

		P.T. supply. The rating suitable for min. three breaker operations
2.11	Rated short time current	18.37 KA (1 sec.) rms
2.12	Making capacity	46 KA (peak)
2.13	Busbar current rating	400 A min.
2.14	Cable entry	Bottom
2.15	Cable size	3c x 240 sq.mm. XLPE armored cable (incoming) (E) 3c x 240 sq.mm. XLPE armored cable (outgoing) (E) Or As Per Design Calculation.
2.16	Breaker particulars :	
	(a) Operating duty	0 – 3 min- CO – 3 min – CO
	(b) Operating mechanism	Motor charged spring / manual trip & close
	(c) Spring charging motor	230 V AC, 200 W[or as per manufacturer design]
	(d) Trip / Closing coil	110 V DC, 180 W[or as per manufacturer design]
	(e) Anti pumping feature	To be provided
	(f) Latching requirement	Trip free
	(g) Emergency trip push	Required

	button	
	(h) Space heater and cubicle lamp	Required
	(i) Earthing truck	Required
2.17	Constructional requirements	
	(a) Thickness of sheet steel for frame, enclosure, doors, covers and partitions	CRCA sheet & thickness as per tender specification, hinge type door with neoprene rubber gasket
	(b) Degree of protection	IP 4X
	(c) Colour	Epoxy powder coating – Siemens grey
	(d) Earth bus size	50 × 6 mm GI
	(e) Foundation frame	ISMC-75, Suitable for three breakers with necessary bed plate and foundations bolt.
	(f) Over all dimension	PI furnish
	(g) Minimum area required on front side as well as rear side	PI furnish
2.18	Annunciation Provision	Min. 12 Windows
2.19	RELAYS	Over Current, Short Circuit, Earth Fault, Transformer Protection etc.
	(a) Relay no. & type	O/C (51) E/F (51N)

	(b) Type of relay	Numerical	Numerical
	(c) Plug Setting Range	5-200%	20-80%
2.20	CURRENT TRANSFORMER		
	(a) Type of CT	Cast Resin, dual core, dual ratio as per Design	
	(b) Accuracy class	As per Design	
	(c) VA burden	As per Design	
	(d) CT ratio	As per Design	
2.21	POTENTIAL TRANSFORMER		
	(a) Type of PT	Cast Resin	
	(b) Accuracy class	As per Design	
	(c) VA burden	As per Design	
	(d) PT ratio	As per Design	
2.22	PANEL ACCESSORIES		
	(a) Toggle switch for space heater and socket	230 V A.C , 10 A	
	(b) Socket	5 pin 5/15 A with switch	
	(c) MCB for spring charging motor circuit	6 A , DP MCB	
	(d) MCB for ON / OFF	Double pole, 16 A, 110 V D.C for D.C ckt. Double pole, 16 A, 230 V A.C for	

	A.C ckt.
(e) Local / Remote selector switch	4 ways, 2 positions, lockable in any position, angular movement, stayput, lever type handle.
(f) Auto- Off – Manual switch	18 way, 3 position, lockable in all position, stayput, wing type handle.
(g) Breaker control switch (Trip – Neutral – Trip)	6 way, 3 position, spring return to neutral, angular movement, pistol grip type handle.
(h) LED indicating lamp (230V A.C)	Breaker On - Red colour Breaker Off - Green colour Auto trip - Amber colour Trip ckt healthy - Amber colour Spring charged - Blue colour 100 ohm, 3 / 4 W resistor
(i) LED indicating lamp 230V A.C	2 / 3 W bulb for R , Y , B , Healthy indication
(j) Space Heater	230 VA.C , 100 W
(k) Panel Illumination	11 W CFL with switch for each panel
(l) Limit switch for test and service position.	Required

- i. Co-ordination of rated voltages, short circuit breaking current and rated normal current for guidance as per IS 13118 for rated voltage 11 kV and above as commonly used.

- ii. Circuit Breaker protection against
 - Over Current
 - Earth fault
 - Under voltage & over voltage protection
 - Under frequency & over frequency
 - Transformer Protection.
 - DC supply failure

6.1.9 Protective Relays

- i. 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, Transformer Protection 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.
- ii. The numerical relays shall have RS 485 port for communication.
- iii. The operating voltage of the relays shall be 110 V DC/220 V DC as per battery bank rating.
- iv. 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 Company/Electricity Authority (DISCOM/GETCO).

5.3.20 Earthing for PV Array

- i. The photovoltaic modules, BOS and other components of power plant requires 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 3.0 m long 40 mm diameter perforated Cu/GI/ chemical compound filled, double walled earthing electrodes including accessories, and providing masonry enclosure with cast iron cover plate having pad-locking arrangement, 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 Company'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 prepared and installed in entire power plant.

5.3.21 Lightning Protection for PV Plant and Earthing

- 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, Inverter Room, and 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 defining 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 table below
 h : 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 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

- ii. 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 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.
- iii. If necessary more numbers of lightning conductors may be provided as per design calculation
- iv. The Contractor shall submit the drawings and detailed specifications of the PV array lightning protection equipment.
- v. 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.
- vi. Contractor shall provide dedicated two earth pits for Lightning Arrestor as per relevant IS standard.

5.3.24 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). **However, this shall be supported by design calculations. Rating shown as above is indicative only.**

- iv. The configuration of the PCCs shall be as per the Single Line Diagram of the system.

11 kV Two Pole Structure

The pole structure comprising of following items:-

- i. All M.S. elements of channels, angles, and flat shall be painted with two coats of primer and further painted with two coats of Aluminium paint. All nut & bolts, washer etc. used shall be hot dip galvanized.
- ii. Vertical pole of minimum ISMB - 175 (175 mm x 90 mm) size of 9.0 mtr. length as indicated in the drawing, with 400 x 400 x 8 mm size base plate welded to one end of both the joists.
- iii. Cross member of minimum ISMC - 100 (100 mm x 50 mm) size channels approximately 3.5 m each Length wherever required as indicated in the drawing.
- iv. Cross bracing angle of minimum ISA - 50 (50 mm x 50 mm x 6 mm) size of 4.5 m. each Length wherever required as indicated in the drawing.
- v. Side clamps, stay clamps, cleats, patties, etc. Fabricated from minimum 50 mm x 6 mm size M.S flats as per actual requirement.
- vi. All nuts, bolts, washers etc. shall be of minimum 15 mm size.
- vii. Erection of poles and fixing of all structural members as per drawing and instruction of Site engineer. The structure shall be erected in plumb, line level, properly facing the incoming and outgoing lines. Cross member shall be firmly tightened.
- viii. All member shall be fabricated to suit the mounting / fixing of GOD, L.A, DOF, DISC/PIN/POST insulators, cable end termination kit / box etc. as per the drawing.
- ix. All necessary hardware, nut-bolts, extra members, sundry items are included in the scope of work.
- x. All M.S parts shall be painted with primer and aluminium paint.
- xi. Earthing terminal shall be provided by welding 12 mm size bolt / cleat of 50 x 6 mm size M.S flat shall be fixed to each joist with a hole of 15 mm size and cadmium coated nuts, bolts, washers shall be provided as earthing terminals. Fixing or joining of any members is allowed by nut and bolt only welding is strictly not allowed.
- xii. Suitable M.S. flat supports and cleats shall be fixed to ISMB poles for supporting / fixing the earthing protection strip in the manner approved by the Client.
- xiii. Vitreous enameled caution boards or any other requirements shall be provided.
- xiv. All drawing shall be prepared and submitted to Industry Mines & energy Dept. for approval. Obtain the approval from I.M. & E. Dept.

xv. C.T.P.T. mounting channels, clamps, bracing angles, nut-bolts, hardwares, etc. shall be supplied and erected.

xvi. Guy wire with suitable turn buckle, stay insulator at required location and direction as per the site requirement.

Air Break Switch

i. The air break switch should be constructed as per IS: 9920 / 1985 and provide test certificate.

ii. The A.B. switch should be triple pole type with movable center pole. All the poles should be opened / closed simultaneously by a lockable operating mechanism.

iii. The porcelain insulator shall be sound free from defects, thoroughly vitrified and smoothly glassed. Insulators shall have compressing type glassed with a good luster and of uniform brown color.

iv. The air break switch should be provided with 1 year guarantee and the test report.

v. The A.B. switch should be manually operated and shall be able to :

- Carry rated current without excessive temperature rise.
- Withstand the short circuit forces developed during fault.
- Carry the inrush current of transformer.
- Interrupt small inductive / capacitive current.

vi. The contacts shall be of silver faced copper ensuring sufficient contact pressure.

vii. The male & female contacts should be of self aligning type to ensure trouble free operation during opening and closing. Mild steel arcing horn capable of breaking the magnetizing current shall be provided.

Drop Out Fuse

i. The D.O. Fuse assembly should be suitable for 11 KV supply and in accordance with IS 9385 / 1985. and provided with a test certificate

ii. The assembly shall be mounted on double pole structure complete with 3 fuse elements of required ampere rating. The fuse link shall consist of iron channel base, stack insulator per phase, fuse carrier bakelite tube, non-ferrous metal parts and spring loaded phosphor-bronze contacts. The insulator shall comply with impulse voltage test in accordance with IS 3106.

Lightening Arrestor

Type and Rating

Lightning arrestor shall be station class, heavy duty, non-linear resistance type with rating as 11 KV. The arrestor shall have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes.

Constructional Features

- i. The arrestor shall be single pole and hermetically sealed off. It shall be of robust construction with excellent electrical and mechanical characteristics.
- ii. Insulators must be non-hygroscopic and shall be wet process porcelain, brown glazed and free from imperfection. All metal parts and hardware shall be hot dip galvanized.
- iii. Creepage distance shall correspond to heavily polluted atmosphere. Grading ring if required shall be provided to maintain voltage gradient within permissible limit.
- iv. The arrestor shall be provided with pressure relief device if applicable to prevent shattering of approach in case excessive gas pressures build up.

Accessories

- i. Lightning arrestor shall be furnished complete with insulating base, surge counter and anchoring hardware for mounting on steel structure.
- ii. A surge counter shall be mounted at a convenient height for reading counter Terminals shall be such as to permit connections with minimum bends.
- iii. A leakage current detector shall be furnished with the counter as an integrate part. This is for monitoring the leakage to indicate any possible breakdown.
- iv. A suitable sized bypass shunt along with necessary terminals shall be furnished for bypassing the discharge counter if required.

Terminals

- i. All connection terminals shall be of corrosion resistant material and shall be provided with complete connection hardware.
- ii. High voltage line terminal connector suitable for ACSR, AAAC conductor.

Related Civil Work

Foundation require for two pole structure in switch yard area shall be carried out by vendor with respective civil material as required to complete the job successfully as mentioned in our drawing.

5.3.25 Execution

- i. Single front / compartmentalized, modular design, degree of protection IP52 with provision of extension on both sides.

- ii. Incomer feeders: mains incomer - Electrically operated draw out type Air Circuit Breakers (ACBs).
- iii. Outgoing feeders : Electrically operated draw out type Air Circuit Breakers (ACBs) / Molded Case Circuit Breakers (MCCBs)
- iv. The color finish shade of switchgear enclosure for interior shall 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.
- v. The PCC shall be fabricated out of **CRCA** sheet steel; 2 mm thick for the outer shall all-round. The internal walls and separators shall be of 1.6 mm thick **CRCA** sheet steel.
- vi. The gland plates shall be 3 mm thick.

5.3.26 Control & Relay Specification for 415V TP & N Power Control Centre(PCC)

- i. This specification is for the 415V TP&N Power Control Centre (PCC).
- v. 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). **However, Bidder shall have to carry out the short circuit current analysis and shall submit to GSECL for approval before selection of short circuit rating of equipments. Rating shown as above is indicative only.**
- ii. The configuration of the PCCs shall be as per the Single Line Diagram of the system.

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

Control Circuit

- a. Control supply for breaker closing / tripping - 110V DC
- b. Air Circuit Breaker spring charge motor – 240 /220 V AC/DC
- c. Molded Case Circuit Breakers – 240 V AC, 1 phase
- d. Indications, annunciation – 110V DC
- e. Space heater, sockets, etc. – 240 V AC, 1 phase

Bus bar 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 load.
- 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.

5.3.27 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 GSECL.

5.3.28 Auxiliary Power Supply

- i. The Contractor shall install a separate 11 kV / 415 V step down transformer to supply power for internal equipment such as power for control equipment, area lighting, water pumps, 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.

5.3.29 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, annunciators 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 GSECL / GETCO.
- iii. DC Batteries the batteries shall have the following specifications
 - a. Type : Nickel Cadmium Stationary/ VRLA, sealed type, storage battery
 - 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 or PP
 - 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 gasses released from the battery cells.
- v. The data sheet for the battery shall be submitted along with the Bid for evaluation.

5.3.30 Earthing

- 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.

Terminals

- a. CT circuit - 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

Specific Requirements

1. 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.
2. ACBs shall be complete with microprocessor release and shall be provided with over current, short circuit and earth fault protections.
3. **Minimum 10% spare feeders of each rating shall be provided in the switchgear for 11kV VCB panel and SMB.**
4. All current transformers shall have 5/1A secondary and all meters shall be suitable for 5/1A operation.
5. 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
6. All indicating instruments shall be flush mounting, Digital, 96 sq.mm size.
7. Window annunciator with hooter and accept, test, reset button shall be provided. Necessary auxiliary relays for contact multiplication shall be provided in the panel.
8. 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.

Instrumentation: Switchgear instrumentation shall be provided as follows:

- a. Mains Incomer – Voltmeter with selector switch
- b. Ammeter with selector switch
- c. Power Factor meter
- d. Frequency meter
- e. TVM + MD meter
- f. Potential indicating lamps
- g. Outgoing Feeders
- h. Ammeter with selector switch on all feeders.

5.3.31 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 Company.

- 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 3 pin switch socket combined unit of 5 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 shall 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. The 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 on each terminal block. 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 voltage specified.
- 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 to 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 dispatch to site at the discretion of GSECL.
- xxxiv. All routine tests shall be carried out on the panel in presence of the Company / 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 on following drawings shall be obtained before manufacturing the panels
 - a. General arrangement drawing.

- b. Wiring Diagram.
- c. 11 kV Transmission Line

The Contractor shall provide 11 kV transmission with bay and metering on Turnkey basis as per GETCO / DISCOM requirement as per the application. Bidder shall confirm the same in the Bid.

xxxvii. Detail bill of material.

11 kV Under Ground Cable

The Contractor shall provide 11 kV Under Ground/Over head 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/Over head line shall also be approved registered supplier in GETCO.

Bidder can opt underground cable or Transmission line. However it shall be as per GETCO guidelines.

5.3.32 Metering System

- i. ABT energy meter shall be provided as approved by GETCO to measure the delivered quantum of energy 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. Metering shall be at GETCO S/s end.
- 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; GSECL will assist Bidder for 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 load.
- 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 0.2 CT cores and Class 0.2 VT windings.
- x. The active and reactive energy shall 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 phases.
- 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 5-11 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		

- xxxviii. 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.
- xxxix. Date/time shall be displayed on demand. The clock shall be synchronized by GPS time synchronization equipment existing at the station provided by Bidder.
- xl. 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.
- xli. 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.
- xlii. 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.
- xliii. 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.
- xliv. 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.
- xlv. 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.
- xlvi. The Company shall have the right to carry out surprise inspections of the Metering Systems from time to time to check their accuracy.

5.3.33 SCADA and Remote Monitoring System

- i. 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.

- ii. 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.
- iii. 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.
- iv. Reliable sensors for solar insolation, temperature, and other weather and electrical parameters are to be supplied with the data logger unit.
- v. The data acquisition system shall measure and continuously record electrical parameters at inverter output, 11KV terminal or the voltage as prescribed by GETCO/DISCOM, 11 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.
- vi. 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.
- vii. The Bill of Materials associated with the equipment must clearly indicate especially the details about the PC and Printers, etc.
- viii. The Data Acquisition System should be housed in a desk made of steel sheet.
- ix. SCADA shall provide following data at a 5-15 minute interval.
 - a. Power at ABT meter at switchyard as per requirement DISCOM/GETCO
 - 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.
- x. 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	11 kv of GETCO/DISCOM Switchyard	Yes		Yes	
2	Isolators	11 kv of GETCO/DISCOM Switchyard	Yes			
3	C & R	11 kv of GETCO/DISCOM Switchyard	Yes	Yes	Yes	Relay Log
4	Power Transformer	11 kv of GETCO/DISCOM Switchyard	Yes		Yes	Marshalling Box
5	Breakers	11 kv of GETCO/DISCOM Switchyard	Yes	Yes		
6	11kV or 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	11 kv of GETCO/DISCOM Switchyard	Yes			Marshaling Box
10	Fire Alarm Panel	MCR / LCR	Yes	Yes		
11	Inverter	LCR	Yes	Yes	Yes	Inverter Data Log
12	11kV RMU	LCR	Yes	Yes	Yes	MFM Meters with RS485
13	Weather Monitoring	MCR	Yes		Yes	

	Status					
14	Plant Switchyard & Lighting	11 kv of GETCO/DISCOM Switchyard	Yes	Yes		Feedback through ACDB & Light ON/OFF Programming
15	CCTV	LCR / MCR / Plant / Switchyard	Yes		Yes	NVR based recording & data transmission 360 degree rotatable, night vision and state of the art Technology of reputed bidder shall be considered. Bidders to submit credentials and specification at the time of detail Engineering.
16	String Junction Box	Plant	Yes		Yes	Each String Monitoring

xi. SCADA shall provide 15 minute daily, monthly and annual average of following parameters:

- Exported Energy to grid at voltage level as prescribed by DISCOM/GETCO
- Energy of each inverter
- Solar Radiation
- Temperature

xii. The SCADA server PC shall be of Industrial type, rugged & robust in nature to operate in a hostile environment. The PC shall 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.

xiii. 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.