process verified bills for release of payment. Payments shall be released in 30 (Thirty) days by A/c payee cheque / RTGS/ NEFT from date of submission of clear invoice.
 - c. The Contractor shall give complete shipping information concerning the weight, size, content of each package including any other information the GGL, may require. Hard copies shall be submitted at site and softcopies shall be submitted on the online portal. Owner may ask additional hard copies as and when required.
 - Insurance certificates (2 copies)
 - Bill (2 non-negotiable copies)
 - Invoice (2 copies)
 - Packing list (2 copies)
 - Test certificate (2 copies)
 - Certificate of Origin (2 copies)
 - One copy of the packing list shall also be enclosed in each case.
 - O & M Manuals &/or Catalogues
 - d. The Contractor shall submit the bill / invoice for the work executed showing separately GST and any other statutory levies in the bill / invoice.
 - e. Any discrepancy and delay in submission of the above document, which result in demurrage and other charges for the consignment (for incomplete/incorrect documentation) will be to the account of the Bidder. All the formalities for custom clearance are in Bidder's scope.



(1) For onshore supply, the following documents shall be submitted through registered post to the GGL within 3 days from the date of shipment, the advance copy of these documents shall be sent through e-mail.

- Invoice (2 copies)
 - LR copies
 - Packing list (2 copies)
 - Test Certificate (2 copies)
 - One copy of the packing list shall also be enclosed in each case.
 - O & M Manuals &/or Catalogues
- f. All taxes and deductions shall be applicable as per prevailing income tax and other statutory rules and provisions in force.
- g. In case Contractor fails to submit the invoice with all the required documents to process payments, GGL reserves the right to hold the payment of the Contractor against such bills.

10. QHSE Requirement:

10.1. SCOPE AND APPLICATION

Contractor/Service providers are the key stake holder and an integral part of Gujarat Gas Ltd (GGL's) business. Contractors'/Service provider' Quality, Health, Safety and Environment (QHSE) performance reflects on the company's business performance and reputation. GGL has established QHSE Management Systems, Procedures & Guidelines to ensure compliance with GGL's QHSE requirements. These requirements apply to all jobs whilst conducting work for GGL including; Project, Construction, Operation & Maintenance, Field Operations and Services within any given contract or agreement.

The overall objective of QHSE management in contract/agreement is to improve the company and Contractor's/Service providers' QHSE performance in all aspects of activities. Active and on-going participation by both the GGL and Contractor/Service provider is essential to achieve this objective.

10.2. RESPONSIBILITIES

Contractors/Service providers work under the direction of GGL Integrated Management System (IMS) Policies, Procedures & Guidelines that describe the GGL requirements for undertaking work within the company. It is the responsibility of Contractors/Service providers to ensure that their staff are informed of and comply with GGL's requirement whilst working for the company.

Contractor/Service Provider are responsible to ensure safe execution of work/service including following:

- Ensuring that the QHSE Policy, Procedures & Guidelines are known and understood by all contractors'/service providers' staff and work force
- Supervising execution of work activities to ensure adherence to the QHSE compliance requirements

Contractor/Service provider to ensure that all aspects relating to QHSE are adequately addressed and implemented in accordance with the GGL QHSE requirements and QHSE Management Plan, which shall include the management processes and activities to be implemented during the course of work with GGL.

Contractor/Service provider shall be responsible for ensuring that adequate HSE resources are put in place to enable satisfactory implementation of QHSE Management Plan.

This responsibility also applies to ensure the Health and Safety of the people are directly and indirectly engaged / involved whilst working or present at GGL's work area / sites.

10.3. MOBILIZATION

- Post selection and awarding of contract, GGL shall arrange a kick-off meeting with Contractor/Service provider where GGL team members Contract Owner (CO), Contract Holder (CH) & HSE representative) will discuss on QHSE Management aspects / plan and requirements in order to make sure that Contractor/Service provider and their team fully understand the expectation of GGL. During the meeting, QHSE Management Plan shall be discussed and agreed between GGL and Contractor/Service provider.
- Contractor/Service Provider shall ensure that all tools, tackles, equipment, machineries & instruments are adequately deployed and are 'Fit for Purpose'. Pre mobilisation checks/inspection shall be carried out by GGL team for the same before the start of work.



- GGL emphasizes on the importance of the Health and Fitness of all staff/work force deployed at GGL work sites. Contractor/Service provider shall adhere to medical check-up as per the GGL Health check-up matrix (as applicable)
- Contractor/Service provider shall ensure that only trained & technically competent person carried out the job and under no circumstances should the Contractor/Service provider commence the work unless relevant certification/qualification documents are submitted to GGL
- A proper HSE orientation and training will be organised by GGL for the Contractor/Service provider workforce before the start of work; under no circumstances should the Contractor/Service provider commence the work unless the manpower have undergone the HSE training (as applicable)
- Contractor/Service provider shall ensure that all their staff/work force are provided required Personal Protective Equipment (PPEs) as per GGL PPE matrix (as applicable) and any additional PPE as directed by Engineer Incharge based on risk assessment
- Contractor/Service Provider shall ensure all required emergency arrangements like Medical treatment, FIRST AID box and Fire fighting equipment (as applicable)

10.4. EXECUTION

Contractor/Service provider is responsible to ensure the compliance with GGL QHSE requirements. GGL overall QHSE performance is directly influenced by the contractors' performance.

- Contractor/Service provider is responsible for QHSE compliance monitoring at site/work activities to ensure that work/activity is performed in a safe manner. Moreover, they are responsible for reporting of all incidents, Hazard and Near Miss that might happen during work/activity
- Contractor/Service provider shall follow and comply with GGL 'Permit to Work' system
- During work execution and activities, GGL team will regularly monitor and evaluate the performance of the Contractor/Service provider to identify the shortfalls and weaknesses and assist to improve the overall performance including QHSE performance through CPAR process (as applicable)

We believe that everyone at GGL, Employees, Contractors, Service providers and Associates have the right to go home safely.

10.5. QHSE GUIDELINE (AS APPLICABLE) FOR ALL TYPE OF CONTRACTS

1. Contractor/Service provider

- a) shall ensure that all staff/work force comply with the requirements of the GGL HSE Management System, QHSE policy, standard, procedures, guideline, plan & Life Savers at work site
- b) shall ensure issuance of Identity Card to their team members
- c) shall apply and obtain Permit to work (PtW/WA) before start of the work
- d) shall arrange work related Personal Protective Equipment (PPEs) for their staff/work force and ensure proper use during the execution of job
- e) shall carry out the work within the duty hours/office hours. No Work shall be carried out without permission of GGL's representative beyond the official duty hours unless otherwise agreed upon and recorded appropriately
- f) shall ensure that all tools, tackles, appliances, machines, vehicles, instruments or other equipment are Fit for Purpose and maintained safe working condition at all times and are used only by authorized and competent persons



- g) shall ensure that all the QHSE requirements are properly discussed for any sub-contracted activities with GGL. No such activity shall be performed without clearance from GGL management
 - h) shall ensure that all Hazards, Near miss, accident, incident, injuries are reported promptly to GGL. Action arising due to reported Hazards, Near miss, incident investigation; audit/inspection shall be closed out as per agreed timelines with site in-charge
 - i) shall deploy staff & work force trained, qualified and competent for the work and well aware of risks and mitigation action/s for the activities undertaken
 - j) shall make necessary arrangements for safe custody of equipment, materials in stores/warehouse and at site
 - k) shall ensure safe transportation, storage and handling of materials to prevent any damage which may impair safe performance of the equipment / material etc
 - l) shall initiate immediate actions to hospitalize injured person(s)
 - m) shall ensure an injury free, incident free workplace and protect people from harm caused by work activities
 - n) shall ensure use of seatbelts while driving four-wheeler and use of crash helmet for Two wheeler riders during job execution
 - o) shall ensure Lock out and Tag out (LOTO) after de-energizing and double check before starting any jobs. In case of conducting job for the purpose of fault finding & monitoring of voltage & current it is to be considered live & working and all PPE'S to be worn to avoid exposure of flash arc current
 - p) shall take note that the use of open wires in sockets, use of wires with tape joints shall not be accepted at work site.
 - q) shall ensure proper collection, storage and disposal of solid / liquid waste as per GGL procedure and guideline
 - r) staff/work force shall not smoke or resort to misuse of drugs, medicines or alcohol while on duty
2. In case of any incident like fire, gas leakage etc. due to gross negligence of the Contractor's staff/work force, GGL reserves the right to impose penalty up to actual damage cost and or termination of work order depending upon the gravity of the situation.
3. Any breach of the QHSE requirements shall be deemed by the company to be a material breach of the terms & condition of the contract. GGL shall be entitled to take appropriate actions including instructing the contractor to (a) remedy the breach; (b) suspend the work or (c) terminate the contract.
4. All activities shall be carried out as per GGL's documented procedures and QHSE requirements, deviation from it shall be dealt with very strictly.

10.6. HSE & CPAR related Penalty Matrix

Sr. No	Parameter	Service Level Agreement	Penalty
1	Reportable Incident	Zero Incident	<ul style="list-style-type: none">For each Fatal Incident - Rs. 1,00,000 or 10% of Total contract value, whichever is lowerFor each LTI* - Rs. 20,000 or 10% of Total contract value, whichever is lower

Sr. No	Parameter	Service Level Agreement	Penalty
			<ul style="list-style-type: none"> For each MTC/RWDC Case# - Rs. 10,000 or 5% of Total contract value, whichever is lower <p>Note: Penalty shall be imposed over and above the payment & compensation that would be made by the service provider to the injured person or family of deceased vide the statutory provisions.</p>
3	Compliance to GGL performance requirements	Performance rating less than 60% against CPAR	<p>Following actions to be initiated against non-achieving of SLA for Monthly CPAR Score.</p> <ul style="list-style-type: none"> ➤ First moth of low CPAR score: warning letter to be issued ➤ Penalty of Rs. 5,000 to be deducted monthly, after one month from the date of warning letter issued, if there is no improvement (i.e. monthly CPAR score < 60%) ➤ Penalty of Rs. 10,000 to be deducted monthly, after fourth month from the date of warning letter issued, if there is no improvement (i.e. still monthly CPAR score <60%) <p>GGL may take actions as per the contract if there is no improvement after six months from the date of warning letter issued or in case CPAR Score is less than 60% for three consecutive months or less than 40% for two consecutive months</p>
5	Compliance to QHSE requirements	Un-authorized work, Work without approved PTW/WA or EIC approval	Rs. 10,000/- per instance
		Non-Compliance – Safety Training Card	Rs. 2500/- per Employee
		Non-compliance – PPE	Rs. 1000/- per person per instance
		Use of non-standard electrical equipment	Rs. 2500/- per instance

***LTI - Loss time Injury:** A disabling Occupational Injury which results from a work-related activity or from a single instantaneous exposure in the work environment and that results in a person being unfit for work beyond the day of the incident. Where the injured party returns to work on the following day but subsequently has to take time off as a result of the injury this shall count as a Lost Time Injury.

MTC - Medical Treatment Case: A work-related injury case is classified as Medical Treatment Case (MT) when the management and care of the injured person is above and beyond First Aid


RWDC - Restricted Work Day Case: Any work-related Injury Case (other than a fatality or lost workday case) which results in a person being unfit for full performance of their regular job on any day after the work-related injury

Note: For further details on glossary (terminology/definitions) and guidelines on same, refer GGL approved Guideline on Glossary related to GGL HSE incident Statistics.

Remark: Issuance of MEMO against HSE non compliances including above mentioned defaults shall be decided by Contract Holder

10.7. FORMATS

MEMO FORMAT


 GUJARAT GAS	<h2 style="margin: 0;">MEMO</h2>	
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Memo No:	Date:	Time:
GA/Location		
Name of the activity		
Name of the contractor		
Memo Issued to		
Memo Issued by		
Observation		
SN	Non Compliance Observed	Close-out timeline
1		
2		
3		
4		


Remarks: |

	GGL	Contractor
Name		
Designation		
Signature		


FIRST AID BOX CONTENTS

 GUJARAT GAS	First Aid Box Contents At worksite – PE/PNG/Steel/CNG Project/Admin and Office vehicles including O&M vehicles & MCV	Doc. No.	HSE-F-40B
		Rev. No.	01
		Effective Date	01/11/2018
SN	First Aid Box Contents	Minimum required Quantity	
1	Small sterilized dressings	3	
2	Medium size sterilized dressings	3	
3	Large size sterilized dressings	3	
4	Large size sterilized burn dressings	5	
5	15 gm. packets of sterilized cotton wool	3	
6	100 ml bottle of suitable antiseptic solution	1	
7	Scissors	1 pair	
8	Adhesive plaster (2 cm x 1 meter)	2 rolls	
9	Sterilized eye pads in separate sealed packets	3	
10	Analgesic or Aspirin tablets	10 nos.	
11	Medical disposable gloves	2 pairs	
12	Safety pins	1 dozen	

FIRST AID BOX CONTENTS USAGE FORMAT

 GUJARAT GAS	First Aid Box content Usage Format					Doc. No.	HSE-F-41
						Rev. No.	0
						Effective Date	15/05/2018
Office/Station/Vehicle details:							
SN	Date & Time	Name of Person treated	Type of Emergency/ Injury	First aid Box Content Used	Quantity used	Name of First Aider	Signature of First Aider


PPE APPLICABILITY MATRIX

<div></div> <div>GUJARAT GAS</div>		PPE Applicability Matrix																				Doc. No.	HSE-F-45				
																						Rev. No.	0				
																						Effective Date	01.06.2018				
SN	Activity / Work	Activity / Task Performer / Executor	Safety Hard hat	Safety Shoes	Safety Goggles/ Glass	Reflective Jacket/ Strip	Dust Mask	Ear Plug/ Ear Muff	Cotton Hand Gloves	Leather Hand Gloves	Rubber Hand gloves	Chemical resistant gloves	Rubber electrical gloves (11KV / 33KV / 66KV)	Electrical Resistant Safety Shoes (HT)	Gum Boot	Fire Retardant Clothing	Cotton dress / cover-all with reflective stripe	Chemical resistant Suit	Seat belt	Crash Helmet	Full Body Harness Double anchor	PETZL (Work at height equipment)	Knee guards	Welding Screen	Face shield	Self Contained Breathing Apparatus	Respirator for Organic Vapour
1	Project, Construction, Connection Site Supervision / Site Visit	GGL Employee / Out Sourced Engineer	✓	✓	NB	✓	NB	NB	NB																		
		TPI / Construction Supervisor / Contractor	✓	✓	NB	✓	NB	NB	NB																		
		Contractor Supervisor / Engineer / Mukadam	✓	✓	NB	✓	NB	NB	NB																		
2	Project, Construction, Connection site	Technician/Fitter/Rigger/Helper/Workers	✓	✓	NB	✓	NB	NB	✓	NB	NB		NB		NB												
3	Customer Premises Visit / Meeting	GGL Employee / Out Sourced Engineer	✓	✓	NB	✓	NB	NB	NB																		
		GGL Non Technical Employee	✓	✓	NB	✓	NB	NB	NB																		
		TPI / Construction Supervisor / Contractor	✓	✓	NB	✓	NB	NB	NB																		
4	Excavation in Soft Soil	Labour / Worker	✓	NB	NB	✓	NB		✓				NB	NB	✓												
5	Excavation in Hard Soil / RCC / PCC	Labour / Worker	✓	✓	✓	✓	NB	NB	✓				NB	NB	NB												
6	Steel Pipeline Welding - Cold work	Welder	✓	✓					✓				NB		NB		✓								✓	✓	
		Helper / Fitter	✓	✓	✓				✓	NB			NB		NB		✓									NB	
7	Steel Pipeline Welding - Hot work	Welder	✓	✓					✓				NB		NB	✓									✓	✓	
		Helper / Fitter	✓	✓	✓				✓				NB		NB	✓										NB	
8	Radiography	Radiographer	✓	✓					✓						NB		with TLD Badge										
9	Joint Coating	Technician / Helper	✓	✓	✓	✓	NB				✓				NB												
10	Holiday detection	Technician / Helper	✓	✓		✓							✓		NB												
11	Drilling	Fabricator / Technician / Rigger / Helper	✓	✓	✓		NB	✓	✓				NB														
12	Grinding / Cutting / Shot Blasting	Fabricator / Technician / Rigger / Helper	✓	✓	✓		NB	✓		✓			NB		NB		✓								✓		
13	PE Pipeline Welding - Cold Work	Welder	✓	✓	✓	✓			✓						NB												
14	PE Pipeline Welding - Hot Work	Welder / Helper	✓	✓	✓	✓			✓						NB	✓											
15	Plumbing	Plumber / Helper	✓	✓	NB		NB		✓																		
16	Working at Height at Riser / Riser Maintenance / Building	Trained Plumber / Civil Worker	✓	✓	✓	✓	NB	✓													✓	✓	✓				
17	Work on road/highways/street or vehicle movement area	Any Level / Category of person	✓	✓	NB	✓	NB		✓																		
18	AMC - Dem/Com		✓	✓	✓	✓	NB		✓								✓										
19	PNG/CNG O&M Cold job on charged gas network /	Any Level / Category of person	✓	✓	NB	✓	NB		✓						NB												
20	PNG/CNG O&M Hot job on charged gas network / Installation	Any Level / Category of person	✓	✓	NB	✓	NB		✓						NB	✓											
21	Odorant transfer / filling activity	Any Level / Category of person	✓	✓	✓						✓					✓		✓									✓
22	CNG Handling (Filling / Transporting)	Technician / Helper	✓	✓													✓										
23	CNG Back-court Operations	Compressor Operator	✓	✓	✓			✓	✓								✓										
24	Testing - Equipment / Pipeline / Valve / PRI	Any Level / Category of person	✓	✓	✓	✓		NB	✓						NB		✓										
25	Gas Commissioning - Network / Gas Installation	Any Level / Category of person	✓	✓	✓	✓		NB	✓						NB	✓											
26	Electrical - Project / Office Site - Cold Work / Installation	Electric Engineer / Electrician / Worker	✓	✓	✓								✓	NB			✓										
27	Electrical - Project / Office Site - Live Work / Installation	Electric Engineer / Electrician / Worker	✓	✓	✓								✓	NB		✓											
28	Driving - Mobile Cascade Van (MCV/LCV/HCV)	Driver / Helper		✓																✓							
29	Handling of Heavy Equipment (Hydra/CB/Crain/HDD machine)	Driver / Helper	✓	✓	✓	✓	NB																				
30	Driving - Four / Three Wheeler	Driver & Co-traveller		✓																✓							
31	Driving - Two Wheeler	Driver / Pillion Driver		✓																	✓						
32	Office Work	Canteen boy / House Keeping Staff		✓			NB		✓																		
33	Work in high noise area	Any Level / Category of person	✓	✓				✓																			
34	Work in confined space	Technician / Worker	✓	✓	✓																NB					NB	
35	Manual Boring	Worker	✓	✓	✓	✓	NB						✓														
36	Loading / Unloading	Technician / Worker	✓	✓		✓			✓	NB	NB																
37	Civil work	Masson / Worker	✓	✓	✓	✓	NB		✓		NB				NB												

TRAINING APPLICABILITY MATRIX

 GUJARAT GAS	Training Applicability Matrix		Doc. No.	HSE-F-46
			Rev. No.	1
			Effective Date	01.08.2021
Job Positions / Area of Work	Basic Safety Training + Fire fighting (Classroom Training)	Competency Training	Practical Fire fighting Training	First Aid Training
Contractor Staff / TPI / Outsourced Employee - Technical				
Plumber	✓	✓	×	×
Plumber - Working at Height	✓	✓	×	×
Supervisor - Working at Height (Rescue Training)	✓	✓	×	✓
PE Pipe Welder (Welder qualification)	✓	✓	×	×
Steel Pipe Welder (Welder qualification)	✓	✓	✓	×
Fitter/Fabricator	✓	×	✓	×
Helper (Project jobs)	✓	×	×	×
Site Supervisor or Mukadam (All jobs)	✓	×	✓	✓
Qualified HSE Engineer	✓	×	✓	✓
QA/QC Engineer	✓	×	×	×
Outsourced Employees - Technical	✓	×	✓	✓
TPI (of TPIA)	✓	×	✓	✓
Construction Supervisor (of TPIA)	✓	×	✓	✓
Project/O&M In-charge/Manager	✓	×	×	×
PE/PNG O&M Staff / Emergency response team	✓	✓	✓	✓
Steel pipeline O&M Staff	✓	✓	✓	✓
PNG (Dom/Com) AMC team	✓	×	×	×
CNG Station Supervisor	✓	✓	✓	✓
CNG Filler	✓	✓	✓	×
Compressor Operator	✓	×	✓	✓
Virtual Pipeline - DCS - Operator cum Technician	✓	×	✓	✓
CNG O&M Staff	✓	×	✓	✓
LNG / LCNG O&M Staff	✓	✓	✓	✓
CNG/LNG/LCNG Project Supervisor / In-charge	✓	×	✓	✓
CNG/LNG/LCNG Project Technician	✓	×	×	×
Civil Staff - CNG/LNG/LCNG Projects	✓	×	×	×
Certified Electrician	✓	×	✓	✓
PRI OEM O&M Staff	✓	×	×	×
Odorant Handling staff	✓	×	✓	✓
Terminal Compressor O&M Staff	✓	×	✓	✓
Terminal Compressor O&M Supervisor	✓	×	✓	✓
Security staff at Gas Installation	✓	×	✓	✓
CNG & LNG Transportation Drivers	✓	✓	✓	×
Hired Vehicle Drivers (non O&M)	✓	✓	×	×
HDD/Hydra/Crane/Excavator Operator	✓	×	×	×
Contractor Staff / TPI / Outsourced Employee - Non- Technical				
Security staff at offices and warehouse	✓	×	✓	✓
Billing staff	✓	×	×	×
DMA/CDMA staff	✓	×	×	×
House Keeping Staff	✓	×	✓	×
GGL Employee (Technical/Non-Technical)				
New GGL Employee - Technical	On joining	On joining	✓	✓
New GGL Employee - Non-Technical	On joining	On joining	×	×
GGL employees - staff & shift engineer as part of emergency response team	✓	✓	✓	✓
Floor Warden	×	×	✓	×
First Aider	×	×	×	✓


TRAINER FREQUENCY & TRAINER MATRIX

 GUJARAT GAS	Training Frequency & Trainer Matrix		Doc. No.: HSE-F-47
			Rev No.: 1
			Effective Date: 01.08.2021
Training Title	Frequency (Years)	Trainer	Target Group
Practical Fire Fighting Training	Once in 3 years	HSE Rep - GA / Corporate	As per Training Applicability Matrix
First Aid Training	Once in 3 years	External Agency	
Basic Safety Training + Fire fighting (Classroom Training)	Once in 3 years	HSE Rep - GA / Corporate	
Induction Training - HSE	On joining	HSE Corporate	GGL Employee - New (including GET/MT)
Functional Training	On joining	Based on recommendation of GAH/Function Head	GGL Employee - New (including GET/MT)
Technical Competency Trainings			
Plumbing Training including Basic Safety + Fire fighting (Classroom Training)	Once in 3 years	External Agency	Plumber
Working at Height Training	Once in 3 years	External Agency	WAH-Plumber
Working at Height Training	Once in 3 years	External Agency	WAH-Plumbing Supervisor & Rescuer
PE Welder Training & Qualification	Once in 3 years	External Agency	PE Welder
CNG Filling Training including Basic Safety + Fire fighting (Classroom Training)	Yearly	External Agency	CNG Filler & CNG Supervisor
On Job Training for Safe CNG Filling	Half Yearly	GA - CNG O&M / HSE Rep	CNG Filler & CNG Supervisor
Steel Pipe Welder Qualification	As per TPI Certification	TPIA	Steel Pipe-welder
Steel/PE/PNG O&M & Emergency Handling Training including Basic Safety + Fire fighting (Classroom Training)	Once in 3 years	External Agency	Steel/PE/PNG O&M Staff / Emergency handling team including GGL Employees - staff & shift engineer as part of emergency response / O&M team
LNG/LCNG O&M Training including Basic Safety + Fire fighting (Classroom Training)	Yearly	External Agency	LNG/LCNG O&M Staff, Emergency handling team & LNG Tanker driver including GGL Employees - staff & shift engineer as part of emergency response / O&M team
Defensive Driving Training	Once in 3 years	External Agency	CNG/LNG Transportation Drivers & Hired Drivers

WASTE MANAGEMENT MATRIX


Waste Management Matrix					
Waste item	Responsibility of collection	Storage Location	Responsibility of Storage & Disposal	Method of Disposal	Record to be maintained
Hazardous Waste					
O&M Waste					
Used oil from Compressor / DG set	GGL EIC through contractor	CNG Station / CGS	Contractor	Disposed to SPCB authorised vendor	From-3, Form 4, Manifest
Cotton Waste- Contaminated with Used oil		CNG Station / CGS	Contractor	Disposed at land fill sites	
Used Gas filter cartridge		GGL Store / Warehouse	GGL Warehouse – rep.	Disposed at land fill sites	Manifest
Ethyl Mercaptan scrubber drums		CNG Station / CGS	Vendor	Disposed to SPCB authorised vendor	Manifest
Used Suraksha hose		GGL Store / Warehouse	GGL Warehouse – rep.	Disposed at land fill sites	Manifest
Condensate during pigging		Condensate tank at site	Contractor	Disposed to SPCB authorised vendor	Manifest
Used Odorant Tank		GGL Store / Warehouse	GGL Warehouse – rep.	Disposed to SPCB authorised vendor	Manifest
Project Waste					
Used Welding Electrodes	GGL Site In-charge through contractor	Respective Contractor store	Respective Project Contractor	Disposed to SPCB authorized vendor	Manifest
Equipment-Used Oil				Disposed to SPCB authorised vendor	
Coating / Chemical cans				Disposed to SPCB authorized vendor	
Coating applicator Pad				Disposed to SPCB authorized vendor	
Used Hydro-test Water		Contractor water tanker		During de watering, care shall be taken to properly dispose the discharging water in order to avoid pollution, damages to fields under cultivation and / or existing structures and interference with the traffic. As chemical have been added to water, dewatering shall be done in such a way that the composition of the efficient water does not exceed the limit set in IS 2490 (Part-I) tolerance limits for industrial effluents discharged into in land surface water. Hence, dewatering circuit shall include chlorination before letting the water out of the pipe section to the environment.	
Other Hazardous Waste					
Plastic / other non-biodegradable scrap < 50 micron	GGL Site In-charge through contractor	GGL Store / Warehouse	GGL Warehouse – rep.	Sold to SPCB approved re-cycler	Monthly Patrak
Used empty paint cans	GGL EIC			Sold to SPCB approved re-cycler	Manifest
Used batteries	GGL EIC			Sold to dealers having authorisation to collect used batteries	Form-VIII
E-waste	GGL IT In-charge			Sold to vendors having authorisation for collecting e-waste	Register
Non- Hazardous Waste					
Project and O&M Waste					
Cotton waste	GGL Site In-charge through contractor	Respective Contractor store	Contractor	Dust bins / garbage container	Challan
Discarded Grinding Disc		Respective Contractor store		Sold to authorised scrap dealer	
Used Stringer brush				Sold to authorised scrap dealer	
Bevel Protector				Sold to authorised scrap dealer	
Foam Pig		Contractor truck		Sold to authorised recycler	
Bentonite Mud used for HDD	Landfill Site				
Metal Scrap (CS, MS) Pipe, Fittings, Valves	GGL Site In-charge through contractor	GGL Store / Warehouse	GGL Warehouse – rep.	Sold to authorised recycler/scrap dealer	
Other Metallic / Non-metallic scrap e.g. meters, regulators etc.					
Aluminium, Brass, Copper Scrap					
Scrap PE pipe pieces, Fittings, valves					
Non-usable Project surplus – Steel & PE					
Admin Waste					
Canteen Wastes	Admin In-charge through respective Contractor	At designated location in premises	Admin Contractor	Local Authority Waste Management arrangement – e.g. Municipal Corporation waste truck	
Used Plastic Water Bottle					
Waste paper					
Broken glasses					
Electrical bulbs/tube lights etc.	Admin In-charge through respective Contractor	GGL Store / Warehouse	GGL Warehouse – rep.	Sold to authorised recycler/scrap dealer	
Rubber Scrap					
Wooden Scrap					
Office Chairs, Fan, Water Cooler					
Electrical Waste - Motor, Pump, Panel, UPS	EIC through contractor	GGL Store / Warehouse	GGL Warehouse – rep.		
Other Non-Hazardous waste					
Plastic / other non-biodegradable scrap > 50 micron	Respective Function In-charge	Waste bins / garbage container	-	Local Authority Waste Management arrangement – e.g. Municipal Corporation waste truck	
Housekeeping waste	Contractor		Admin		
Building material (civil) waste	GGL EIC through contractor		Contractor		

CONTRACTOR PERFORMANCE ASSESSMENT REPORT


		Contractor Performance Assessment Report (CPAR)		Doc. No. : HSE-F-28 Rev. No. : 04 Eff Date : 01.11.2021	
GA / Function:		Month of Evaluation:			
Location:		Department:			
Type of Work/Services:		Work order number:			
Name of the Contractor / Firm:		Contractor Name:			
Contractor Work In-charge:		GGL Work In-charge:			
		Actual Marks	Maximum Marks	CATEGORY	Total Score
A. Business Performance (Weightage 70%)					
1	Business targets achieved within SLA or scheduled / agreed timelines	140	140	(Work Done/Work allotted)*140	
B. Contract Management (Weightage 5%)					
1	Timely deployment & mobilization of qualified, competent and trained manpower & equipment	2	2	Non-compliance/ Un-adherence Full compliance/ Adherence Not applicable	0 2 NA
2	Supply of materials and equipment as per contractual requirements within timelines	2	2		
3	Effective liaison with permission issuing authority / with private entity / other utilities	2	2		
4	Timely resolution of Complaints & settlement of all site issues	2	2		
5	Maintain complete records at the site & Submission of reports, Invoices / RA bills in time and promptly closing of queries	2	2		
C. Quality Controls (Weightage 5%)					
1	Quality of Workmanship / Job execution / Services	2	2	<90% compliance 90 - 99% compliance 100% compliance/ Adherence Not applicable	0 1 2 NA
2	Quality of Supervision, Inspection etc.	2	2		
3	Quality of Tools & Tackles, Equipment, Instruments used for GGL work	2	2		
4	Quality of materials used for GGL work (Supplied by Contractor)	2	2		
5	Proper storage and handling of materials & equipment at store, camp and at site	2	2		
D. HSE Compliance (Weightage 10%)					
1	Adherence to use of PPE's at site	4	4	Non-compliance/ Un-adherence Partial Compliance Full compliance/ Adherence Not applicable	0 2 4 NA
2	Immediate Incident reporting & management	4	4		
3	Proper Waste management (collection, storage and disposal)	4	4		
4	Minimum 2 Work place Inspection per month by Project Manager / Contractor owner & Reporting of minimum 2 numbers of job related Hazard / Near-miss per month	4	4		
5	No overdue actions from reported Hazard / Near-miss / WPI (Work Place Inspection) / Safety tour / Internal or External Audit Observations	4	4		
E. Life Saver (Weightage 5%)					
1	Compliance to GGL Life Savers	10	10	<80% compliance >=80% to <90% compliance >=90% compliance	0 5 10
F. Other Key Performance (Weightage 5%)					
1	Compliance with Statutory & Legal requirements	5	5	Non-compliance/ Un-adherence Full compliance/ Adherence Not applicable	0 5 NA
2	Closure of recommendation from previous month CPAR to the satisfaction of GGL	5	5	<80% closeout 80% - 90% closeout >90% closeout Not applicable	0 3 5 NA
NOTE : N/A (not applicable) should be used if the ratings are not going to be applied to a particular area for evaluation					
Total Actual Marks (A+B+C+D+E+F)		200			
Total Maximum Marks = All Applicable line items of (B*2 + C*2 + D*4 + F*5) + 10 + 140		200			
CPAR Score = Total Actual Marks / Total Maximum Marks x 100		100%			
Performance Category (as per Table-1 of HSE-P-08)		Exceptional <input type="checkbox"/>	Satisfactory <input type="checkbox"/>	Below Satisfactory <input type="checkbox"/>	Poor <input type="checkbox"/>
Recommendations for Improvements (to be reviewed next month):					
1					
2					
3					
Reviewed by		Evaluator (GGL)		Contractor Representative	
GA / Function Team	Designation & Name	Signature & Date		Signature & Date	
	Work in charge				
	Technical / Function Manager				
	HSE Representative				
Approved by		GA Head / Function Head			

Note: Draft CPAR format for reference only

LIFE SAVER COMPLIANCE



LIFE SAVERS- FOLLOW LIFE SAVER RULES TO AVOID ACCIDENTS



1. Driving

- Plan your journey in advance considering route, duration, road condition and weather condition
- Never drive or allow driving when driver is fatigued or under influence of substances like alcohol, painkillers, anti-depressants, recreational drugs etc.
- Ensure vehicle is fit for purpose
- Ensure periodic inspection, servicing and maintenance of vehicles
- Ensure provision of leg guards on two wheelers
- Always wear seatbelt while driving / travelling in passenger or commercial vehicle
- Always wear crash helmet while riding two-wheeler
- Never exceed passenger limit in vehicle nor allow unauthorized person in driver's cabin of hazardous goods vehicle
- Avoid use of two wheelers / three wheelers for travel on highways and / or dark roads
- Practice defensive driving - Respond promptly to unsafe act of others on the road
- Obey traffic rules, traffic signs and signals
- Obey speed limits
- Avoid harsh braking and harsh acceleration
- Avoid overtaking on the roads without divider
- Drive in correct lane only
- Reduce speed based on road conditions and at accident prone areas like sharp turn, blind turn, steep curve, narrow bridge, heavy traffic area, road under construction, road diversions, etc.
- Maintain safe distance from the vehicle ahead
- Never use mobile phones or any other communication device while driving
- Keep parking lights ON when parking on highway and use reflective parking triangle to avoid accident
- Look for traffic while getting down from vehicle

2. Safe System of Work (SSoW)

- Before commencement of any job, ensure:
 - Job & site related hazards are identified and appropriate control measures are in place
 - An appropriate emergency/ rescue plan is in place
- Obtain Permit to Work (PTW) authorization from issuing authority as applicable to the job
- Ensure that approved PTW mentions detailed scope of work, must have clearly identified hazards, associated risks and necessary control measures
- Ensure no personnel is working at worksite without prior intimation and authorization
- Avoid Simultaneous Operations (SIMOPS) which have potential to lead to hazardous situations
- Carry out Tool Box Talk (TBT)
- Provide cautionary instructions about exposure to hazards to people in vicinity of worksite
- Prior to commencing a job on isolated facilities, get confirmed all electrical & mechanical isolations (e.g. Gas installation, Gas pipe section, equipment, etc.) by authorised person and follow Lockout & Tag out (LOTO) system
- Ensure the job is performed by trained & competent personnel
- Ensure safety critical job is being supervised by competent supervisor
- Wear appropriate Personal Protective Equipment (PPE) for the concerned job
- Ensure material, tools and equipment required for performing the job are fit for purpose
- If unsure about job to perform safely, stop the job immediately and discuss with supervisor/ manager
- Intervene and stop unsafe job at site
- For any change in conditions, stop work, reassess the risk and obtain reauthorization as appropriate
- In case of exposure of worksite to road traffic, ensure safety measures like use of flashlight, reflective traffic cones, barricades with reflective stripes to divert the traffic well before the working location/ parked vehicle/equipment etc.
- Do not override or bypass any safety controls without proper authorization and additional safety measures to mitigate the risk
- Before closing & leaving the site, ensure that site is safe, clear & tidy
- Follow Management of Change (MoC) process for changes to plant/ equipment

3. Excavation, Manual Boring and Horizontal Directional Drilling

3.1 Excavation

- Follow "Safe System of Work" Life Saver rules
- Identify, locate and protect all underground utilities e.g. power cable, gas pipeline, etc. as necessary
- Use insulated crow bar / pick-axe for manual excavation
- Identify & mitigate the hazards as necessary e.g. contaminated soil, equipment movement, traffic etc.
- Follow correct trench protection techniques as per soil conditions like step out (benching) or sloping ("V" shape) or shoring
- Keep machinery and excavated spoil away from edge of trench / pit
- For any change in ground conditions, stop work and consult supervisor
- Keep children away from pit / trench / work sites
- Display warning signs, use appropriate barricades at work area and provide easy means for getting in and out of trench / pit
- Make provision of proper crossover for pedestrian as required

3.2 Manual Boring

- Follow "Safe System of Work" Life Saver rules
- Identify, locate and protect all underground utilities e.g. power cable, gas pipeline, etc. as necessary
- Identify & mitigate the hazards as necessary e.g. contaminated soil, equipment movement, traffic etc.
- Give preference to open cut excavation over manual boring
- Before each manual boring work, ensure:
 - Approved bore plan is in place
 - Entry and exit locations for manual bore are visibly marked
 - Permit to Work (PTW) for the job is in place
- Ensure protection against potential electric shock by:
 - Use of electrical shock resistant (Teflon or equivalent approved insulating material coated) manual boring tool
 - Wearing of rated electric shock resistant hand gloves and shoes
 - Provision of "Electrical Insulating Rubber Mat" on the ground
 - Avoiding work in wet conditions if electrical power supply is not isolated

3.3 Horizontal Directional Drilling (HDD)

- Follow "Safe System of Work" Life Saver rules
- Identify, locate and protect all underground utilities e.g. power cable, gas pipeline, etc. as necessary
- Identify & mitigate the hazards as necessary e.g. contaminated soil, equipment movement, traffic etc.
- Before starting HDD operation, ensure:
 - Approved bore plan is in place
 - HDD entry and exit locations are visibly marked
 - Capacity of HDD drilling rig is adequate
 - Proper earthing / grounding of machine
 - Cable strike alarm is in working condition
 - Moving parts of machine are guarded
 - Out rigger of HDD machine is working and rigidly put on stable & firm ground
 - Availability of tracking equipment / device
 - Crane is in good condition
 - Preferably auto rod loading facility is available in the machine
- During drilling operation, do ensure:
 - Track movement of the drilling tool as per approved bore plan
 - Auto greasing & auto loading of machine rod is functioning properly. In case of manual loading of the machine rod, ensure additional safety measures to mitigate the risk from moving parts
 - Entry of unauthorized personnel in the work area is prohibited
 - No maintenance activity is carried out while HDD machine is in operation

4. Work at Height

- Follow "Safe System of Work" Life Saver rules
- Use only approved and certified working at height equipment e.g. rope access system, scaffold, ladder, etc.
- Give preference to safe working platform in place of rope access system or ladder wherever possible for carrying out work at height job
- Ensure use of rope protectors to avoid any damage to ropes from sharp edges
- Identify fall from height hazard before starting of plumbing job (including plumbing at balconies) and ensure use of safety harness with proper anchoring

11. List of Annexure:

11.1. Annexure 1: List of sites for the captive consumption

11.2. Annexure 2: Check list of land documents

(Please put "tick" as applicable)

Sr. No.	Description	YES	NO	NA (NOT APPLICABLE)
1	Survey Number Details issued by the Revenue Dept./ Concerned local authority.			
2	Copy of 7-12 issued by the Revenue Dept./Concerned local authority.			
3	Copy of Form-6 issued by the Revenue Dept./Concerned local authority.			
4	Copy of Form8A issued by the Revenue Dept./Concerned local authority.			
5	Location plan of the plot w.r.t. the existing adjoining areas, Approach Road, NH, Railway station, Water Canal, Sub Stations etc. (Preferably on Google map). Location of the plot marked on Master Plan/City Plan/Village plan of that area			
6	Location of the plot marked on the approved Master Plan/Village Plan of the area.			
7	Layout plan of the site showing all dimensions, Permanent structures with dimensions, HT/LT lines, Sectoral/other roads, hillock, low lying area/ponds etc.			
8	Title documents of the land (sale deed /lease deed/ Mutation papers/allotment letter etc.)			
9	Certificate from the local development authorities/District Town Planner regarding permissible land use of offered land.			
10	Copy of Jamabandi (Title) of land for last 30 years			
11	Calculations for applicable stamp duty / registration fee for the offered land based upon the prevailing circle rates of that area issued by the Tehsil /Lawyer along with the copy of Notification for circle rates.			
12	Copy of the approved sanction plan (if available) of the Offered land issued by the local authority.			
13	A certificate from the local DM / L&DO / Land acquisition office /Circle office or any other concerned body / authority, certifying that the offered land has neither been acquired nor under any proposed acquisition as on date.			
14	Memorandum of Articles of Associations			
15	Confirmation by the Contractor (as per Form-F6)			



Sr. No.	Description	YES	NO	NA (NOT APPLICABLE)
16	Any other documents required for in support of Clear Title of land ()			

Remarks: In case of Documents / Details required as mentioned at Sr. No 7 to 13 are not readily available, Bidders/Applicant shall give undertaking or provide same before signing of Lease agreement with GGL.

Confirmation to be given by the successful contractor as per the annexure F-5 of section V (forms and format)