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Technical specification for Supply of Balance of System items, Installation & Commissioning of 75MW (AC) Solar Photovoltaic Grid-connected Power plant at Charanka Solar Park, Gujarat

Revision details:	Prepared	Approved:	Date:
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1.0 Introduction

1.1 Overall project outline of 75MW (AC) solar photovoltaic power plant

Bharat Heavy Electricals Limited (BHEL), Electronics Division, Bangalore is setting up a 75MW (AC) solar photovoltaic (SPV) power plant for GIPCL at Charanka Solar Park, Gujarat.

Solar PV modules employed at the plant generates DC electricity that in turn shall be inverted to AC in the range 300-400V. Output of each solar block (5MW) with independent inverter room (IR) / transformer yards shall be stepped up to 33kV. Solar plant comprises of 15 nos. of Inverter rooms with associated array and 1 no. of Main Control Room (CMCS). Output of each 5MW Inverter room is combined at CMCS at 33KV level. Combined AC output is stepped up to 66kV using 60MVA and 30 MVA power transformer. At these outgoer levels, there are two outdoor switchyard bays together with necessary gantries/ towers/ beams/ Cables to facilitate 66kV transmission.

The total land of solar plant is distributed into two areas Plot-B2 and Plot-C, separated by a distance of approx. 500m. Plot-B2 will consist of 4 inverter rooms i.e 20MW (AC) and Plot-C will consist of Main control room and 11 inverter rooms i.e 55MW (AC).

Power generated at the above SPV plant shall be transported to GETCO substation using 66kV underground cables from each of two bays. Distance between SPV plant and substation is 3000m approximately.

The plant is envisaged to have several other infrastructural support systems such as module cleaning system for SPV modules, plant illumination system, fire alarm system, boundary fencing, approach roads, pathways, drainage system etc.

1.2 Scope of this tender specification

Vendor scope includes supply, installation, testing and commissioning of certain identified activities of the solar photovoltaic power plant.

This scope includes activities but not limited to obtaining approval from BHEL/GIPCL for the datasheets/ drawings/ MQP, manufacture/ testing/ inspection at manufacturer's works, packing, supply, transportation, transit insurance, delivery to site, unloading, storage, installation and commissioning of certain AC and DC side activities of power plant identified under this specification.

Note: The above is only a broad outline of vendor scope for the sake of introduction. The detailed vendor scope is elaborated under various other sections of this specification.

1.3 Enclosures to this tender specification (Tender purpose only)

1	Tentative AC single line diagram of overall Solar PV power plant
2	Tentative SPV plant layout with solar array, control/ inverter rooms, switchyards
3	Tentative layout of main control room
4	Tentative layout of inverter room
5	Indicative drawing of Module Mounting Structure
6	Approved vendor list for procurement of BOS items.

1.4 Location/ address of power plant:

75MW (AC) Solar Photovoltaic Power Plant (Plot-B2 and Plot-C)
Gujarat Solar Park,
Village: Charanka, Taluka: Patan,
District: Patan, Gujarat.

2.0 Vendor scope of supply, Installation and Commissioning

The table below indicates the scope of work for the vendor, as briefly outlined. Vendor shall submit the offer as per this list and quantity.

#	Scope of work (as briefly outlined)	Qty
1	**Supply of Items for Control Room (CMCS)** This includes the supply of 200KVA ONAN aux Trf, Weather monitoring system, cable lugs, glands, cable tray, earth chambers, checkered plate, AC, Fridge, Furniture, cable tags, sign boards, danger boards, nuts bolts, hardwares, termination kits, jointing kits etc. as per the various clauses of this specification	1 Set
2	**Supply of Items for Inverter room (IR) and its associated array** This includes the supply of Mc4, Y-connector, cable ties, HDPE pipes, cable lugs, glands, cable tray, checkered plate, cable tags, sign boards, danger boards, nuts bolts, hardwares, termination kits, jointing kits etc. for Inverter room and its associated solar array as per various clauses of this specification	15 Set
3	**I&C of Items related to Control Room (CMCS)** This includes, installation, testing and commissioning of panels, Aux, Transformer, ACDB, UPS, FCBC, Battery bank, WMS, SCADA, furniture, earthing, cable tray, cable laying and terminations etc. as per the various clauses of this specification	1 AU
4	**I&C of Items related to Inverter room (IR) and its associated array** This includes, installation, testing and commissioning of SMB, PCU, Inverter transformers, Aux transformer, ACDB, FCBC, UPS, panels, earthing, cable tray, cable laying and terminations etc. as per the various clauses of this specification	15 AU

3.0 BHEL scope of supplies and works

For clarity to the vendor, other items and activities within BHEL scope of solar PV plant end of the project are listed below:

1	Supply of 1C x 10 sqmm Solar Cable	~700 KM
2	Supply of DC cable, 2C x 400, Al, XLPE, armoured as per IS: 7098 (from SMB to PCU)	~120 KM
3	Supply of LT cable, 1C x 630, Al, XLPE, armoured as per IS: 7098 (from PCUs to Inverter transformers)	~18 KM
4	Supply of 33kV cable, 1C x 300, Al, XLPE, armoured as per IS: 7098 (for all 33kV connections within plant including Aux transformer HV side)	~60KM
5	Supply of OFC cables along with termination kits. Also, termination of the cables at both ends (SCADA panels of inverter rooms, SCADA panels of main control room and at SMBs)	As required
6	Supply of power conditioning units (PCUs) of 1250 kW with ducts	60 Sets
7	Supply of String Monitoring Box	540 Nos

8	Supply of inverter transformer 2.7MVA, 33kV/350-350 V, ONAN	30 Nos
9	Supply of 33kV breaker panels	17 Sets
10	Supply of SCADA system including PLC panels, computers, software systems and related peripherals & accessories.	17 panels
11	Supply of Aux, control and communication cables **except lighting cables for IR**	As required
12	Supply of ACDB	16 Nos
13	Supply of UPS with battery bank	17 Nos
14	Supply of FCBC and Battery	16 Nos
15	Supply of Dry type aux transformer for Inverter rooms	15 Nos
16	Supply and Installation of Lightning arrestor for PV array	1 Set
17	Supply and Installation of Peripheral lighting system	1 Set
18	Supply and installation of CCTV system	1 Set
19	Supply and Installation of Fire alarm System	16 Sets
20	Supply of Earthing material for PV array, IR and CMCS	1 Set
21	Supply and Installation of Module mounting structure including module mounting	~7500 Sets
22	Supply and Installation of Module Cleaning system	1 Set
23	Construction of Inverter and aux Transformer foundation including fencing	1 Set
24	Supply and Installation of 66KV switchyard	1 Set
25	Unloading/ movement/ storage/ security for BHEL supplied items.	-
26	Construction of PEB inverter rooms, RCC main control room except those vendor scope supply/I&C activities defined under this specification.	15 + 1 rooms
27	Construction of civil works such as approach roads, pathways, drains, overall plant boundary fencing, soak pit, septic tank.	-

4.0 Ordering Methodology

Total scope of supply and work shall be divided into following packages:

Package A (L1 vendor)	Supply of Items for CMCS room	1	Set
	Supply of Items for IR and associated array **(IR-1 to IR-8)**	8	Set
	I&C of items related to CMCS	1	AU
	I&C of items related to IR and associated Array **(IR-1 to IR-8)**	8	AU

Package B (L2 vendor)	Supply of Items for IR and associated array **(IR-9 to IR-15)**	7	Set
	I&C of items related to IR and associated Array**(IR-9 to IR-15)**	7	AU

5.0 Technical specification for supply, installation and commissioning

#	BHEL specification
5.1	**Temporary site office for vendor use** Vendor shall make necessary office arrangements such as porta cabin, furniture, electrical points/ fittings etc. on their own for their use/ occupation at site during the period of project execution. **Note:** Site offices for BHEL and GIPCL shall be arranged by BHEL.
5.2	**Electrical power / water for construction** Vendor shall organize, on their own, necessary electrical power supply such as DG sets and water supply etc. required for construction activities.
5.3	**Construction of temporary yards for safe storage of vendor supplied items** Vendor shall, at a suitable location at the site, as decided based on discussions with BHEL site engineer, construct temporary yards for safe storage of vendor supplied items.
5.4	**Unloading, safe storage and movement of supply items received at site:** **A. Items supplied by vendor** (1) Vendor shall organize all necessary resources such as labour, machinery and tools (cranes, hydra, forklifts, transportation trucks/ trolleys, lifting accessories etc.) for unloading the items (supplied by the vendor) received at site and subsequent movement to storage yards. (2) Similar arrangements shall also be made by vendor for movement of the stored items from storage yards to the exact construction locations within the project site. (3) Vendor shall maintain proper documentation / compilation of all the records related to shipping (invoices, LRs, delivery challans, material receipt certificates etc.) and shall take approval from BHEL site engineer for every consignment. The documents shall be suitably preserved for further handing over to BHEL. (4) Registers shall be maintained for the yard to keep track of incoming/outgoing items. (5) Safety of items shall be in vendor scope. Accordingly, suitable watch and ward shall be deployed on round-the-clock basis. **B. All other items (supplies from BHEL and other vendors)** (1) Receipt, unloading, storage, security guards shall be in scope of BHEL/ other vendors. (2) However, movement of these items from their respective storage locations to the points of construction is in scope of vendor. Accordingly, vendor shall organize all necessary resources such as labour, machinery and tools (cranes, hydra, forklifts, transportation trucks/ trolleys, lifting accessories etc.) for this purpose.
5.5	**Series interconnection of SPV modules to form strings** Supply of SPV modules is in BHEL scope. Type of module: L24270 (~325Wp). Total quantity = ~3,00,000 Nos Vendor shall interconnect the SPV modules as follows: (a) Each module is fitted integrally with a junction box having positive and negative polarity cables (4 sq-mm). (b) Positive cable of one module shall be connected to the negative cable of adjacent module. The cables have MC4 type of connectors. One polarity cable has male type connector, while the other has female type connector. (c) This way, 20 modules shall be connected in series. Each set of connections is called as a series string. (d) Each Module mounting structure (MMS) contains 40 nos of SPV modules. Thus from

	each MMS, two sets of series strings (top row forms one string and bottom row forms other string) will be formed via **leap-frog method**. These two strings will be paralleled at MMS itself using Y-connectors to form a combined output and will be terminated at the input side of SMB as a single input. After placing the purchase order on vendor, BHEL will provide layout drawings that will describe the exact way in which the series strings are formed. Vendor shall implement the interconnection as per these drawings.
5.6	**Installation of SMBs including erection of SMB mounting structures** (1) Supply of string monitoring boxes (SMB), 540 sets, is in BHEL scope. These are 16-in/1- out type. (2) Vendor shall install the SMBs on the module mounting structures. Provision will be provided in the Module mounting structure legs to mount the SMB. However, necessary hardwares like nuts, bolts, washers etc. and **canopy of SMB** shall be in the vendor scope of supply. Details of canopy shall be submitted to BHEL for approval. (3) All necessary labour, tools, machinery etc. for erection work shall be in vendor scope.
5.7	**Interconnection of SPV module strings to 1Cx10 cable** (1) Vendor shall connect two series strings of 40 SPV modules to 1Cx10 cable (copper, XLPO insulation cable) using **Y-connector and MC4 connectors**. (2) Vendor shall supply **500 sets** (1 set = 2 nos) each of Y-connectors and MC4 connectors for array associated with each Inverter room. (3) Y-Connectors and MC4 connectors shall have rating of 1000VDC (IEC), rated current of 30A (min), type approved by TUV Rheinland for product safety. (4) Approved make: Multicontact, Bizlink, Sunlont or other reputed equivalent subject to BHEL/ GIPCL approval during detailed engineering. (5) Required tools and tackles for crimping of cable etc. shall be arranged by vendor.
5.8	**Ferruling for 1Cx10 cable** 1) For 1Cx10 sqmm DC solar array cable, vendor shall provide UV resistant ferrules printed with source/destination identification of cable. Printing details shall be submitted for BHEL/GIPCL approval during detailed engineering. Printing shall be of appropriate size to ensure readability. 2) Supply of ferrule shall be in vendor scope. 3) Ferrules shall be provided on both the termination ends: module end and SMB end
5.9	**Routing of 1Cx 10 cable below the SPV modules** (1) 1Cx10 sq-mm cables connecting the SPV module strings to SMBs shall be suitably routed below the SPV modules and along the horizontal C-lip purlin member of MMS structure. Also, the cables shall be fastened to the purlin using UV resistant cable ties. (2) Cable ties shall be in vendor scope of supply. (3) Cable ties, nylon polyamide 6.6 UV stabilized black, UL94 flammability rating V2, operating temperature up to 85 deg C, shall be used to arrest any possibility of movement or sagging. Cable ties shall be of make: 3M, Phoenix contact, Weidmuller, Hellermanntyton, Panduit or other reputed equivalent subject to BHEL/GIPCL. Width and Length shall be so appropriate as to ensure that the bunched cables are held firmly to the mounting structure. During detailed engineering, BHEL/GIPCL approval shall be obtained for the selected brand and sizes of cable tie. (4) Spacing between two adjacent cable ties shall be so appropriate as to ensure that there is no loose hanging of cables.

5.10	**Routing of 1Cx10 cable in pipes underground between the rows of solar array** (1) Where 1Cx10 cables run between two rows of structure (or) where the cables cross over the pathway separation between two adjacent solar array blocks, HDPE double walled corrugated (DWC) pipe shall be provided to route the cables underground from one row/ block to the other. HDPE DWC pipe together with necessary HDPE couplers/ joints (T-joints, elbows, bends etc) shall be within scope of vendor supply. (2) Specification of HDPE DWC pipe: As per relevant IS; ID shall be selected to accommodate the number of 1Cx10 cables to be guided. ID shall be minimum 60mm. However, exact ID shall be selected to ensure that only a maximum of 60% of the ID space is occupied by the cables. Make, part number, sizes/ dimensions shall be submitted for BHEL/GIPCL approval during detailed engineering. (3) Cables with HDPE pipe (and couplers/joints etc.) shall be directly buried underground as per IS: 1255. a. Trench depth = 400 mm minimum b. Trench width = As per conduit size and number of conduits c. HDPE conduit with cables shall be laid in the trench. d. Trench shall, then, be filled with refill soil and compacted. (4) Total length of HDPE DWC pipe and quantity of couplers/joints shall be as required. (5) Bending radii for cables shall be as per IS: 1255. (6) At road crossings, cables shall be routed through GI pipe of appropriate size that shall be in vendor scope of supply and technical details/ brand etc. shall be submitted for BHEL/ GIPCL approval during detailed engineering. (7) All cable entry openings of conduit pipes, after laying/ termination of the cables, shall be sealed using appropriate sealant (single component thermoplastic insulating compound) to ensure water proof tightness.
5.11	**Termination of 1Cx10 cables on input side of SMBs** (1) 1Cx10 cables of positive and negative polarities originating from SPV module strings shall be terminated at the input side of SMBs using suitable lugs. (2) Vendor scope includes removal of sleeve at the cable end, crimping with suitable cable lug of appropriate type/size and connecting the lugged end to the terminal block (connector) within the SMB. Cables shall enter the SMB through the cable glands that are provided as part of the SMBs supplied by BHEL. (3) Cable lug shall be in vendor scope of supply. Type of lug (pin type etc.) shall be in accordance with the termination arrangement within the SMB. Quantity required shall be appropriately selected by the vendor (cable lug + any other hardware if required). (4) Any other hardware, if necessary for fulfilling the connection, such as bolts, nuts, screws, washers etc. shall be in vendor scope of supply. All hardware shall be of SS304. (5) All necessary tools such as pliers, strippers, MC4 crimping tools etc. shall be within vendor scope.
5.12	**Underground cable trenches and laying of 2Cx400 and RS485 and OFC cables in solar array field** (1) DC power cable 2Cx400 (from SMB to PCU), data cable RS485 (for looping between SMBs to SMBs) and OFC cable (from SMBs to SCADA) shall be laid underground by way of direct burying as per IS:1255. Supply of above the cables shall be in BHEL scope. Cable laying shall be carried out as per **"Cable installation methodology"** defined in this specification.

	(2) Typical trench details/dimensions are below only for tender purpose. (a) Total trench depth = 750 mm minimum (b) Trench width = As per number of cables laid. (c) Trench shall have layers one over the other as below (from bottom to top): 1. Bottom layer shall be sand of IS: 383 with 75mm minimum thickness 2. 2Cx400 cable shall be laid over the sand layer 3. Another layer of sand of 75 mm minimum thickness. 4. Then, 300mm backfilled with soil. 5. Layer of sand of IS:383 with 75mm minimum thick 6. OFC cables shall be laid in HDPE pipe. Supply of HDPE pipe is in BHEL scope. 7. Layer of sand of IS:383 with 75mm minimum thick 8. Single layer of brick as protective cover 9. Trench shall, then, be filled with refill soil and compacted (3) Data communication (RS 485) cables shall be laid between SMBs to form daisy chain loop (Not more than 10 SMBs in one loop) and from the end SMB of each loop, optical fiber cable shall be laid to the SCADA panel in the inverter room/ control room. (4) Bending radii for cables shall be as per IS:1255. At road crossings, cables shall be routed through GI pipe of appropriate size that shall be in vendor scope of supply and technical details / brand etc. shall be submitted for BHEL/GIPCL approval. (5) Vendor shall take utmost care in laying the cables in order to prevent wastages and damages on outer sheath and inner insulation. In case cables found to be damaged/ cut after the laying in trenches, vendor shall implement suitable corrective action such as cable jointing, or re-lay a new cable in consultation with BHEL.
5.13	**Laying of 2Cx400/ OFC cables in inverter rooms and terminations at PCU/SCADA** (1) 2Cx400 cables (Al conductor, XLPE insulation, armoured: BHEL scope of supply) and OFC (unarmoured, BHEL scope of supply) running from SMBs (through outdoor cable trenches) shall be routed into the respective inverter rooms and laid on the cable trays therein. Supply and laying of cable trays within the rooms shall be in vendor scope of supply. Vendor shall route/lay/dress the cables neatly on the trays. Cable ties shall be in vendor scope of supply. OFC Cable shall be laid inside the HDPE pipe. (2) Vendor shall carry out drilling of holes in cable gland plates of the PCUs for the 9 positive and 9 negative DC inputs of 2Cx400 cable. Similarly, holes for entry of OFC cables into SCADA panels. Gas cutting method is strictly not allowed. Vendor shall organize hole-saw cutters of appropriate size for this purpose. All necessary drilling machines / tools etc. shall be made available at site. (3) Prior to termination, each cable shall be checked for continuity and megger. In case any cable found defective, vendor shall implement suitable corrective action such as cable jointing, replacement/re-laying of cable etc. as applicable. (4) Vendor shall carry out glanding of the cables following which the glands shall be fitted to the respective holes of gland plates. (5) Vendor shall carry out the 2Cx400 cable terminations for the 9 positive and 9 negative inputs that include tasks such as unsleeving, crimping, connecting to the tinned copper bus bars, tightening using torque wrench etc. Lugs and glands for power cable termination at PCU is in BHEL scope of supply. (6) Cable glands (metallic, single compression) for OFC cable termination is in vendor scope of supply. (7) Vendor shall arrange torque wrench of appropriate range. Torque setting shall be as

	per the bolt size and property class. For the setting, approval shall be obtained from BHEL site engineer. (8) Vendor shall submit details of cable glands/lugs/ties/hardware (Make, part number, size, quantity etc.) for BHEL/GIPCL approval. Glands shall be of COMET make or other reputed equivalents subject to BHEL/GIPCL approval. Cable lugs shall be of Dowell or other reputed equivalents subject to BHEL/GIPCL approval. (9) All tools/accessories such as crimping tools etc. required to carry out the termination shall be within scope of vendor.
5.14	**Termination of 2Cx400 DC power cables and RS 485 cables at SMBs** (1) Cables of 2Cx400 (Al conductor, XLPE insulation, armoured) shall be terminated at the output side of SMBs (positive, negative terminals). Supply of this cable is in BHEL scope. (2) Vendor scope includes removal of sleeve at the cable end, crimping with suitable cable lug of appropriate type/size and connecting the lugged end to the tinned copper bus bar within the SMB. Cables shall enter the SMB through the metallic cable glands that are also supplied by BHEL along with SMBs. (3) Cable lug with bimetallic washers shall be in vendor scope of supply. Make shall be Dowell, or equivalent subject to approval of BHEL/GIPCL. (4) SS304 bolts/ nuts/ plain washers and Zinc/epoxy coated spring washers shall be in vendor scope of supply. (5) Quantity of lug and hardware shall also include contingency requirements arising out of shortage due to various reasons (damage, theft etc) during installation. (6) All necessary tools such as pliers, strippers, crimping tool etc shall be within vendor scope. (7) Similarly, vendor shall carry out RS485 cable terminations at SMBs. Supply of Cable glands is in BHEL scope as part of SMBs. Cable lugs, connecting hardware shall be in vendor scope of supply for which details of make, part number, size etc. shall be submitted for BHEL/GIPCL approval during detailed engineering. Shield of the RS485 cables shall be suitably earthed at SMB end.
5.15	**Laying and Termination of 1Cx630 LT AC power cables at PCU and Inverter Transformer** (1) LT Cables 4 runs of 1C x 630 sqmm shall be laid between AC side of the PCU and the LT side of the Inverter transformer as per **"Cable installation methodology"** defined in this specification. Supply of this cable is in BHEL scope. (2) Vendor scope includes removal of sleeve at the cable end, crimping with suitable cable lug of appropriate type/size and connecting the lugged end to the tinned copper bus bar within the PCU and Transformer. Cables shall enter the PCU and Transformer through the metallic cable glands. Supply of Lugs and Glands for PCU side termination is in BHEL scope. Supply of Lugs and Glands required for Inverter Transformer side termination shall be in vendor's scope. (3) Cable lug make shall be Dowell, or equivalent subject to approval of BHEL/GIPCL. (4) Cable gland metallic type shall be of COMET make or equivalent subject to approval of BHEL/GIPCL (5) Quantity of lug and hardware shall also include contingency requirements arising out of shortage due to various reasons (damage, theft etc.) during installation. (6) All necessary tools such as pliers, strippers, crimping tool etc. shall be within vendor scope.

5.16	**Identification marking of cables using cable tags** 1) Cable tags shall be provided on all power cables at both ends just before entering the equipment enclosure. 2) Cable tags shall be of rectangular shape. 3) Cable tag shall be of 2mm thick aluminum with number punched (embossed) on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. 4) Vendor shall submit the technical details of cable tags, ID numbering scheme for BHEL/ GIPCL approval during detailed engineering.
5.17	**Installation of electrical panels within inverter rooms and main control room** **Panel installation within inverter rooms:** Vendor shall organize necessary resources such as labour, cranes, hydra, forklifts, transportation trucks / trolleys and other accessories for movements and positioning of the panels as below (Quantities mentioned are per inverter room): (a) 1250 kW PCU panels: 4 sets (b) 33kV VCB panels: 3 sets (2 incomers + 1 outgoer) (c) 30KVA Dry type Aux Transformer – 1 No (d) Distribution boards: ACDB, UPSDB AC, LDB (room lighting): 1 No each + any extra boards as required (e) SCADA panel: 1 No (f) UPS with battery bank: 1 Set (g) FCBC battery charger – 1 No (h) Battery bank – 1 No **Panel installation within main control room:** (a) 33kV VCB panels: 1 set (10 incomers + 1 outgoer + 1 Aux TRF outgoer) (b) 33kV VCB panels: 1 set (5 incomers + 1 outgoer) (c) ACDB main panel: 1 set (d) Distribution boards (wall mounted): DCDB, UPS DB, CR DB (room utilities), LDB (plant lighting), PDB (power DB): 1 No each + any extra boards as required (e) SCADA panel: 2 Nos (f) HMI SCADA control desk with PCs and accessories: 1 set (g) UPS with battery bank – 2 No (h) FCBC battery charger – 1 No (i) Battery bank – 1 No (1) Panels shall be moved to the respective positions and placed over the cable trenches in control room, in the exact sequence and locations as per drawings approved by BHEL/GIPCL. (2) PCUs, VCB panels shall be placed on cable trench of inverter / main control rooms, with cable entry openings to match cable trench on bottom side. (3) Panels shall be suitably grouted using welding/ bolting methods as per relevant standards. BHEL approval shall be obtained for the grouting arrangement. All necessary hardware for the same shall be within vendor scope of supply.

5.18	**Installation of cable trays, cable laying/dressing etc. in inverter rooms / main control room** **A. Installation of cable trays** (1) Vendor shall supply and install cable trays, fittings and accessories within control room for laying 33kV HT, DC/AC LT, control, communication cables etc as per "**Cable installation methodology**" section of this specification. Cables trays shall be ladder type with horizontal corner bend pieces. 750mm minimum width, 3mm minimum thickness and appropriate height. Drawings/ make/ part number of these shall be submitted for BHEL/GIPCL approval. (2) Vendor shall place and fit these cable trays over steel support structure (angles, sections etc.) that are provided in the cable trenches of inverter/ main control rooms by BHEL. (3) Cable trays shall be in three vertical layer arrangements: bottom for 33kV cables, middle for LTAC/DC cables and top for control/data/ communication cables. (4) Suitable cut outs, wherever applicable, shall be made in the cable trays to provide path for the cable to reach the panel. (5) Adjacent cable trays shall be interconnected using suitable hardware items that shall be in vendor scope of supply. (6) Cable trays shall be double earthed to the earth mat grid of the room. **B. Cable routing, laying, dressing** (1) Cables entering into the inverter/ main control rooms from outside (solar array/ transformer yards) shall be bunched appropriately LT/HT/control category wise. The multiple bunches shall be routed through PVC conduit pipes of appropriate type, diameter and length that shall be fixed below the plinth beam of room. (2) Cables (HT, LT, communication, control etc.) shall be laid on cable trays in separate tiers with appropriate spacing as per IS: 1255. (3) Control/ data/ instrumentation cables that run from inverter rooms to marshalling box of inverter transformers shall be routed through HDPE DWC conduit pipes of appropriate size. (4) Cables shall be dressed using appropriate cable ties at appropriate intervals to ensure firmness of their position over the trays. (5) Trefoil clamps shall be used wherever single core cables are used for three phase system. These clamps shall be at appropriate intervals to ensure firmness of bunching of cables. (6) All cable entry openings of conduit pipes, after laying/ termination of the cables, shall be sealed using appropriate sealant to ensure water proof tightness. (7) All cable accessories such as cable conduits/pipes, ties, trefoil clamps, sealants etc for the above purpose shall be in vendor scope of supply. (8) All the supply and installation works as mentioned above shall be as per "**Cable installation methodology**" section of this specification and as per drawings approved by BHEL/GIPCL during detailed engineering.
5.19	**Laying, termination of LT/HT/aux supply cables in inverter/ main control rooms** (1) For all electrical panels viz. PCUs/ VCB panels, UPS/ battery charger/ battery bank /DB boards and inverter transformers of the inverter rooms, laying and termination of LT/HT/Aux power cables shall be in vendor scope. (2) For all electrical panels viz. VCB panels/ ACDB panel/ UPS/ FCBC battery charger/ Battery bank / DB boards / aux transformer of main control room, laying and termination of LT/HT/Aux power cables within the room and up to 33kV side of power

	transformers shall be in vendor scope. **Exception:** supply, laying and termination of aux supply cables for C&R panel and 66kV switchyard shall be in BHEL scope. (3) Cable glands, cable lugs, 33kV HT cable termination kits (indoor/ outdoor types as applicable), Cable jointing kits, bolts, nuts, washers etc. shall be in vendor scope of supply (except for the cable lugs and glands for AC & DC side of the PCU which is BHEL scope of supply). (4) For marshalling box of transformer/ UPS/ SCADA/ DB boards, single compression nickel plated brass glands shall be provided by vendor. Make shall be COMET or reputed equivalent subject to approval of BHEL/ GIPCL. (5) HT termination kits (indoor/ outdoor as applicable) shall be Raychem make. HT termination shall be carried out by certified jointers. Credentials / certification of experience from Raychem for the proposed jointers shall be submitted for BHEL/GIPCL approval during detailed engineering. (6) Quantity of 33KV End termination and straight through jointing kits shall be supplied by vendor as follow: a. 33KV End termination kit for 1Cx300 sqmm (E) cable = 19 nos (for each Inverter room) b. 33KV Straight through jointing kit for 1Cx300 sqmm (E) cable = 6 nos (for each Inverter room) c. 33KV End termination kit for 1Cx300 sqmm (E) cable = 45 nos (for Control room) d. 33KV Straight through jointing kit for 1Cx300 sqmm (E) cable = 5 nos (for Control room) (7) **The scope of HT cable laying and termination at CMCS incomer panels for the cables coming from IRs shall be in the scope of the vendor executing the respective inverter room.** (8) Vendor shall make appropriate holes in the gland plates of PCUs, HT VCB panels, UPS panel, Distribution boards etc. for fixing the cable glands. Gas cutting is strictly prohibited. Hole-saw cutters of appropriate sizes with suitable drilling machines shall be made available at site for this purpose. (9) Terminations with M10 and above shall be tightened using torque wrench. Torque setting shall be as per size, property class of bolt. BHEL approval shall be obtained for the settings prior to tightening. (10) All resources such as labour, machinery, tools and accessories to carry out the above electrical works shall be in vendor scope. (11) All applicable/relevant clauses under "**General specification of LT cables**" and "**Cable installation methodology**" sections of this specification shall be adopted for all aspects of these cables such as technical specifications (ratings, sizes, calculations etc.), cable selection, tests on cables, cable installation, cable accessories etc. Note: For Power cable size/ number of runs per phase/ required for quantity estimation. Vendor shall refer the SLD enclosed.
5.20	**Laying and installation of Control / data / instrumentation / OFC cables** (1) BHEL shall supply all the SCADA related data communication cables All the cable installation accessories such as cable trays, cable conduits, cable glands, cable lugs, ferrules, cable ties, bolts, nuts, washers etc. shall be in vendor scope of supply. Cable laying and cable terminations shall be in vendor scope. All necessary resources such as labour, tools and accessories required to carry out laying and

	termination works etc. shall be in vendor scope. (2) **OFC cable** along with HDPE conduit, termination kits shall be in BHEL scope of supply. Vendor scope includes laying of the OFC cable underground in the conduit from inverter room SCADA panels to main control room SCADA panel. Termination of the OFC cables at both the ends shall be in BHEL scope. (3) Vendor shall lay and terminate the **RS485 cables** to SCADA from (a) MFM meters of VCB panels, (b) MFM meters of ACDB panel, (f) Weather monitoring station. These cables shall be laid between the panels of respective inverter/ main control rooms. (4) Vendor shall lay and terminate the Ethernet cables to SCADA from (a) PCUs, (b) numerical relays of VCB panels. These cables shall be laid between the panels of respective inverter/ main control rooms. (5) All applicable/relevant clauses under "**Cable installation methodology**" sections of this specification shall be adopted for all aspects of these cables such as technical specifications (ratings, sizes, calculations etc), cable selection, tests on cables, cable installation, cable accessories etc.
5.21	**Erection of 33kV transformer yards attached to inverter rooms and main control room** (1) Each inverter rooms is attached to two transformer yards each having one inverter transformer. (2) Aux transformer 200kVA, 33kV/433V shall be placed at an appropriate location near Main Control room. (3) Construction of RCC foundations, fencing and gates for all transformer yard is in BHEL scope. (4) Vendor shall erect the transformers on RCC foundation as per transformer GA details. Vendor scope of I&C of transformers shall include: a) Movement of transformers and its accessory parts such as radiators, cable boxes, hardware etc from storage yard and placement on foundation pedestal. b) Assembly of transformer parts. c) Cable laying and terminations at LV/HV/Marshalling boxes of transformers. The 33KV cable from Main outgoer panel to the LV side of the 16 MVA transformer shall be laid on the Cable tray support structure. For this required material like cable trey, support structure, hardware etc. is in vendor scope of supply. d) All activities applicable to oil filling and filtration including measurement of oil BDV and PPM in NABL accredited laboratory. Particularly for inverter transformers, filtration of oil shall be carried out to such an extent as to obtain the desired BDV (>60 kV) and PPM (< 15ppm) values. e) Testing of transformers as per "**pre-commissioning checks**" section of this section. (5) After installation of transformers at the transformer yards of each inverter/ main control room, vendor shall level/compact the ground with an appropriate magnitude and direction of slope to facilitate draining of rain water away from transformer yard. Accordingly, to prevent stagnation of water within transformer yard, vendor shall implement suitable civil works in and around the transformer yard. This shall include filling up the land (wherever necessary) with suitable soil and compact the filled-up portions either manually or with rollers, as applicable, as per site conditions, to achieve required compaction/slope. (6) Vendor shall provide the 100 mm layer of stone gravels in transformer yards as per relevant IS standards / CBIP/ CEIG requirements etc. Also, PVC pipes shall be

provided at appropriate locations along the periphery of transformer yard fencing for draining out of water from the yard. PVC of appropriate size shall be in vendor scope of supply.

(7) Vendor shall provide applicable earthing connections to transformers, fencing / gates etc. in the yard as per relevant clauses under the "**Earthing system**" section of this specification.

(8) All other items (if any, other than the above) that are required to meet the technical requirements of transformer yard as per applicable standards / electricity rules shall be incorporated by the vendor.

5.22 33KV HT cable Laying and termination from Control room to power transformer at 66KV switchyard

The 33KV KV HT cable laying and termination work at main out goers and power transformers shall be in the scope of the vendor executing the control room I&C works.
For 60 MVA transformer, 4Rx1Cx300 sqmm/ph shall be laid and terminated at both ends
For 30 MVA transformer, 2Rx1Cx300 sqmm/ph shall be laid and terminated at both ends
Note: **These cables shall be laid on the cable trays from Control room to Power transformers.** For this vendor to provide the necessary cable support structure. Supply of cable tray, support structure and necessary hardware is in vendor's scope of supply and installation.

5.23 Specification of auxiliary transformer 200kVA, 33kV/433V, Dyn11, Outdoor, ONAN

1.0 Technical parameters and specifications:

#	Technical parameter	Specification
1	Transformer type	Outdoor, oil-immersion type
2	IP class	Transformer, including cable box and marshalling box shall be of IP55
3	Type of cooling	ONAN
4	Governing Standard	IS: 1180
5	Rating in KVA	200 kVA
6	No. of phases	3
7	Frequency	50 Hz, +/- 3%
8	HV winding	33kV, 3-Ph, with **Delta** connection
9	LV windings	433V, 3-Ph, with **Star** connection
10	Winding material	Electrolytic grade copper for both HV and LV windings
11	Winding Insulation	Class A
12	Neutral on LV side	Neutral terminal shall be brought out separately to facilitate earthing connections.
13	Vector Group	Dyn11
14	Short circuit withstand time (thermal)	2 sec.
15	% Impedance	As per IS: 1180
16	Termination HV/LV/Orientation	Air insulated cable box with disconnecting chamber, for both HV and LV sides. Cable box / Cable box / 180^0.

17	Cable entry on HV side	Bottom entry of cables. HV cable in BHEL scope.
18	Cable entry on LV side	Bottom entry of cables. Cable supply in BHEL scope.
19	Cables and accessories	HV & LV Cables, termination kits (for HV), cable lugs (Dowell make), (Comet make) and connecting hardware shall be in vendor scope of supply. Vendor shall provide hole on the bottom-side gland-plate of HV & LV side cable box for cable entry as per the final outer diameter of cable provided by BHEL during detailed Engg.
20	Tapping on HV winding	Off circuit tap changer (OCTC) switch with five tap positions: +5%, +2.5%, 0, -2.5%, -5%.
21	Loading Capability	Continuous operation at rated KVA on any tap with voltage variation of +/-10%. Transformer shall be capable of being loaded in accordance with IS: 6600 / IEC 60076-7.
22	Ambient temperature	Max 50 deg C
23	Temperature rise	For top oil: Max. 50 deg C by thermometer method For winding: Max. 55 deg C by resistance method Both rises shall be over an ambient temperature of 50 deg C irrespective of tap position.
24	Flux density	Not to exceed 1.9 Wb/sq.m at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over-fluxing conditions due to combined voltage and frequency fluctuations: a) 110% for continuous rating b) 125% for at least one minute c) 140% for at least five seconds Vendor shall furnish over-fluxing characteristics up to 150%
25	Air Clearance	As per CBIP
26	Load loss principal tap at 75^0C, with IS tolerance	This shall be provided by vendor.
27	No Load loss at rated voltage on principal tapping and at rated frequency, with IS tolerance	This shall be provided by vendor.
28	No load current at rated voltage and rated frequency	This shall be provided by vendor. To be indicated as percentage.
29	Efficiency at 75^0C, UPF	As per IS 1180 and CBIP

30	Regulation at full load, 75 ^{o}C	< 2 % for UPF For 0.8 PF lagging, to be indicated by vendor.
31	Harmonics	Shall be designed to suppress harmonics especially 3rd& 5th.
32	Vibration & noise	Noise level shall be according to NEMA TR-1 standard
33	Highest system voltage	LV side: 1.1kV HV side: 36 kV
34	Insulation levels as per IS:2026 Rated Lightning Impulse withstand voltage / Short duration power frequency withstand voltage	LV side: -- kVp / 3 kV rms HV side: 170kVp / 70kV rms
35	Overall dimensions in mm Length x Breadth x Height	This shall be provided by vendor.
36	Oil capacity (in Litres)	This shall be provided by vendor.
37	Weight of transformer in Kg	This shall be provided by vendor.
38	Painting	Shade 631 of IS:5
39	Constructional features	As per relevant clause of this specification
40	Fittings and accessories	As per relevant clause of this specification

2.0	**Tests on auxiliary transformer**
2.1	**Routine Tests:** As per IS: 1180 – MQP shall be submitted for approval.
2.2	**Type Tests** (a) **Temperature rise test** This test shall be performed as a type test on one sample of transformer. This is a mandatory test and shall be witnessed by BHEL/GIPCL. Vendor shall include the price for this test in the price of auxiliary transformer. This temperature rise test shall be carried out at a tap corresponding to maximum losses as per IS: 1180. Test report shall be furnished to BHEL. (b) Valid type test report for all other type tests on similar rating transformers shall be submitted during detailed engineering.

5.24 Auxiliary AC/DC power supply system

i. Following DB boards for application in main control room shall be in vendor scope of supply, installation and commissioning:
   UPS DB for 230V AC UPS supply to SCADA, weather monitoring system, fire alarm system, emergency loads, nitrogen fire protection system, CCTV system - 2 Nos
ii. Following DB boards (wall mounted, 1 No each) for each inverter rooms shall be in vendor scope of supply, installation and commissioning:
   1. UPSDB 230V UPS supply for PCUs (control circuits), fire alarm system panel, emergency loads etc.
   2. LDB (lighting DB) room lighting and other electrical fitting.
iii. Above DB boards shall also provide for any other feeders, if necessary, to meet functional requirements. In addition, at least two spare feeders shall be provided in each of the above DB boards.
iv. Above DBs shall be wall-mounted board, of reputed make such as Legrand, Siemens, Schneider pr any other reputed make as approved by BHEL/GIPCL.
v. DB boards shall be provided with incoming/ outgoing MCB as applicable (based on rating requirements) with spare feeders as shall be approved by BHEL/GIPCL.
vi. and installation of all the above items including all necessary cable terminations/ installation shall be in vendor scope.

5.25 Electrical works in PEB inverter rooms

Vendor scope includes complete electrical works for all these inverter room. Erection of electrical panels (PCUs, VCB panels, SCADA/ACDB/DCDB/UPS panels etc), Laying / interconnection of power/control cables between these panels in the inverter rooms are elaborated elsewhere in this specification.

This clause is particularly on electrical works related to supply and installation of all electrical appliances / utilities of the inverter room such as lights / light fittings, ceiling fans, exhaust fans, ventilators, switchboards, MCB boxes, wiring/routing of cables for these, termination of electrical cables at both ends (appliances and ACDB panel), electrical conduits/pipes/casing etc.

Vendor shall submit the design of electrical layout for these PEB rooms for BHEL/GIPCL approval. For this, BHEL will submit approved GA drawings of PEB rooms to the vendor after placement of purchase order. However, typical layout of PEB inverter room (for tender purpose only) is enclosed herewith. Electrification of PEB rooms shall be carried out as per IS:732-1989, IS:4648-1968, NBC 2016 and other relevant standards.

List of electrical items for one PEB inverter room:

1) Industrial twin FTL luminaire with 2x28W each T5 lamps: 12 sets
2) Industrial single FTL luminaire with 28W each T5 lamps: 6 sets (fitted inside the room)
3) Domestic ceiling fan 240V 1200mm sweep: 3 No
4) Fan regulator: 3 No
5) Exhaust fan (450mm min): 2 No
6) 3-pin 6A socket with switch: 2No

	7) 5-pin 6/16A socket with switch: 1 No 8) 6A modular type switches: as required 9) Light distribution boards: Quantity as required to meet the above requirements. 10) Electrical cables Copper conductor PVC FRLS shall be of appropriate size / rating 11) Electrical conduits/casings etc shall be of heavy duty type that as approved by BHEL/GIPCL during detailed engineering. 12) All necessary fixtures, fittings and accessories for mounting the appliances (lights, fans etc) shall be provided by vendor. **Make** : For above mentioned items shall be Philips/Bajaj/Wipro/Havells/ or any other reputed make subject to BHEL/GIPCL approval.
5.26	**Electrical works in Security room and watchman cabin** **This scope pertains to vendor executing the supply and installation works for Control room (package-A).** In addition to Inverter rooms and control room, power plant consist of 2 Security room and 8 watchman cabins. This clause is particularly on electrical works related to security room supply and installation of all electrical appliances / utilities of the security room inverter room such as lights / light fittings, ceiling fans, exhaust fans, ventilators, switchboards, MCB boxes, wiring/routing of cables for these, termination of electrical cables at both ends (appliances and ACDB panel), electrical conduits/pipes/casing etc. **List of items for one PEB security room:** 1) 2X18W CFL wall/ surface mounting luminaire: 2 sets 2) 2x11W CFL wall/surface mounting luminaire: 2 Nos 3) 1x9W bulkhead luminaire: 1 No 4) Ceiling fan: 1 No 5) MCB Junction box with feeders: 1 Nos 6) Fan regulator: 1 No 7) 6A modular type switches: 5 Nos 8) 6/16A 5Pin switched socket outlet modular type: 2 Nos 9) Exhaust fan: 1 No 10) Electrical cables Copper conductor PVC FRLS shall be of appropriate size / rating 11) Electrical conduits/casings etc shall be of heavy duty type that as approved by BHEL/GIPCL during detailed engineering. 12) All necessary fixtures, fittings and accessories for mounting the appliances (lights, fans etc) shall be provided by vendor. **List of items for one watchman cabin:** 1) 2X18W CFL wall/ surface mounting luminaire: 1 sets 2) 2x11W CFL wall/surface mounting luminaire: 1 Nos 3) 1x9W bulkhead luminaire: 1 No 4) MCB Junction box with feeders: 1 Nos 5) 6A modular type switches: 3 Nos 6) 6/16A 5Pin switched socket outlet modular type: 1 Nos 7) Electrical cables Copper conductor PVC FRLS shall be of appropriate size / rating 8) Electrical conduits/casings etc shall be of heavy duty type that as approved by BHEL/GIPCL during detailed engineering.

9) All necessary fixtures, fittings and accessories for mounting the appliances (lights, fans etc) shall be provided by vendor.

Make : For above mentioned items shall be Philips/Bajaj/Wipro/Havells/ or any other reputed make subject to BHEL/GIPCL approval

5.27 Supply and installation of Weather monitoring system

Weather Monitoring system shall be installed on roof of CMCS. As part of weather monitoring system (WMS), vendor shall supply, install and commission the following measuring instruments with all necessary software and hardware such as data logger, power supply/ control/ data/ communication cables etc. required to integrate with SCADA.

Scope of vendor shall also include supply and erection of all the mounting arrangements including all necessary civil works/ foundations etc. as recommended by manufacturer. Communication cables shall be laid and terminated at both SCADA station at main control room and data logger at weather monitoring station end. Similarly, power supply cables shall be laid between WMS and DB boards in main control room.

Exact location of the weather monitoring station (on the top of main control room) shall be decided during detailed engineering. Vendor shall submit all necessary GTP/ GA drawings of instruments and installation arrangement, installation manual, make/ model number/ part number etc. for BHEL/GIPCL approval during detailed engineering.

Pyranometer (3 Nos)
Vendor shall provide 3 Nos pyranometers for measuring the incidental solar radiation at horizontal and inclined plane of array. Out these, 2 shall be mounted horizontally and one shall be mounted in tilt position. Hence one no. adjustable tilt mounting plate shall be provided by the vendor

Specification of the pyranometer shall be as follows:

1	Spectral response	0.31 to 2.8 micron
2	Sensitivity	Min 7 micro-volt / W/ m2
3	Time response (95%)	Max 15s
4	Nonlinearity	+/- 0.5%
5	Temperature response	+/- 2%
6	Tilt error	< +/- 0.5%
7	Zero off-set thermal radiation	+/- 7 W/m2
8	Zero off-set temperature change	+/- 2 W/m2
9	Operating temperature range	-40 deg to +80 deg
10	Uncertainty (95% confidence level)	Hourly- Max 3%, Daily-Max 2%
11	Non stability	Max +/-0.8%
12	Resolution	Min +/- 1W/m2
13	Input power for instrument and peripherals	230V AC (if required)

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. Vendor shall provide Instrument manual in hard and soft form.

Thermometers
Vendor shall provide two thermometers (one for ambient temperature measurement with shielding case and other for module temperature measurement). The thermometers shall be RTD/ semiconductor type measuring instrument. Instrument shall have a range of -5°C to 60°C.The instrument shall have valid calibration certificate.

Anemometer and wind vane
Vendor shall supply double cup anemometer on tubular type made up of hot dipped Galvanized Iron. Velocity range upto 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.

1) Velocity range with accuracy limit	+/- 0.10 m/s
2) Wind direction range with accuracy limit	0 to 360 deg with accuracy +/- 4 deg.

Note : 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.

Data Logger
Vendor shall provide 1 no. of data logger with internal reliable battery backup and data storage capacity.

5.28 Installation and commissioning of SCADA integration systems

(1) SCADA system, supply of which shall be in BHEL scope, comprises of data station panels and PC based control desks with software to collect, store, process and report the data parameters of power plant and also to control the operations of the power plant by integrating the various equipment at the segments as follows:
- (a) String monitoring boxes (540 Nos) in solar array field
- (b) Weather monitoring equipment: Pyranometers for solar irradiation (3 Nos), thermometer for ambient temperature (1 No), thermometer for module surface temperature (2 No), anemometer for wind speed and direction.
- (c) Power conditioning units (60 Nos): DC input / AC output parameters of inverters, grid data, fault status and events logged, etc.
- (d) Inverter transformers (30 Nos): Alarm/Trip signals, WTI/OTI temperature values.
- (e) 33kV VCB breaker panels (as per SLD): status of VCB breakers, status of protection relays of transformers, oil / winding temperatures, AC parameters at every 5MW level of the plant.
- (f) ACDB multifunction meters (16 Nos): AC auxiliary utility consumption parameters
- (g) Fire alarm system (all inverter/ main control rooms): status signals

(2) BHEL scope of SCADA:

(a) Data station panels with necessary data loggers / PLCs and other accessories such as power supply etc to integrate the data signals as listed below. This includes main panel at main control room and intermediate (linking) panels at

	each inverter room. (b) Desktop PCs (HMI control desks) provided with necessary software packages and remote monitoring features. (c) Supply of SCADA related communication/data / LAN cables as brought out in other clauses of this specification. **(3) Vendor scope of supply and installation of SCADA system:** (a) Vendor shall install the BHEL supplied SCADA system in the air-conditioned SCADA room in main control room. Vendor shall also install SCADA panels in each of the inverter rooms. (b) Cable laying/ terminations of all SCADA cables at respective panels / equipments shall be in vendor scope of supply. BHEL will provide the necessary cabling schedule during detailed engineering.
5.29	**Earthing for solar array structures and SMBs** Vendor shall install the earthing system for solar array, MMS structures, SMBs and various other electrical equipments installed by the vendor. The Material for eathing like, Earth electrode with back fill compound, GI strips, earthing cable etc. will be part of BHEL scope of supply. All necessary hardwares like nut, bolts, lugs etc. shall be in vendor's scope of supply. BHEL will provide the array/Inverter room/ Control room earthing drawing during detailed engg. Vendor has to provide the earth chamber precast/prefab type for each earth electrode with following details. (a) Minimum Inner diameter shall be 300mm. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc. (b) Projection of chamber above FGL = 150mm minimum (c) Top of electrode shall have minimum clearance of 100 mm below cover plate. (d) Cover plate with suitable lifting hooks and padlocking arrangement. Supply and installation of all materials related to Earth chambers shall be in vendor scope. **Earth mat grid shall have following dimensions:** (1) Earth mat grid shall be buried 600mm minimum below ground level. Where it crosses trenches, pipes, ducts, channels etc, it shall be at least 300mm below them. Back filling soil to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Backfilled surface shall be well compacted. (2) Outer grid shall be with GI flat 25x6 mm (Supply of GI strip by BHEL). (3) Inner branches (along the solar array rows) with GI flat 25x3mm (Supply of GI strip by BHEL). (4) Inner branches shall be welded to outer grid. (5) Electrode shall be bolted to a horizontal GI flat 25x6 that in turn bolted (M10 minimum) to two GI flat 25x6 raisers on either side of horizontal flat. Raisers shall be connected to outer grid of earth mat by way of welding. (6) Total No. of electrodes for solar array is 60 Nos (4 Nos of Each IR).

	Earthing of MMS structures shall be as follows: (a) Solar array MMS structure shall be connected to Inner branch of earth mat using GI flat 25x3 mm minimum; Bolting on structure (M10 minimum), Welding on earth mat end. (b) Adjacent structures shall be connected to one another using GI flat 25x3 mm minimum. Both ends shall be bolted (M10 minimum). (c) Wherever the clear distance between the adjacent structure is more than 1m, 25x3 GI strip shall be laid below the ground **Earthing of SMBs shall be as follows:** (a) SPD earth point shall be earthed using 1Cx16 flexible copper (unarmoured) green cable. Both ends of cable shall be suitably lugged and connected using matching hardware. (b) Data card of the SMB shall be earthed using 1Cx2.5 flexible copper (unarmoured) green cable. Both ends of cable shall be suitably lugged and connected using matching hardware. (c)Earthing cable is BHEL scope of supply. Lugs for these earthing cable shall be in vendor's scope of supply. **General points:** (a) GI bolts, nuts, plain washers shall be used. Spring washers shall be zinc/epoxy coated. (b) Welding for GI flats shall be using electric arc welding. Both the flats shall be overlapped for the full width where they are in perpendicular direction in same plane. Where the connection is along same line, both flats shall be overlapped for a minimum of 50mm. L-bend with weld length of 50mm minimum shall be adopted wherever overlap length to be ensured. (c) Resistance of welded joint shall not be more than that of GI flat. (d) Welds shall be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection. (e) While laying earthing electrodes, adding/mixing of chemical compound and water around the electrode in the dug hole shall be as per instructions of OEM. (f) 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.
5.30	**Earthing system for inverter rooms, main control room, 33kV transformer yards** (1) Vendor shall install and commission earthing system for protection against faults as guided by IEC 60364 for the inverter rooms, main control room, 33kV transformer yards. (2) Earthing system Layout for Inverter room, Control Room and Transformer yards will be provided by the BHEL during detailed Engg. (3) Earthing electrodes of 3m minimum long, 17.2 mm minimum diameter, copper bonded MS, chemical compound filled will be supplied by BHEL. Quantity of Earth electrode in each IR = 17 Nos. and for CMCS = 20 Nos. (4) Bore holes of appropriate diameter shall be made by vendor on the earth for insertion of such chemical earthing electrodes with filling of mix of chemical compound and water around. Inverter rooms and main control room shall be provided with separate earth mat grids.

(5) Earthing connections to electrical panels within the inverter room/ main control room: Flats GI 65x8 (BHEL scope of supply) shall be provided for double earthing of 33kV VCB panels, UPS/ FCBC/ Battery banks, C&R panel, ABT metering panels, cable trays. The earthing for PCU shall be done through 1Cx 700 flexible copper cable and for SCADA through 1Cx 16 sqmm copper cable (6) Earthing of inverter transformers in the transformer yards of inverter rooms/ Aux transformer in 66kV switchyard near main control room:

(a) Flats GI 65x8 minimum shall be provided for interconnecting various parts of the inverter transformer (for body earthing) viz tank, conservator, disconnecting chambers, cable boxes, marshaling box, radiators etc.
(b) Such interconnected local grid shall be double earthed to the main earth mat grid running underground through GI flats 65x8
(c) Flats shall be bolted on transformer side and overlap welded to earth mat grid. Two earth pits shall be located close to each transformer for body earthing.
(d) Shield earthing of inverter transformers shall be separate and connected to two earth pits using GI flat 65x8.
(e) Neutral of aux transformer shall be connected to two earth pits using GI flat.

(6) Transformer yard fencing shall be earthed at two different locations using GI flats 65x8 minimum. Gate shall be looped to the fencing mesh by way of GI wire of suitable size.

(7) Earth mat grid shall be buried underground up to a depth of 600mm minimum from FGL. Back filling soil to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Backfilled surface shall be well compacted.

(8) Vendor has to provide the earth chamber precast/prefab type for each earth electrode with following details

a) Minimum Inner diameter shall be 300mm. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc.
b) Projection of chamber above FGL = 150mm minimum
c) Top of electrode shall have minimum clearance of 100 mm below cover plate.
d) Cover plate with suitable lifting hooks and padlocking arrangement.

(9) Supply and installation of all materials related to Earth chambers shall be in vendor scope.

(10) Earth electrode shall be bolted to a horizontal GI flat 65x8 minimum that in turn bolted (M10 minimum) to two GI flat 65x8 minimum raisers on either side of horizontal flat. Raisers shall be connected to earth mat grid by way of overlap welding.

General points:

(a) All earthing electrodes, GI flats is in BHEL scope of supply
(b) All hardware etc shall be in vendor scope of supply.
(c) GI bolts, nuts, plain washers shall be used. Spring washers shall be zinc/epoxy coated.
(d) Welding for GI flats shall be using electric arc welding. Both the flats shall be overlapped for the full width where they are in perpendicular direction in same plane. Where the connection is along same line, both flats shall be overlapped for a minimum of 50mm. L-bend with weld length of 50mm minimum shall be adopted wherever overlap length to be ensured.
(e) Resistance of welded joint shall not be more than that of GI flat.

(f) Welds shall be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.
(g) While laying earthing electrodes, adding/mixing of chemical compound and water around the electrode in the dug hole shall be as per instructions of OEM.

5.31 Firefighting systems

Firefighting systems: Fire extinguishers and sand buckets

Vendor shall provide fire extinguishers/ sand buckets as follows for fighting fire of oils, solvents, gases, paints, varnishes, electrical wiring, live machinery fires and flammable liquid/ gas as per recommendation by relevant fire safety authority and as per relevant standards IS: 2171 and IS: 10658 marked. Make shall be Safex/ Ceasefire/ Vintex/ Unicare fire safety or any other reputed equivalent subject to BHEL/GIPCL approval.

- DCP type (ABC) 10 Kg designed/tested IS 15683 with safety release valve, NRV and CE approved valve. Dry powder IS 14609 with standard accessories.
- CO2 type Hand 9 Kg with wheel. Designed/tested IS 2878 complete with hose, screw valve, CO2 gas IS 1522, cylinder IS 7285, valve IS 3224. Tested at 250 Kgf/cm2.
- Foam type hand 9Kg, squeeze grip CO2 cartridge type, throw period 35s, range of Jet 6m, designed/tested IS:15683, Gas cartridge IS:4947.
- Sand bucket should be wall mounted made from at least 24 SWG sheet with bracket fixing on wall conforming to IS 2546 at strategic locations.

Quantity requirements:

Type of extinguisher	DCP type (ABC) 10 Kg	CO2 type Hand 9 Kg	Foam type hand 9 Kg	Sand buckets
Main control room CMCS	1	4	2	4
Each inverter room (total 15 rooms)	1	2	1	2
Each transformer yard of inverter room (total 30 yards) and CMCS (1 yard)	1	1	1	2
Security room(2 Nos)	-	1	-	2

5.32 Identification marking using painting

Following items shall be identified by way of artistic painting in black letters with yellow background. For danger symbol/text, white letters in red background. Identification number/ text to be painted shall be submitted for BHEL/GIPCL approval during detailed engineering for the following.

(1) Solar array structures: ~7500 Nos
(2) String monitoring boxes: 540 Nos
(3) Size/ source/ destination of DC cable 2Cx400 with arrow mark (power flow direction) to be painted on SMBs and PCUs
(4) PCUs front side: PCU ID number (1 to 60) with rating 1250kW, AC chamber/ DC chamber, Danger text/symbol.
(5) PCUs DC chamber back side: SMB ID numbers, cable size (2Cx400 +,-) with upward arrow mark, danger text/symbol

(6) PCUs AC chamber back side: Inv Trnfmr ID, cable size (4Rx1Cx630 / ph) with downward arrow mark, danger text/symbol

(7) Same way as above, the corresponding panel ID with rating, cable destination with arrow mark in power flow direction, danger text/symbol shall be painted for all VCB panels, Inverter transformers (HV and LV sides), Aux transformer (HV and LV sides), ACDB panel.

(8) For UPS/ FCBC/ SCADA/ ABT metering panels, C&R panel, all DB boards/ fire alarm panels/ N2 fire protection panel, ID number shall be painted. Cable size/ destination/ arrow marks not required to be painted as cable tags shall be adequate.

(9) For earth chambers of inverter rooms and main control room, ID number shall be painted.

(10) All switchboards shall be painted with ID number.

5.33 Cable markers and cables tags

(1) Cable markers and joint markers for underground cables shall be provided along the route of the cables as per section "**Cable installation methodology**" of this specification.

(2) Cable tags shall be provided at either of the cable (at the entry point to the panel / equipment to which it is connected / terminated) shall be provided as per section "**Cable installation methodology**" of this specification.

(3) Vendor shall submit the respective schemes of marking and tagging for BHEL/GIPCL approval during detailed engineering.

5.34 Display boards and sign boards

Sl. No	Description	Qty for Each Inverter room	Qty for Control room
1	Board displaying instruction chart for restoration from Electric Shock	1 No	1 No
2	Board displaying instruction chart for artificial respiration	1 No	1 No
3	Board displaying dos and don'ts.	1 No	1 No
4	Board displaying fire extinguishers details and operations	1 No	1 No
5	"No smoking" board	2 Nos	5 Nos
6	Danger boards: 33000V with danger symbol in Hindi, Gujrati, English	As required	As required
7	Identification boards, of suitable sizes, within and outside control room such as Inverter room 1, Inverter room 2, Inverter room 3, Main control room, Executive lounge, Store room, Gents toilet, Ladies toilet, SCADA room, Battery room, Pantry room etc. BHEL will provide list.	1 No	5 Nos

(a) 5mm thick sun board with LG make vinyl sticker (computerized cutting and pasting) shall be used for Sl Nos 5, 6 and 7.

(b) For others, flex banner with design & printing shall be used.

5.35	**Electrical insulation mat** (1) Vendor shall supply electrical insulating mats as follows: (a) Reputed make as shall be approved by BHEL/ GIPCL (b) As per IS: 15652:2006 (c) Class B (d) Thickness 2.5 mm minimum (e) Size = 2m x 1m minimum, exact size shall be as approved by BHEL/GIPCL during detailed engineering. (f) Colour: to be approved by BHEL/GIPCL (g) Max use voltage = 33 kV (h) Marking of IS standard on the mat (2) Test certificate shall be provided by vendor (3) Vendor shall lay the mats in front of all the indoor electrical panels viz. PCUs, VCB panels, ACDB panels, SCADA panels, UPS panels, FCBC battery charger, battery banks etc.
5.36	**Checkered plates** Vendor shall supply and install checkered plates made of MS for closing the cable trenches (a) behind/ in front, as applicable, of the panels such as PCUs, LT panels, ACDB panels etc in inverter rooms / main control room to cover up the cable trench and also (b) all other open trench areas. (1) MS plates shall have a suitable handle (welded to the plate) to facilitate ease of lifting and movements. (2) Plate thickness = 8 mm minimum (3) Width and length of checkered plates shall be selected so that the cable trenches are neatly sealed without any gaps. (4) Plates shall be red oxide coated followed by black painting. (5) BHEL/GIPCL approval shall be obtained for overall arrangement of checkered plate.
5.37	**Supply and Installation Miscellaneous Items for Control Room** (1) Split Air conditioner of 1.5 tonne (4Nos) of split type for SCADA room, conference room of Voltas/ Hitachi/ Samsung/LG make. (2) Furnitures for SCADA room as below • Table with drawer for desktop PC – 5 Nos • Chair, industry standard, revolving type, with wheels, arm rest, provisions for adjustment of height (hydraulic/ gas lift):5 Nos • Storage almirah: 4 No • Filing cabinet: 4 No • Printer table: 1 No (3) Furniture for Conference Room • 1 number of LED TV of 48 inch of Sony/ Phillips / Samsung make, • 1 number of 150 Ltr Refrigerator of Voltas/Godrej/Wirlpool make. • 1 No of projector with 2x2 m screen • 1 no of conference table of 10 person equipped power sockets and 10 chairs revolving type with wheels. • 1 Set of Sofa 3+1+1 Note : Make of the above mentioned furniture shall be Godrej/Duraim/Zuari/Usha/Lexus.

5.38 Tool kits and instruments

Each vendor executing Package A and Package B shall supply 1 set of the following tool kits and measuring instruments:

A. Measuring instruments

1	Digital Earth Resistance Tester	Cambridge Instruments	DET-2000	1 Nos
2	Digital multimeter	Reputed make		1 Nos
3	AC-DC Clamp Meter Amp range	Lutron	DM-6506	1 Nos
4	AC-DC clamp meter mA range	Lutron		1 Nos
5	Thermometer, Laser Beam	Fluke	62 Mini	1 Nos
6	Digital thermometer (wall hanging)	Reputed Make		1 Nos
7	Digital megger – 5KV type	Reputed Make		1 Nos
8	Electrical Tester	Reputed Make		1 Nos

Note: Make / model number etc shall be approved by BHEL/GIPCL prior to procurement.

B. Tool kits

1	Double ended spanner Set of sizes 10-11, 12-13, 14-15, 16-17, 17-18	1 No each
2	Screwdriver Set	1 Set
3	Crimping tool with Dye range 50-630sq-mm cable, mechanical gear power, hand operated	1 Set
4	Crimping tool up to 10 sq-mm cable	1 set
5	Drilling machine AC, hand operated, with bit size up to 20 mm	1 set
6	Measuring Tape, 5m	1 No
7	Measuring Tape, 50 m	1 No
8	Allen Key set	1 Set
9	Adjustable spanner 2-inch size	1 No
10	Hammer	1 No
11	Rough file kit	1 Set
12	Platform balance, 50Kg range	1 No
13	Cutting Pliers	1 No
14	Nose Pliers	1 No
15	Vacuum cleaner, of industrial type, for control room sweeping / cleaning.	1 No
16	Blowers for cleaning the panels	1 No

Note: Prior to procurement, vendor shall obtain approval from BHEL for the make and specification of the items.

5.39 Cable installation Methodology

1. CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanizing of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 6.6kv up to and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands elastomers and plastic insulated cables.
	Indian Electricity Act
	Indian Electricity Rules.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

2. DESIGN AND CONSTRUCTIONAL FEATURE

Inter Plant Cabling

Interplant cabling for main routes shall be laid in Cable trenches/duct banks. Cables from main plant to control room shall be laid in Cable trenches/duct banks. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly burried cables, if essential ,shall not have concentration of more than 4 cables in one route. All buried cables shall be armoured.

Trenches

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

No subzero level cable vault/trenches shall be provided below control building/switchgear rooms in plant.

General

The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.

Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. foraluminium conductor and 2.5 sq.mm. for copper conductor cable.

Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:

- Meet all safety requirements
- Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc

3. Cable accessories

3.1 Cable trays, Fittings & Accessories

a) Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

b) Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.

c) Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.

d) Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanised as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.

3.2 Support System for Cable Trays

(a) Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

(b) Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types: (i) C1:- having provision of supporting cable trays on one side and (ii) C2:- having provision of supporting cable trays on both sides. The support system shall be the type described hereunder:

1. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.
2. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares, fitings and accessories shall be prefabricated factory galvanised.
3. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer &aluminium paint shall be applied.
4. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drill ing and other machining operation.
5. Support system shall be able to withstand
   - weight of the cable trays
   - weight of the cables (75 Kg/ Metre run of each cable tray)
   - Concentrated load of 75 Kg between every support span.
   - Factor of safety of minimum 1.5 shall be considered.

3.3 Pipes, Fittings & Accessories

a) Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

b) GI Pipes shall be of medium duty as per IS:1239

c) Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

d) Hume pipes shall be NP3 type as per IS 458.

3.4 Junction Boxes

a) Junction Boxes with IP:55 degree of protection, shall comprise of a case with hinged door constructed from cold rolled sheet steel of thickness 2mm. Top of the boxes shall

be arranged to slope towards rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

b) Terminal blocks shall be 1100V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded copper conductors of size upto 2.5 sq mm each. All internal wiring shall be of minimum 1.5 sq. mm cu. Conductor PVC wire.

3.5 Terminations & Straight Through Joints

a) Termination and jointing kits for 33kV,11kV, 6.6 kV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 33kV, 11kV and 6.6 kV grade joints and terminations shall be type tested as per IS: 13573. 3.3kV grade joints and terminations shall be type tested as per VDE0278. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solderless crimping type cable lugs & ferrule as per DIN standard.

b) Straight through joint and termination shall be capable of withstanding the fault level for the system.

c) 1.1 KV grade Straight Through Joint shall be of proven design and make shall be approved by BHEL.

3.6 Cable glands

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

3.7 Cable lugs/ferrules

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to relevant standard.

3.8 Trefoil clamps

Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the peak value of maximum system short circuit current.

3.9 Cable Clamps & Straps

The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.

3.10 Receptacles

Receptacles boxes shall be fabricated out of MS shet of 2mm thickness and hot dipped galvanized or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break, AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity.

3.11 Galvanising

- Galvanising of steel components and accessories shall conform to IS: 2629, IS: 4759 & IS: 2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.
- The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

3.12 Welding

The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595.

4. CABLE INSTALLATION

4.1 Cable tray and Support System Installation

a) Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.

b) Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with relevant standard.

c) The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.

d) The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval.

e) All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/ stenciled with identification numbers at every floor.

f) In certain cases it may be necessary to site fabricate portions of trays, supports and other non- standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

4.2 Conduits/ Pipes/ Ducts Installation

a) The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.

b) GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

c) Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.

d) Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and

true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	Spacing
Upto 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm and above	3.0 M

e) For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

4.3 Junction Boxes Installation

Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

4.4 Cable Installation

a) Cable installation shall be carried out as per IS: 1255 and other applicable standards.

b) For Cable unloading , pulling etc following guidelines shall be followed in general :

- Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.
- While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.

c) Cables shall be laid on cable trays strictly in line with cable schedule

d) Power and control cables shall be laid on separate tiers in line with approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, HT cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center

lines and clamped at every two meter. All multi core cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multi core power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multi core power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.

e) Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.

f) Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.

g) No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.

h) In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

i) Wherever few cables are branching out from main trunk route troughs shall be used.

j) Wind loading shall be considered for designing support as well Cable trays wherever required.

k) Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.

l) The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

4.5 Separation

At least 300mm clearance shall be provided between :

- HT power & LT power cables,
- LT power & LT control/instrumentation cables,

4.6 Segregation

a. Segregation means physical isolation to prevent fire jumping.

b. All cables associated with the unit shall be segregated from cables of other units.

c. Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of

auxiliaries of same unit shall be segregated from the other set.

d. In switchyard, control cables of each bay shall be laid on separate racks/trays.

4.7 Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

No. of cores in cable	No. of spare cores
2C,3C	NIL
5C	1
7C-10C	2
14C and above	3

4.8 Directly Buried Cables

a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS: 1255. Reference drawing for buried cables is included as a tender drawing and enclosd with this specification.

b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

4.9 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags.

4.10 While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.

5. Cable Terminations & Connections

a) The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

b) Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the

satisfaction of the Project Manager.

c) The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.

d) Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self-locking type nylon cable ties with de interlocking facility to keep them in position.

e) All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, -etc along with cable numbers and coiled up after end sealing.

f) All cable terminations shall be appropriately tightened to ensure secure and reliable connections.

5.40 Pre-commissioning inspections/ checks/tests, MRT tests, coordination/liaison with state /central departments/CEIG etc. for necessary approvals/clearances for commissioning, synchronization with grid/ plant commissioning:

#	**Scope description** **Vendor shall be responsible for carrying out following activities for the respective IR and CMCS as per his scope**
1	Pre-commissioning inspections / checks / tests, MRT tests and coordination / liaison activities with state / central departments / Transco/ DISCOM/ CEIG etc for necessary approvals / clearances for commissioning, synchronization with grid and post-commissioning operation of the plant. (Clearances shall include obtaining prior approvals for all applicable drawings/ documents etc from concerned state / central departments / Transco/ DISCOM/ CEIG etc.)

A	Basic checks	
	A1	Tightness checks:
		1) Terminations of AC/DC power cables at SMBs, PCUs, Inverter transformers, Aux transformer, ACDB panel, UPS/ FCBC/ Battery banks, Aux AC/DC DB boards, ABT metering panel, 33kV VCB panels, 33kV LV side of Power transformer, SCADA panels etc. 2) Terminations of Control/ Instrumentation/ Data/ Communication cables wherever applicable. 3) Terminations of earthing at all electrical equipment/ panels of inverter rooms/ control room 4) Terminations of earthing of inverter transformers, aux transformer 5) Terminations of earth chambers of vendor scope. **Note:** For M10 and above, torque wrench settings shall be followed for reference.
	A2	Electrical continuity checks

					A3	Megger (5kV) checks for all HT (33kV) cables		
					A4	Hi-pot testing for all HT (33kV) cables prior to connection to the panels/ transformers.		
					A5	Megger (1kV) checks for all 1.1kV grade cables		
					A6	AC/DC supply checks at TBs of all electrical panels/ DBs/ Transformers.		
				B	Pre-commissioning electrical tests:			
					B1	Power conditioning units (with the support of PCU service engineer at site)		
						1) DC side open circuit voltage and verification with SMB side measurements 2) Vendor to provide technician support to PCU service engineer for all other pre-commissioning tests as per OEM checklist 3) Functioning of duct fans (operation, direction of rotation)		
					B2	Inverter transformers and Aux transformer		
						1) Oil filtration: Equipment of adequate evacuation/ heating/ oil circulation capacity shall be deployed at site for this purpose. Filtration shall be carried out adequately in order to achieve the BDV, ppm, tan delta values within the limits as per relevant standards and as measured by NABL accredited laboratory. The machine shall have built-in BDV measuring set up for in-situ checking of BDV during filtration process. DG if required for oil filtration shall be arranged by vendor. 2) IR tests LV-HV, HV-E, LV-E 3) Vector group 4) Voltage ratio 5) Magnetizing current 6) Magnetic balance 7) Winding resistance at all taps 8) Fault simulation checks (at VCB breaker panels): Buchholz, OTI, WTI, PRV, LOLA etc 9) Alarm, trip settings (S1, S2) for WTI, OTI 10) Oil level at conservator (to be topped up, if required)		
					B3	Indoor CTs 33kV		
						1) IR tests (all cores): Pri-Sec, Sec-Sec, Pri-E, Sec-E 2) Ratio tests / primary injection		
					B4	Indoor PTs 33kV including Bus PTs		
						1) IR tests (all cores): Pri-Sec, Sec-Sec, Pri-E, Sec-E 2) Voltage ratio test 3) Polarity test		
					B5	Indoor VCB breakers 33kV		
						IR tests Contact resistance measurement (CRM) Timing test: close/ open/ close-open Functional checks: breaker open/close, spring-charged motor Remote operation from SCADA panels: open/close, command/		

					status, lamp indications		
				B6	Numerical relays at VCB breaker panels		
					1) Relay calibration using applicable kit/ software 2) IDMT, DT curves with timing/pickup settings in all relays based on gradation across from downstream to upstream taking into account settings at STU substation 3) Overcurrent/ earth fault pickup/ tripping time tests		
				B7	CT ratio / PT ratio to be set in meters/relays		
					i. All MFM meters ii. ABT meters iii. Protection relays		
				B8	ACB breaker settings (with the help of PCU service engineer)		
					1) Over load, Short time fault, ground fault		
				B9	Earth resistance measurements for all chambers of vendor scope		
					1) With electrode connected to grid 2) Without connecting electrode to grid		
				B10	UPS/ FCBC charger/ Battery banks		
					1) All functional checks: battery charging/ discharging, FCBC/ battery output parameters etc. as per OEM checklists		
			C	Testing agency			
					Credentials of testing agency shall be submitted to BHEL for approval prior to awarding of work.		
			D	Coordination and Liaison activities to be carried out by vendor:			
					1) Vendor shall suitably support the upstream contractor of BHEL executing the 66kV switchyards (at SPV, Substation ends) and transmission lines in the process of obtaining approval from Transco/ DISCOM/ CEIG/ CEA etc as applicable for line charging/ grid synchronization/ plant commissioning. 2) Liaison responsibility for getting the approvals rests with the respective vendors for their scope of works. However, wherever technical clarifications are required by the approving agencies with regard to SPV portions (including solar array) up to 33kV side of power transformer, vendor shall suitably coordinate/liaison with the concerned state/central approving agencies to make the approval process successful. Accordingly, vendor shall participate in direct discussions with the approving agency whenever necessary. Also, all the necessary payments/expenditures to be incurred with ref to such coordination/ liaison in this regard shall be borne by the respective vendor. 3) For solar array details including earth mat grid, vendor shall suitably coordinate with the respective downstream contractor of BHEL for mobilization of inputs from them necessary for the approval process. 4) Following are the areas of approval, as applicable, for the SPV-side portions including solar array and up to 33kV side of power transformers. (a) GTP/ datasheets/ GA drawings/ Bill of materials, MQP etc of		

				supply items. (b) Site test reports of transformers, transformer oil, VCB breakers, CTs, PTs, resistance of earth mat grids etc (c) Interaction with supervising/ inspection agency such as MRT departments, Transco, CEIG, CEA etc, as applicable, for applying to them/ inviting them for supervision/ inspection at site. (d) Interaction/ coordination with customer (GIPCL) in the above process as and when required. (e) All necessary testing kits/ instruments shall be arranged as per the requirements of inspection agency. Basic instruments such as digital multimeter, 5kV digital megger with PI feature, earth resistance meter, VCB open/close timing test kit, clamp meters etc shall be organized at site at the time of inspection. Competent electrical technician shall also be made available at the site. (f) Subsequent to site inspection by the concerned agency, vendor shall obtain the clearance for grid synchronization of their respective. (g) Vendor shall implement all the observations of CEIG related to SPV-side portion including solar array and up to 33kV side of 16MVA transformer.		
			E	Commissioning of power plant		
				1) Vendor shall organize all necessary tools/ measuring instruments required to operate the various electrical equipment at the time of commissioning: Digital megger 5KV with PI feature, Earth resistance tester, Phase sequence meter, Clamp meters etc., discharge rods, PPE safety gadgets (helmets, shoes etc.). 2) It is the responsibility of the vendor to interact technically with upstream/ downstream contractors for successful charging of 66kV grid line followed by charging of 33/66kV transformer at SPV plant end and grid synchronization of inverters/ plant commissioning. 3) Vendor shall participate actively in the commissioning until it is established that there is successful export of power from all the PCUs and through the 66kV transmission line/ switchyards of power plant.		

5.41	**Spares required to be supplied along with main consignment:** 1) Fuses of all types: 1 % of total population of respective items 2) MCB of all types: 1% of total population of respective items 3) Indicating lamp set of all types: 1% of total population of respective items 4) Surge protection devices/ MOV: 1% of total population of respective items 5) Room lighting LED lamps: 5% each type. 6) Y-connectors: 50 Sets (1 set = 2 nos) for each IR 7) Fuses of all types: 1 % of total population of respective items 8) MCB of all types: 1% of total population of respective items 9) Indicating lamp set of all types: 1% of total population of respective items 10) Surge protection devices/ MOV: 1% of total population of respective items 11) Room lighting LED lamps: 5% each type. 12) Y-connectors: 50 Sets (1 set = 2 nos) for each IR 13) MC4 connectors: 50 sets (1 set = 2 nos) for IR

	14) Spares of aux transformers: a) HV bushings with metal parts and gaskets: 1 set b) LV bushings with metal parts and gaskets: 1 set c) Neutral bushing with met metal parts an gaskets: 1 set d) Gaskets : 2 sets e) Silica gel breather with charge: 1 set f) Diaphragm of explosion vent: 1 set g) Prismatic oil level gauge: 1 set h) Valves: 1 set Notes: (a) 1 set refers to total quantity of the item used in one transformer. (b) In case quantity arrived based on percentage is a decimal figure, it shall be rounded off to next higher integer. (c) Each Vendor shall supply the above mentioned item as applicable in their scope. % above defined is as per the supply scope under the respective vendors

6.0 General conditions applicable during supply, installation and commissioning and O&M phase

6.1	As already mentioned in previous clauses, vendor shall organize power supply on their own. Accordingly, DG sets of suitable capacity shall be deployed by the vendor for construction works.
6.2	Similarly, water required for construction works shall be organized by vendor (tankers etc).
6.3	All machinery such as cranes, hydra, JCBs, forklifts, transport trucks, trolleys etc necessary for movement and installation of materials / panels / equipment etc shall be organized by the vendor.
6.4	All necessary tools and tackles such as crimping tool (including heavy duty tools for crimping copper/ aluminium cables up to 630 sq-mm), screw driver set, power screw drivers, cutting pliers, nose pliers, spanner sets, adjustable spanners, hole-saw cutter set, bending tools, torque wrenches, hack saw blades, pipe wrenches, flat / round files, HV termination tools, drilling machines, welding machines, concrete mixers, steel bar bending tools / templates/ shuttering materials for RCC works, spade, shovel, hammer etc shall be organized by the vendor.
6.5	All necessary measuring instruments such as digital multimeters, measuring tapes, vernier calipers, electrical testers, digital meggers (1kV, 2.5kV, 5kV), earth resistance meters, clamp meters, transformer oil BDV kit, relay testing kit (secondary injection), primary injection kit, infrared thermal imaging handheld temperature meter etc. All these instruments shall possess valid calibration certificate issued from approved NABL laboratory.
6.6	Vendor shall make their own arrangements for necessary food, drinking water and accommodation for their labour and employees posted at the site. Similarly, food and drinking water required at the site, during the construction operations, shall also be in scope of vendor.
6.7	Vendor shall organize all necessary steps to meet statutory requirements such as labour license, PF, ESI etc and also ensure compliance with relevant acts such as minimum wages act, income tax act, employee insurance act etc for their labour deployed at site.
6.8	Vendor shall maintain updated labour register, with name, age, qualification, salary, attendance details etc. at the site.
6.9	Vendor shall use danger boards, wherever required, to ensure safety of the persons during the work at site.

6.10	Vendor shall adhere to all necessary safety norms such as use of helmet, goggles, hand gloves, gumboots, aprons etc. It is the ultimate responsibility of the vendor in all respect to prevent accidents at the site and safeguard their labour from accidents.
6.11	Vendor shall, at the completion of every work, clear off the debris, which resulted out of the work. In case of excavation work such as cable trench etc, vendor shall finish the land neatly with necessary leveling, rolling etc.
6.12	Vendor shall carry out the work without causing inconvenience to other contract groups at the site. In case of conflicts with other groups, vendor shall ensure that the matter is resolved at once amicably so that the progress of work is not affected.
6.13	**65% of the jobs created due to the project in the supervisory and managerial cadres & 80% of the jobs that will be created in other cadres shall be filled in by employing local persons. The expression "Local person" shall mean a person domiciled in Gujarat State for 15 years prior to applying for employment to vendor.**
6.14	**Before engaging the labour in to work, vendor should get the NOC from labours' native police station as well as NOC from Santhalpur, Gujarat police station.**
6.15	Any damages on the building, structures etc. attributable to the acts of labour / employees of vendor shall be rectified and made good by the vendor at their own cost.
6.16	No child labour shall be employed for execution of the present contract.
6.17	Any miscellaneous materials, which are found essential for technical completion of the contract but not mentioned explicitly in this specification, shall be deemed to be included in the specification. Accordingly, such materials shall be included by the vendor as part of the offer.
6.18	Special instruction for earthing: In compliance with Rule 33 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. Accordingly, all cases such as cable support structures, cable ladders, cable trays (control room) etc. shall be earthed.
6.19	BHEL/GIPCL shall witness routine/ acceptance/ type tests performed at manufacturer works for the items supplied by vendor. Vendor shall accordingly provide inspection call to BHEL with submission of quality assurance plan in advance. For the items bought out from dealers, test certificates, as per relevant IS / IEC standards, as issued by manufacturer shall be submitted to BHEL. However, prior approval shall be obtained from BHEL/GIPCL for procurement of the item from dealers.
6.20	Field Quality Plan / Quality control system (if applicable) Vendor shall set up a field quality control laboratory with full set up to facilitate testing of all construction materials in accordance with FQP (Field quality control plan) as approved by BHEL/GIPCL. Vendor shall deploy a well experienced quality control engineer to monitor all QC activities at site as per approved FQP. Specifically with reference to civil works, vendor shall submit all concrete mix designs and bituminous mix designs for BHEL/GIPCL approval before starting of the work. All the third party testing should be conducted in NABL approved laboratories only. Vendor shall submit the FQP for the civil construction works before starting of the works for approval of BHEL/GIPCL.
6.21	Any deviations shall be discussed with BHEL/GIPCL site engineers and implementation shall be taken up only after approval from BHEL /GIPCL.
6.22	Vendor shall submit periodic status report, on daily as well as weekly consolidated basis, to BHEL on the progress of the contract.

6.23	Vendor shall, as and when required by BHEL/GIPCL, participate in the review meetings conducted by BHEL/GIPCL at project site, BHEL-EDN (Bangalore), BHEL-Corporate office (New Delhi), GIPCL office (Vadodara) etc.
6.24	**General Guidelines** a) Any civil or electrical work which is not mentioned or included in this tender document but necessary for functional requirements of the plant shall be carried out by vendor. b) Vendor shall prepare all designs / drawings based on the specifications given in the tender and in light of relevant BIS/IS/ equivalent standard. c) Vendor shall provide type test reports and datasheet/ GTP for all equipments covered under vendor scope of supply. d) BHEL reserves right to modify the design at any stage to meet local site conditions / project requirements. e) All work shall be carried out in accordance with the latest edition of the Indian Electricity Act and rules formed thereunder and as amended from time to time.

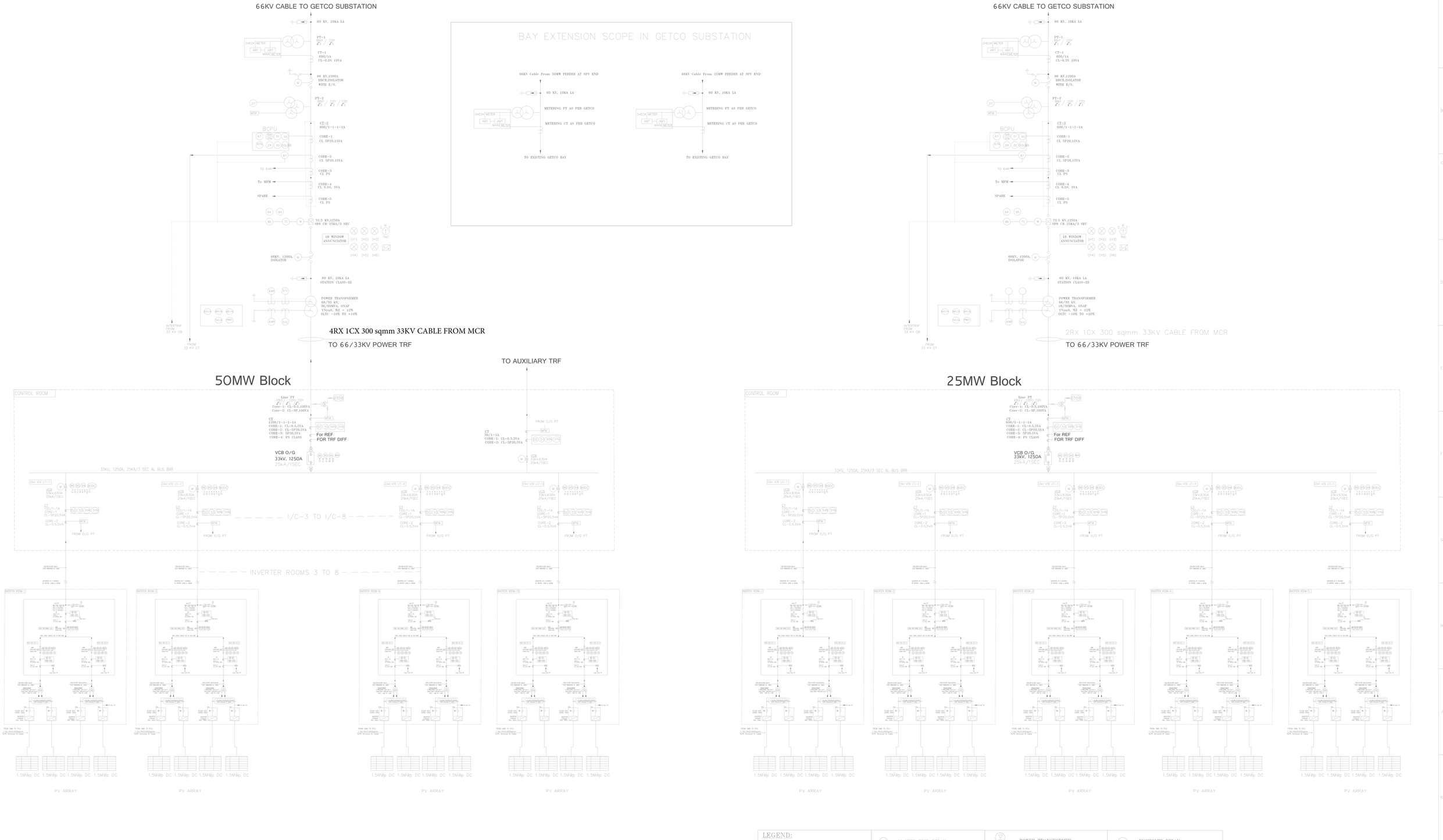
7.0 Documents to be submitted for BHEL/GIPCL approval during detailed engineering

7.1	BHEL/GIPCL approval shall be obtained for the following technical documents, which shall be submitted to BHEL in phased manner based on priority sequence of activities during detailed engineering (after receipt of purchase order from BHEL).
7.2	Name of vendor/ make, model number/ part number, specification/ sizes/ dimensions/ drawings/ datasheets shall be submitted for all the vendor supplied items.
7.3	Design calculations/ general arrangement drawings/ single line diagrams/ GTP particulars/ datasheets/ schemes/ layouts/ bill of materials etc., as applicable, shall be submitted for the following: (1) GI cable trays for internal cable trench, cable ties, HDPE DWC conduits, 33kV termination kits, 33kV straight through jointing kits, cable glands, cable lugs, (2) Earth chambers of solar array/ inverter/ main control rooms: GA, cross section, BoM with GTP/ datasheets etc. (3) Room lighting system: lux calculations, lighting layouts, GA drawings of street light pole/ wall-mounted/ column-mounted/ fence-mounted systems, SLD, BoM with GTP/ datasheets etc. (4) Fire extinguisher datasheets (5) Weather Monitoring system BoM with GTP/ datasheets etc. (6) Any other designs/ schemes/ layouts etc as per BHEL/GIPCL requirements that will be discussed during detailed engineering.
7.4	Manufacturing Quality Plans for all the vendor supplied items
7.5	Field quality plan for the field work: civil works, electrical works
7.6	Detailed activity-time chart for project implementation
7.7	Detailed manpower deployment schedule

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN mm

DRAWING NO. BHEL-GIPCL-ELEC-ACSLD-024



LEGEND:

- INVERTER TRANSFORMER
- CIRCUIT BREAKER
- POTENTIAL TRANSFORMER 1 PRIMARY , 2 SECONDARY
- CURRENT TRANSFORMER
- MFM – MULTI FUNCTION METER
- 49 – WTI & OTI
- 63 – BUCHHOLZ RELAY
- 50 – INST. OVER CURRENT RELAY
- 51 – IDMT. OVER CURRENT RELAY
- 86 – MASTER TRIP RELAY
- 95 – TRIP CIRCUIT SUPERVISION RELAY
- 80DC – DC CIRCUIT SUPERVISION RELAY
- 26 – MAGNETIC OIL LEVEL GAUGE
- 74 – PRESSURE RELIEF DEVICE
- 94 – ANTI PUMPING RELAY
- A – AMMETER
- V – VOLTMETER
- LOAD BREAK SWITCH (LBS)
- POWER TRANSFORMER
- LIGHTNING ARRESTOR
- ISOLATOR WITH EARTH SWITCH
- 630A VCB
- 87T – TRANSFOEMR DIFFERENTIAL RELAY
- 195/295 – TRIP CIRCUIT SUP RELAY
- TVM – TRI VECTOR METER
- 80 – DC SUPERVISION RELAY
- 30 – ANNUNCIATION RELAY
- 78 – PHASE-ANGLE MEASURING REALY
- 63X – BUCHOLTZ RELAY
- INTEGRATED RELAY FOR 50N,51N.
- $ – INTEGRATED RELAY FOR 27,29.
- & – RS 485WITH MODBUS COMM.

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PROJECT : 75MW SOLAR POWER PLANT
CUSTOMER : GIPCL

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

TITLE: AC SINGLE LINE DIAGRAM

No. OF SHEETS	01
SHEET No.	01
REV.	00

BHEL DRG. No. BHEL-GIPCL-ELEC-ACSLD-034

A0 SIZE

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MASTER DRY NO.

FIRST ANGLE PROJECTION

DRAWING NO. BHEL-GPCL-ELEC-ARRAY-036

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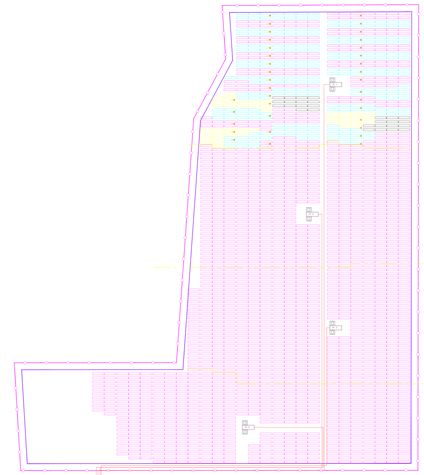
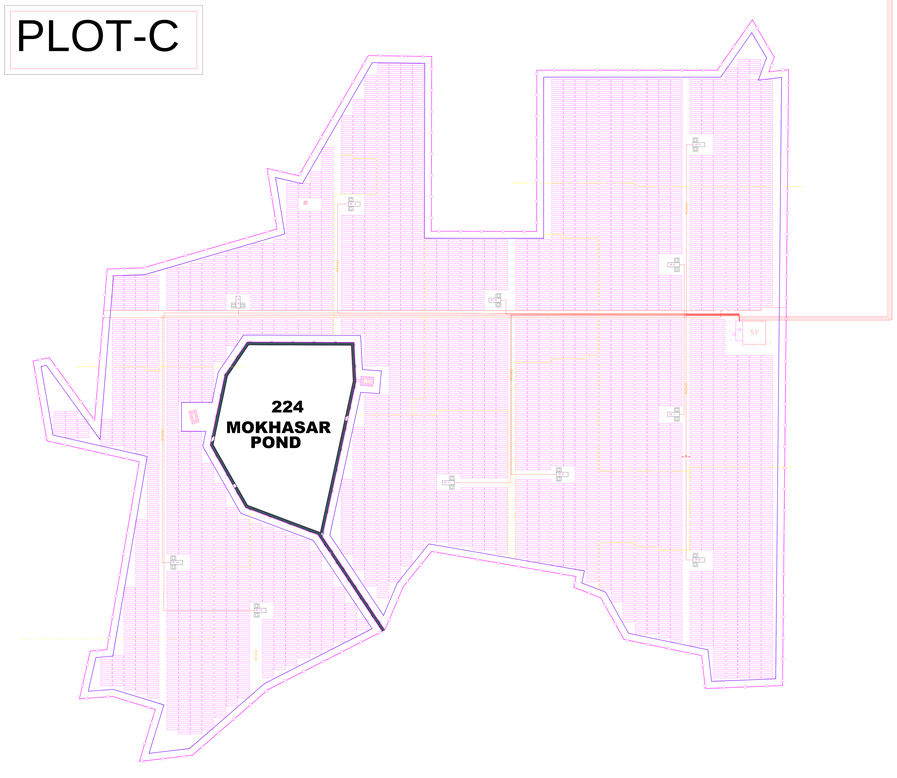


PLOT-B



PLOT-C

NOTES

a. Module Tilt Angle: 26°
b. Tables populated: 7556nos
c. Each MMS Table =40–(PV Modules)
d. Total number of Inverter Rooms :15
e. Total number of Control Room :1
f. Road Width :14 Mts
g. Plan of MMS table at 26 deg–(20x3.57)m
h. Inter row spacing from tip of one table to tip of another table (clear distance) – 3.36m
i. Invertor Room Size – 20.5m X 7.5m
j. Control Room Size – 36m X 11m
k. Switch Yard Size – 40m X 40m
l. Invertor Rooms in Plot B2 – 4
Invertor Rooms in Plot C – 11
m. All around Periphery – 12m offset maintained.

IMPORTANT NOTES

1. This layout is tentative as Topo Survey of Plot C yet to be completed.
2. This drawing is not to scale.Only Written dimensions to be read.

LEGEND

IR Room
Control Room
Switchyard
MMS
Road
Boundary of plot B2
Boundary of plot C

ALL DIMENSIONS ARE METER

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PROJECT : 75MWp SOLAR POWER PROJECT
CUSTOMER : GIPCL

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

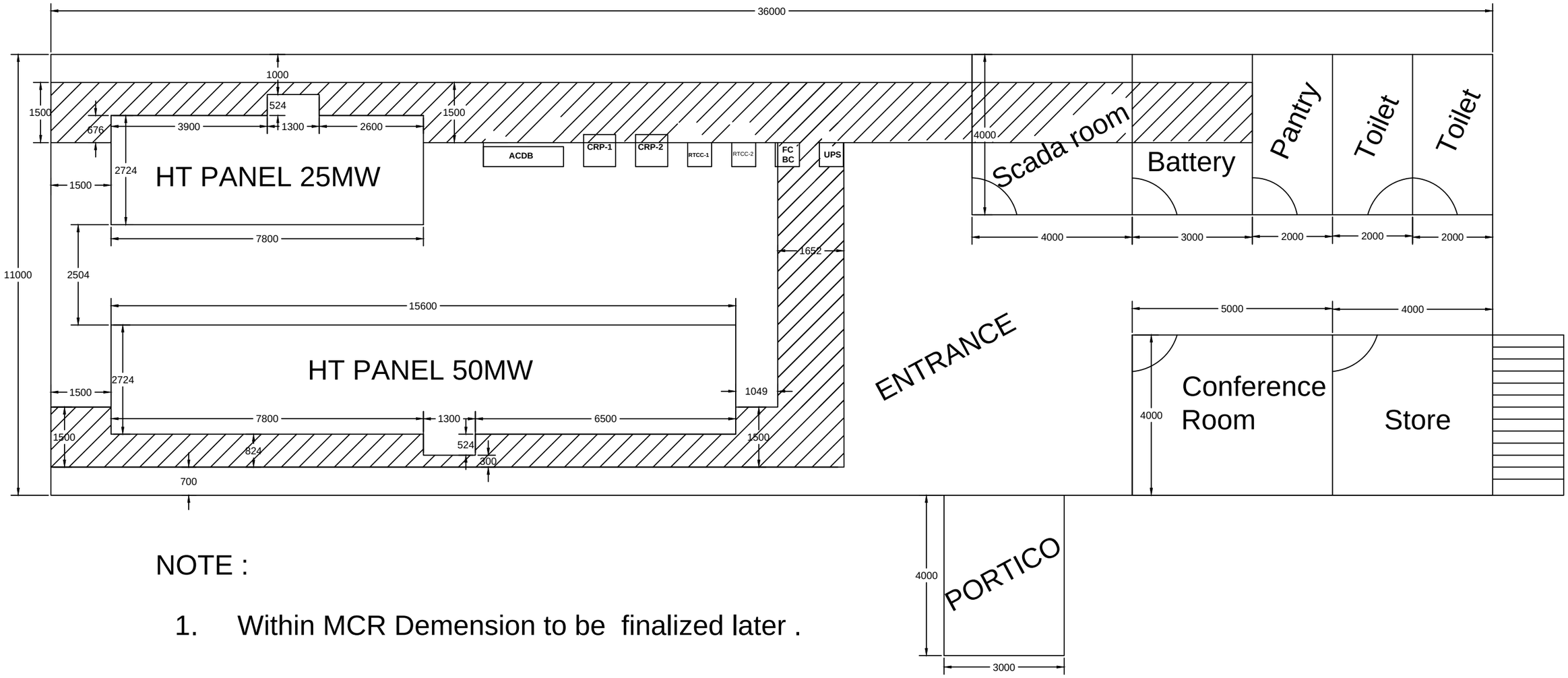
TITLE: ARRAY LAYOUT OF SPV PLANT

No. OF SHEETS	01
SHEET No.	01
REV	01

BHEL DRG. No. BHEL–GIPCL–ELEC–ARRAY–036

A0 SIZE

PRELIMINARY MCR LAYOUT



NOTE :

1. Within MCR Demension to be finalized later .

2. It is for overall dimensions and to Start Civil work accordingly .

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. No. BHEL–GIPCL–CIV–IR–010

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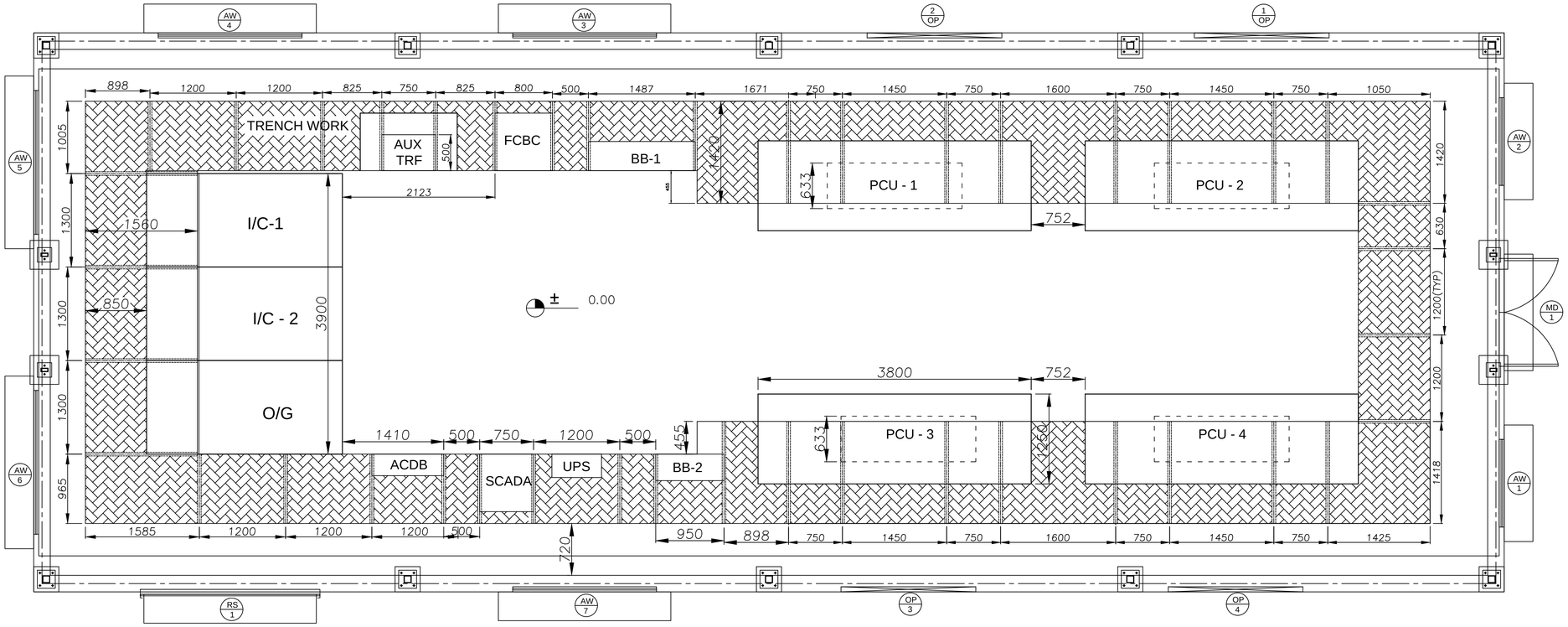

DIEMNSIONS:

FCBC	800x800mm (LxD)
BB-1	1487x405mm (LxD)
BB-2	950x370mm (LxD)
PCU	1000x300mm (LxD)
ACDB	1000x300mm (LxD)
SCADA	750x800mm (LxD)

TENTATIVE INVERTER ROOM LAYOUT FOR GIPCL 75MWP

ALL DIMENSIONS ARE IN "mm"

Note:
1. This drawing is to be referred only for location of equipment support channels in cable trench.
2. For all other details of latest approved inverter room drawings to be referred.

PROJECT : 75MW SOLAR POWER PLANT
CUSTOMER : GIPCL

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APPROVED	PR		170518

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BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

TITLE: EQUIPMENT LAYOUT AT INVERTER ROOM

No. OF SHEETS	01
SHEET No.	01
REV	00

MO. No.

DRG. No. BHEL–GIPCL–CIV–IR–010

REF. DRG. No.

SIGN. & DATE

INVENTORY No.

FORM No. A3–03

A3 SIZE

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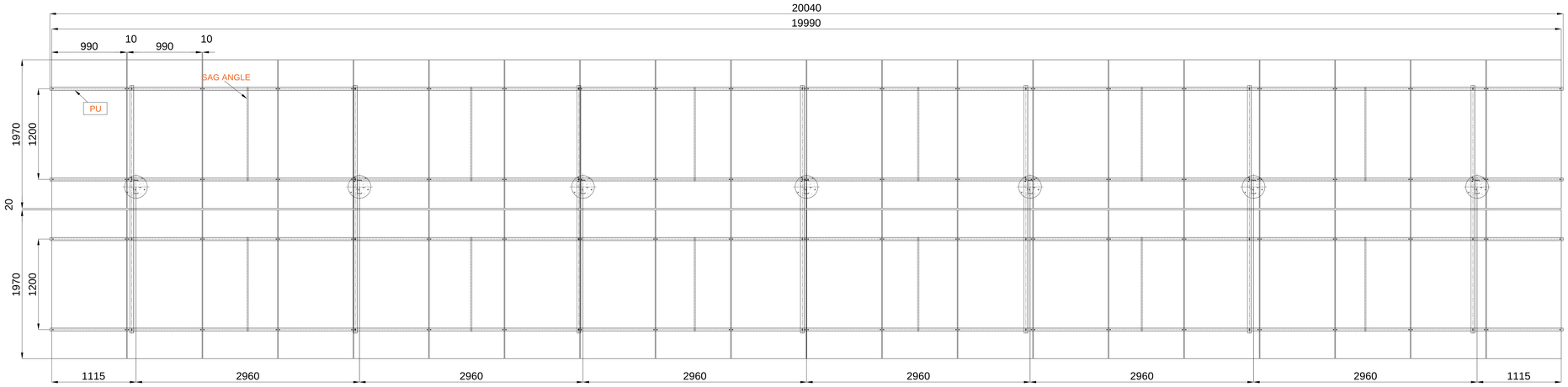
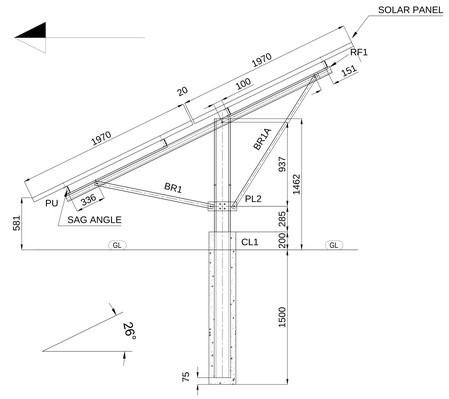
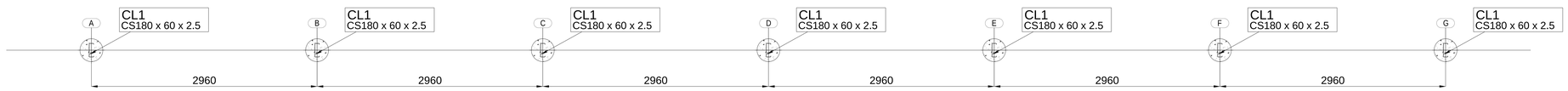


PLAN OF STRUCTURE (WITH SOLAR MODULE) FOR 0°



SIDE VIEW FOR 26°(FIXED TILT)MADE LOOKING FROM



FOUNDATION DETAILS

NOTES:(This note has to be read alongwith the Bill of material).

1. DIMENSIONS FOR COLD ROLLED STEEL ANGLE/CHANNEL SECTIONS SHALL BE IN ACCORDANCE WITH IS:811:1987.
2. DIMENSIONS OF PLATES, FLAT BARS SHALL CONFORM TO IS:1730.
3. FABRICATION AND ERECTION SHALL BE CARRIED OUT INACCORDANCE WITH IS:800 AND IS:801.
4. ALL MMS MEMBERS TO BE HOT DIP GALVANISATED IN ACCORDANCE WITH IS:2629-1985 AND IS 4759 . HOWEVER THE MINIMUM GALVANIZATION THICKNESS TO BE AS PER BOM.
5. GENERAL ASSEMBLY TOLERANCE LINEAR +/- 2MM.
6. GENERAL ASSEMBLY TOLERANCE ANGULAR +/- 1°.
7. HOLE SIZES ARE SHOWN AFTER GALVANIZATION/TREATMENT.
8. REMOVE ALL SHARP AND BURR EDGES.
9. MMS EARTHING ARRANGEMENT TO BE SHOWN IN RELEVANT DRAWING.
10. PROTOTYPE TO BE DONE AS PER CLAUSE MENTIONED IN PURCHASE SPEC NO PS-439-1189.

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. DO NOT SCALE THE DRAWING ONLY WRITTEN DIMENSIONS TO BE READ.

PROJECT : 75MWp SOLAR POWER PROJECT
CUSTOMER : GIPCL

REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED			CHECKED
		APPROVED			APPROVED

	NAME	SIGN	DATE
DRAWN	SAN		180418
CHECKED	PM		180418
APPROVED	MS		180418

DISTRIBUTION OF PRINTS

DEPT.	CODE
SC&PV	439

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

TITLE: GA OF MODULE MOUNTING STRUCTURE

No. OF SHEETS	02
SHEET No.	01
REV	00

BHEL DRG. No. 3 679 05 00923

REF. DRG. No.
SIGN. & DATE
INVENTORY No.

shall be UL 9th edition Approved/Listed and in conformance with international standards such as NFPA 72 2010 edition National Fire Alarm and Signalling 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.

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.

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.

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.

Monitor, Control Modules & Fault Isolators: UL listed, modules complete with mounting arrangement on North American junction box as per requirements of contract works.

5.3.39 Vendor List

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

Sr.	Description	Vendor Name
1	PCU / Inverter	M/s SMA
		M/s ABB India Ltd.
		M/s Hitachi Hi-Rel Power Electronics Pvt Ltd.
		Bidder to propose other reputed make based on reference and credentials for approval of GIPCL
2	PV Modules	Tier-1 manufacturer as per Bloomberg BNEF Q4 2017 report and fulfilling the other tender requirements, subject to approval of Owner
3	HT Panel /HT Breaker	Siemens
		L & T
		ABB

		Schneider
		Jyoti
		CGL
4	Control and relay panel	ABB
		Siemens
		Schneider
		Alstom
5	LT Switchgear component (LT switchgear panel shall be CPRI approved vendor)	L & T
		Siemens
		ABB
		Schneider
6	Power Transformer	Voltamp
		Schneider
		CGL
		ABB
		BHEL
		ALSTOM
7	Inverter Transformer	Schneider
		Electrotherm
		Voltamp
		ABB
		CGL
		T & R
8	Auxiliary Transformer (Dry Type)	Voltamp
		Kotson
		Danish
		Melcon
9	Solar Cable and DC Cable	M/s LAPP
		M/s Siechem
		M/s KEI Cables
		M/s UniFlex Cables
		M/s Cords Cables
		M/s Apar
		M/s Universal
		M/s KEC
10	AC Cable (Up to 33 kV)	M/s LAPP
		M/s KEI Cables
		M/s Havells
		M/s Universal
		M/s KEC
10	HT termination kits	Raychem
		3M
	Optical Fiber Cable	Finolex

11		D-Link
12	Earthing Pit Materials	Ashlok
		Powertrac
		ERICO
13	SJB	M/s Hensel Electric Pvt Ltd
		M/s Trinity Solar
		M/s Eaton
		M/s ABB
14	Lugs	Dowell
		Comet
		3D
15	Cable Glands	Comet / 3D
16	SCADA System	M/s Rockwell
		M/s Siemens
		M/s Schneider
17	Weather Sensors	a. Pyranometer : i) Keep & Zonen ii) Ingenieurbüro Mencke & Tegtmeyer 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 – GIPCL in charge engineer's approval is required.
18	Batteries	Exide
19	UPS	Hitachi HI-REL
		Eaton
		Emerson
20	Battery Charger	M/s Chhabi Electrical
		M/s. Caldyne
		M/s. HBL Niap power system Ltd
		M/s Servilink
21	Lightning Arrestor (ESE type)	Erico
		Nimbus
		AT, Spain
		Ingesco
		Indelec
22	ABT Energy Meter (subject to approval of GETCO /GUVNL)	SEMS
		EDMI

23	HT Isolator (Upto 66 kV Outdoor Type)	Siemens
		ABB
		CGL
		GR Power switchgear
24	HT CT & PT (Upto 66 kV Oil Filled Type)	ABB
		CGL
		Pragati
		Jyoti
25	LA (Upto 66 kV Outdoor Type)	CGL
		Oblum
		Elpro
26	66kV Cable (Subject to approval of GETCO)	M/s Universal (Satna, MP)
		M/s Torrent (Ahmedabad, Gujarat)
		M/s KEI (New Delhi)
		M/s Polycab (Daman, Gujarat)
27	Disc and post insulator	BHEL
		Birla
28	GI structure for the switchyard	Sujana Towers
		Kalpatru Power transmission
		OR Any other Approved vendors of GETCO
29	Insulator hardware	3M
		ITIPL
		Approved vendors of GETCO
30	Clamps and connectors	Klemenn engineering corporation
		Approved vendors of GETCO
31	Numerical Relay	Siemens
		Areva
32	Switch fuse unit	Siemens
		L & T
33	PLCC equipments	ABB
34	Lighting fixture / system	Philips / CGL/Bajaj/Havells
35	CSS (Compact Sub-station)	ABB
		CGL
		Siemens
		Alstom
		Schneider
36	LED Lighting	CGL
		Wipro
		Bajaj
		Panasonic
		Philips
37	MCCB	SIEMENS
		ABB

		Schneider
		L & T
38	RMU (Ring Main Unit)	ABB
		Schneider
		Siemens
		CGL
		L & T
39	Steel Structure for MMS	TISCO
		SAIL
		JINDAL
		RINL
		ESSAR
40	Submersible/Sump Pump	Kirlosker
		KSB
		CGL
		CRI
		Jyoti
41	CCTV Camera & Monitoring System	Sony /Honeywell/Milestone

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 / equipments, 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 all Plots allotted to GIPCL& GSECL i.e.2x75 MW. GIPCL/GSECL will provide required co-ordination for matching vendor of SCADA system for 2x75 MW projects.

INTEGRITY PACT

Between

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi – 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for _____

_____

_____. The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1 – Commitments of the Principal

1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

Section 2 – Commitments of the Bidder(s)/ Contractor(s)

2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he / she is not legally entitled to, in

order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant IPC/ PC Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

2.1.4 The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidders(s)/ Contractor(s) from the tender process or take action as per the separate “Guidelines for Suspension of Business Dealings with Suppliers/ Contractors” framed by the Principal.

Section 4 – Compensation for Damages

4.1 If the Principal has disqualified the Bidder(s) from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/ Bid Security.

4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/Performance Bank Guarantee, whichever is higher.

Section 5 – Previous Transgression

5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.

5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6 – Equal treatment of all Bidders/ Contractors/ Sub-contractors

6.1 The Bidder(s)/ Contractor(s) undertake(s) to demand from his sub-contractors a commitment consistent with this Integrity Pact. This commitment shall be taken only from those sub-contractors whose contract value is more than 20% of Bidder's/ Contractor's contract value with the Principal.

6.2 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.

6.3 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

Section 7 – Criminal Charges against violating Bidders/ Contractors /Sub-contractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 –Independent External Monitor(s)

8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.

8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality.

8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

8.5 As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or

take corrective action, or heal the situation, or to take other relevant action. The Monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

8.6 The Monitor will submit a written report to the CMD, BHEL within 8 to 10 weeks from the date of reference or intimation to him by the Principal and, should the occasion arise, submit proposals for correcting problematic situations.

8.7 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.

8.8 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant IPC / PC Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.9 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.

8.10 The word ‘Monitor’ would include both singular and plural.

Section 9 – Pact Duration

9.1 This Pact begins when both parties have legally signed it. It expires for the Contractor 12 months after the last payment under the respective contract and for all other Bidders 6 months after the contract has been awarded.

9.2 If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified as above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 – Other Provisions

10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.

10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders/ contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

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For & On behalf of the Principal	For & On behalf of the Bidder/ Contractor
(Office Seal)	(Office Seal)

Place----------

Date----------

Witness: _____	Witness: _____
(Name & Address) _____	(Name & Address)_____
_____	_____