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Technical Specification for

Supply of Balance of System items and Installation & Commissioning

For 7.5 MW Solar PV grid connected power plant at

BHEL-Trichy, Tamilnadu

Revision details:	Prepared:	Approved:	Date:
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1.0 Introduction

Bharat Heavy Electricals Limited (BHEL), Electronics Division, Bangalore is setting up a 7.5 MW (5MW+2.5MW) Grid Connected SPV Power Plant for BHEL-Trichy, Tamilnadu.

The plant will have PV modules of mono-crystalline / poly-crystalline type mounted on module mounting structures. Electrically, the PV array will have 6 nearly equal segments, each generating DC power of ~1250kWp, which is then inverted to AC by grid-connected power conditioning units (PCU) of 1250kW rating. At the AC output level, every two PCUs are combined using a 3-winding oil-cooled transformer of 2.7 MVA rating which will step up the voltage to 11kV.

The solar array will have 54 string monitoring combiner boxes (SMBs) that collect the solar PV generated DC power and provide inputs to the 6 PCUs housed in centralized control room. Control room building will also house HT switchgear panels, ACDB, SCADA, battery bank, FCBC, UPS and other associated panels along with store room and toilets.

There will be 3 Nos. transformers (2700KVA, 11KV/ 350-350V) located in switchyard adjacent to control room. A typical layout of control room and switchyard is enclosed. The plant will have SCADA integration and PC based monitoring desk to gather DC, AC and other parameters from SMBs, PCUs, weather monitoring equipment, transformers, LT / HT breaker panels.

The output of solar power plant shall be connected by two separate feeders of 5MW and 2.5 MW to 11KV substation through 11KV transmission line which will be in the scope of BHEL.

This technical specification provides requirements of BHEL for supply, installation, commissioning of balance of system items and defect liability period of 6 months. BHEL scope of supply and work is mentioned under section 3.2.

Note:

Vendor shall visit the site to assess all the technical and operational requirements and familiarize with the site conditions before placing the bid.

2.0 Documents enclosed with this specification

1	Tentative Single line diagram of overall power plant
2	Tentative Site layout with locations of solar array, control room and switchyard (Autocad drawing of site layout will be provided on request by vendor through e-mail)
3	Tentative Control Room & Switchyard Layout
4	Tentative drawing of String Monitoring box



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3.0 Scope of Supply and work

3.1 Vendor scope of supply and work

The table below indicates the vendor's scope of supply, installation and defect liability period of 6 months as briefly outlined. Quantities mentioned below are indicative only. Vendor shall estimate exact requirement and quote accordingly.

S.No	Item description	Qty	Unit
1	Cable ties	1	Set
2	SMB mounting structure & hardware	54	Set
3	MC4 connectors	1270	Set
4	HDPE DWC pipe 63 mm	2000	М
5	300 sqmm Cable lugs with bimetallic washers and hardware in SMB	108	Set
6	Cable trays inside CR	120	М
7	Cable tray support structure inside CR	1	ST
8	Cable glands 300 sqmm in PCU	108	Nos
9	300 sqmm Cable lugs with bimetallic washers and hardware in PCU	108	Set
10	Cable glands 300 sqmm for transformer	252	Nos
11	Cable lugs with bimetallic washers and hardware for transformer	252	Set
12	Cable trays outside CR	90	М
13	Cable tray support structure outside CR	1	ST
14	11 KV Outdoor LA	6	Nos
15	11 KV Outdoor single-phase metering CTs	12	Nos
16	11 KV Outdoor single-phase metering PTs	12	Nos
17	Outdoor ABT metering panel	2	ST
18	ABT meters	4	Nos
19	RSJ poles	8	Nos
20	11KV GOS Isolators with earth switch	4	Nos
21	GI Support channels, ACSR conductor, pin/disc insulators, clamps and hardware etc. as required.	1	Set
22	HT cable - 11KV(UE), 3CX240 sq.mm	500	М
23	Half-cut RCC hume pipes	1	ST
24	HT termination kits - outdoor	2	ST
25	HT termination kits - indoor	8	ST
26	FCBC-110V, 20A	1	No
27	Battery bank 110V, 100AH	1	No
28	ACDB	1	No
29	UPS-5 KVA with battery with UPSDB	1	No
30	Weather Monitoring System	1	ST
31	DWC pipe for RS485 cable	1	ST
32	Control cables	1	ST
33	12CX2.5sqmm cable	1	ST
34	Lugs & hardware for data, auxiliary and control cables	1	ST
35	25X3 GI flat	1	ST
36	25X6 GI flat	1	ST
37	Earthing electrodes for MMS	1	ST



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38	Hardware for array earthing	1	ST
39	SMB earthing electrodes	54	Nos
40	Copper cable -16 sqmm	1	ST
41	Copper cable -2.5 sqmm	1	ST
42	Copper flat- 50X4	1	ST
43	Copper cable -25 sqmm	1	ST
44	Copper cable -70 sqmm	1	ST
45	Earthing electrodes	1	ST
46	Switchyard earthing electrodes	1	ST
47	Earth flat 65X8	1	ST
48	ESE LA and earthing	1	ST
49	Yard lighting system	1	ST
50	Module cleaning system	1	ST
51	Identification tags, markers etc.	1	ST
52	Hoarding board	1	ST
53	Display boards and sign boards	1	ST
54	Electrical insulation mat	1	ST
55	Checkered plate	1	ST
56	Air conditioner	1	ST
57	Tool kits and instruments	1	ST
58	Office furniture	1	ST
59	Fire alarm system	1	ST
60	safety related items	1	ST
61	Spares	1	ST
62	Installation & Commissioning as per respective clauses in specification	1	AU

Note: For all civil related activities in the scope vendor, quality documents (Material test reports, Design mix report etc.) shall be submitted by vendor as per Annexure-C of BHEL tender.



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3.2 BHEL scope of supply and work

For the sake of clarity to the vendor, the items that are within the scope of BHEL supply are listed below.

#	BHEL Scope of supply		
1	Supply of Solar PV Modules		
2	Supply and Erection of Solar array structures with modules mounted on structures (MMS), with each having 20 Nos. of PV modules	1270 sets	
3	Supply of Cable, 1Cx 6 sq-mm (for connection of PV modules to string monitoring boxes)	~ 105 km	
4	Supply of Cable, 1.1KV, 1C x 300sq-mm (for connection from SMBs up to PCUs and PCUs to transformers)	~ 31 km	
5	Supply of String monitoring boxes (24-in, 1-out)	54 Nos	
6	Supply of Power conditioning units (PCUs) of 1250 kW rating along with duct	6 Nos	
7	Supply of Transformers 2700kVA, 11KV/350V-350V (1 HV winding, 2 LV windings)	3 Nos	
10	Supply of 11KV indoor HT panels	1 set	
11	Supply of SCADA system with PC, accessories and software	1 set	
12	Supply of RS-485 cable and Ethernet LAN cable for SCADA		
	BHEL Scope of work		
13	Construction of control room including partitions for SCADA, store and toilets	1 No	
14	Construction of transformer foundations and switchyard fencing in switchyard	1 set	
15	Construction of boundary wall for the entire plant, pathways, approach road, drains within the solar plant	1 set	

4.0 Documents to be submitted along with offer

- 1. Clause-wise compliance shall be filled-up in the column provided in this specification, with signature and seal on every page.
- 2. Company brochure.
- 3. Project implementation time schedule.
- 4. Stage-wise manpower schedule.

Note: Wherever approved vendors are provided, in case if it is required to propose additional vendors, the same shall be done with prior approval by BHEL. For all the items wherever approved vendors are not provided, approval of makes shall be obtained from BHEL before placement of P.O on sub-vendors.



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5.0 Detailed technical specification for supply, installation and commissioning

Vendor shall indicate clause-wise compliance (Yes/No) in the column provided below. In case of non-compliance or deviation, vendors shall record their comment.

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#	BHEL specification	Vendor compliance (Yes / No) In case of non-compliance or deviation, vendors shall record their comments:
5.1	 Setting up of temporary site office Vendor shall set up a temporary site office using one porta cabin of minimum 160 sq.ft along with chemical toilet, water tank and septic tanks for BHEL use within 10 days from the date of purchase order to enable speedy commencement of site activities. Porta cabin shall be retained at the site until completion of 1 month after commissioning or till completion of vendor's works whichever is later. Cabin shall be furnished with essential amenities such as one computer with internet connection, printer, two work tables, six chairs and necessary number of power points, lamps, air conditioner and fans. Vendor shall arrange drinking water in site office for the site engineers of BHEL and the staff/employees of vendor. Vendor shall make arrangement for pantry shed for preparation of beverages such as Tea/ Coffee etc. Vendor shall depute office boy-cum-cook for preparation of Tea/Coffee. All the utensils, facilities such as LPG/electric stove and service requirements shall be included in vendor's scope. Consumables such as milk, tea, coffee powder, snacks etc. shall be arranged by BHEL. 	
5.2	Electrical power and water for construction (1) BHEL shall organize necessary electrical power supply and water supply required for construction activities in vendor's scope and also for the porta cabin on chargeable basis. Vendor shall pay the charges to BHEL based on consumption. Necessary metering arrangement shall be made by vendor.	
5.3	 Construction of temporary yards for safe storage of BHEL as well as vendor supplied items except PV modules and MMS (1) Vendor shall, at suitable locations at the site, as decided based on discussions with BHEL site engineer, construct a temporary yard for safe storage of all BHEL as well as vendor supplied items except PV Modules and Module mounting structures. This includes storage of all items such as electrical panels (SMBs, PCUs, HT panels, Transformers, Battery banks, Battery chargers, Distribution boards etc), cables, spares, tools, instruments etc. (2) Area of storage yard shall be min. 500 sq.m. However, exact size shall be decided mutually with BHEL based on site conditions. (3) A portion of storage yard area (min. 150 sq.m) shall be provided with suitable temporary roof and side covers (asbestos, FRP, steel sheet etc.,) for storage of critical electrical panels (PCUs, SMBs, Battery, Battery chargers, electrical DBs etc.) in order to ensure that there will not be any water spillage which may 	



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damage the equipment. This should be supported by steel poles that shall be
grouted using suitable concrete foundations. Height should be appropriately
decided to ensure safe operation of hydra for loading/unloading etc.,
Necessary raised / covered arrangements shall be provided to the individual

- (4) Necessary raised / covered arrangements shall be provided to the individual panels / equipment to ensure that these items are not affected by water at the ground level during time of rain storm, flood etc.
- (5) Yards shall be fenced all around with a steel gate of width of 4m minimum. Height of fence and gate shall be 2.5m minimum above the ground level.
- (6) Suitable fencing shall be provided using steel poles at every 3m intervals and barbed wires between the poles.
- (7) Gate shall be suitably secured to the fencing poles and shall be provided with lock and key.
- (8) Sufficient watch and ward security personnel shall be provided for the storage yard and complete solar plant erection area on round-the-clock basis.

5.4 Receipt, unloading, safe storage and movement of BHEL and vendor supplied items except PV modules and MMS

- (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 BHEL and vendor supplied items except PV Modules and MMS received at the site and subsequent movement to the storage yard. Similar arrangements shall also be made by vendor for movement of the items from storage yard to the point of construction for vendor's scope of works.
- (2) Vendor shall maintain proper documentation / compilation of all the records related to shipping (invoices, delivery challans etc.) and shall take verification and approval from BHEL site engineer for every consignment. The documents shall be suitably preserved for further handing over to BHEL.
- (3) Safeguarding the items from pilferage etc. is responsibility of vendor. For this purpose, vendor shall post adequate watch and ward for the yard on round-the-clock basis.
- (4) Registers shall be maintained for the yard to keep track of incoming / outgoing items.
- (5) BHEL will ensure insurance for all the items. Vendor shall provide necessary documentation and assistance to BHEL for making insurance claim in case of damage /theft of BHEL supplied items.

5.5 Interconnection of SPV modules to form strings.

Supply of SPV modules is in BHEL scope. Vendor shall interconnect the modules as follows:

Each module is fitted integrally with a junction box having positive and negative polarity cables (4 sq-mm).

- (a) 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.
- (b) This way, 20 modules shall be connected in series. Each set of connections is called as a series string.
- (c) 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 and interconnected to the respective SMBs. Vendor shall implement the interconnection as per these drawings.
- (d) Interconnected cables shall be neatly routed and dressed using UV resistant nylon cable ties of appropriate dimension.
- e) These cable ties shall be in vendor scope of supply. Recommended make: 3M,



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Phoenix contact, Weidmuller, Hellermanntyton, Panduit. BHEL approval shall be obtained by vendor for use of any other make. Specs: Nylon cable ties, polyamide 6.6 UV stabilized black, UL94 flammability rating V2, meant for outdoor use. Operating temperature up to 85 deg C. Width of cable tie shall be minimum 4.5 mm. BHEL approval shall be obtained for the selected brand and length of cable tie. (f) Cables shall not be loosely hanging. Installation of string monitoring boxes 5.6 (1) Supply of string monitoring boxes (SMB) is in BHEL scope. These are 24-in and 1-out type. (2) Vendor shall install the SMBs on Module mounting structure in the solar array field as per final array layout. (3) Supply of SMB mounting structures using GI channels/angles and necessary hardware required for installation of SMBs are in the scope of vendor. (4) Drawings of SMB and the fixing arrangement will be provided to the vendor after placement of purchase order. (5) SMB location will be identified by BHEL and will be provided in the wiring (6) SMBs shall be fixed on the structures using necessary hardware which shall be supplied by vendor. (7) All tools necessary for mounting shall be in vendor scope. Interconnection of SPV string cables to 6 sq-mm cable 5.7 (1) Each SPV module string shall be connected to SMB using 1Cx 6 sq-mm cable supplied by BHEL. Overall diameter ~ 6 mm. Diameter under the outer sheath (i.e over the insulation) ~ 4.6 mm. (2) SPV module is provided with positive and negative cables (4 sq-mm) having male and female parts of MC4 type connectors. (3) Vendor shall supply plug connectors of MC4 type, each set having a pair of male and female parts, to join the 6 sq-mm cable with SPV module string. Necessary crimping and termination is in the scope of vendor. (4) MC4 connectors shall have rating of 1000VDC (IEC), rated current of 25A (min.), Type approved by TUV Rheinland for product safety. (5) Approved make: Multi-contact or other reputed equivalent subject to BHEL approval during detailed engineering. (6) Total quantity of MC4 connector sets required = 1270 sets (each set having a male and a female part). (7) Extra quantity shall also be procured considering possibilities of damages during the installation. Vendor shall ensure that there shall not be any shortage during execution time. (8) Vendor should make available MC4 tool kits of quantity as required during execution for simultaneous working on the array. 5.8 Routing of 1Cx 6 sq-mm cable: (1) 6 sq-mm cables connecting the SPV module strings to SMBs shall be neatly routed along the module mounting structures using cable ties. (2) 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. Width of the cable ties shall be a minimum of 4.5 mm. BHEL approval shall be obtained for the selected brand and length of cable tie. (3) Cables shall not be loosely hanging.



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5.9 Underground laying of 6 sq-mm cables between the rows

- (1) Where 6 sq-mm cables run between two rows of structure, HDPE double walled corrugated (DWC) pipe shall be used to guide the cables underground from one row to the other in trenches.
- (2) HDPE DWC pipe of required length shall be within scope of vendor supply. Vendor to procure necessary quantity of HDPE pipes based on the actual requirement and ensure no shortfall in supply during the time of installation. Oty required ~ 2000 M
- (3) Inner Diameter (ID) shall be selected to accommodate the number of 6 sq-mm cables to be guided. However, Inner diameter shall be limited to a minimum of 63mm. Make: Tirupati Plastomatics, Jaipur or reputed make, as approved by BHFI
- (4) Make, part number, sizes / dimensions, datasheet shall be submitted to BHEL for approval.
- (5) Details of cable trench:
 - (a) Trench depth = 600 mm minimum.
 - (b) Trench width = 200 mm minimum.
 - (c) Bottom layer shall be sand of IS: 383 with 100mm thick.
 - (d) HDPE conduit shall be laid over the sand layer.
 - (e) Another layer of sand of 100 mm thick.
 - (f) Then, a single layer of class-2 brick (burnt clay type) of 75 mm thickness shall be laid.
 - (g) Trench shall, then, be filled with refill soil and compacted.

5.10 Connecting the 6 sq-mm cables on input side of SMBs

- (1) 6 sq-mm cables of positive and negative polarities originating from SPV module strings shall be terminated at the input side of SMBs using MC4 connectors.
- (2) MC4 connectors are fitted on input side of SMBs. Matching MC4 connectors will be supplied by BHEL in loose.
- (3) Vendor scope includes removal of sleeve at the cable end, crimping with MC4 connectors. These MC4 connectors have to be terminated on to the MC4 connectors that are part of the SMBs supplied by BHEL.
- (4) All necessary tools such as pliers, strippers, crimping tool etc. shall be within vendor scope.

5.11 Connecting the DC power cables on output side of SMBs

- (1) Cables of size 1Cx 300 sq-mm (Aluminium, armoured, XLPE insulation, PVC sheathed) shall be terminated at the output side of SMBs. Supply of this cable is in BHEL scope.
- (2) Overall diameter of cable ~ 32mm.
- (3) 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 bus bar within the SMB. Cables shall enter the SMB through the cable glands that are supplied by BHEL along with SMBs.
- (4) Aluminum Cable lug and bimetallic washer (Cu and Al) shall be in vendor scope of supply. Vendor shall submit catalog and datasheet of lug before procurement. Make: Dowell's /3D / 3M or any other reputed equivalent as shall be approved by BHEL. Quantity required ~ 108 Nos.
- (5) Hardware such as bolts, nuts, plain washers and spring washers shall be in vendor scope of supply. The size and type of these shall be in accordance with termination arrangement on the bus bar of SMB. Hardware should be SS304. Spring washers should be Zn coated.
- (6) All necessary tools such as pliers, strippers, crimping tool etc., required to complete the work shall be within vendor scope.



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5.12 Cable trenches for laying power cables from SMB to inverters:

- (1) 1Cx 300 sq-mm (Aluminium, armoured, XLPE insulation, PVC sheath) cables of positive and negative polarities are routed from SMB box to power conditioning units (PCUs) located at control room.
- (2) These cables shall be laid underground from the point near SMB to control room
- (3) Two cables (+, -) from each of the SMBs have to be routed to respective inverters.
- (4) Tentative Array layout with location of SMBs and control room is enclosed for vendor's reference and for estimation purpose. Exact solar array layout will be provided by BHEL after placing purchase order. Vendor shall prepare and furnish cable routing layout as per standards for approval by BHEL.
- (5) Vendor shall estimate the length of cable trench. Generally these power cables will be packed in 1000 m drums. Vendor has to carefully plan laying of farther cables first to ensure cut lengths can be used for shorter cables. Any shortage of cable occurring because of vendor's works will be in the scope of the vendor.
- (6) Vendor shall construct the underground trench as follows:
 - (a) Trench depth = 750 mm minimum.
 - (b) Trench width shall vary en route to control room, based on the number of cables. As the cables join from SMBs en route, bunching takes place and the width of trench shall increase. Max trench width expected = 2m.
 - (c) Sand as per IS: 383 of 100 mm layer thickness shall be laid at the bottom most level of trench.
 - (d) Over the sand layer, cables shall be laid one adjacent to the other. Cables shall not be laid one over the other. In other words, only one layer of cables shall be allowed.
 - (e) Over the layer of cables, one more layer of sand of 100mm shall be laid.
 - (f) Then, a single layer of class-2 brick (burnt clay type) of 75 mm thickness shall be laid.
 - (g) Trench shall then be filled up with refill soil.
 - (h) Subsequently, land over the cable trench shall be leveled and compacted suitably.

The cables shall be laid inside Class-B GI pipes/ RCC hume pipes of suitable size under road crossings, drains, sewerage lines, entry and exit points of the buildings or where there are chances of mechanical damage Only terminal cable joints shall be accepted. No cable joints to join two cable ends is acceptable. Supply of GI/RCC hume pipes is in the scope of vendor.

5.13 Installation (indoor) of PCUs, HT panels, battery bank, FCBC battery charger panel, SCADA panel, ACDB, located inside control room together with cable trays in cable trench:

- (1) Vendor shall organize necessary resources such as labour, cranes, hydra, forklifts, transportation trucks / trolleys and other accessories for movements and positioning of the items as below within the control, inverter and security rooms:
 - a. PCU panels: 6 sets (each ~2500 Kg)
 - b. 110V DC Battery bank: 1 sets
 - c. FCBC battery charger panel: 1 No
 - d. ACDB panel: 1 No
 - e. SCADA panel: 1 Nos (~500 Kg each)
 - f. Control desk with PCs and accessories: 1 set
- (2) Panels shall be placed over the cable trenches in control room, in the exact sequence and locations as shown in BHEL drawings that will be provided to vendor at an appropriate time during the period of execution.



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- (3) Panels shall be suitably grouted using welding / bolting methods as appropriate. BHEL approval shall be obtained for the grouting arrangement. All necessary hardware for the same shall be within vendor scope of supply.
- (4) Vendor shall supply and install cable trays of required length and corner bends as required within control room for laying DC, AC & signal cables over the trays. Vendor shall supply cable trays as follows:
 - a. Ladder type GI cable trays
 - b. Hot dip galvanized
 - c. Depth = 40 mm min.
 - d. Width = 600 mm min.
- (5) Vendor shall fix the cable trays on the projecting steel sections in cable trench of control room. Supply and works related to the appropriate placement of these steel sections will be in the vendor's scope.
- (6) Adjacent cable trays shall be interconnected using suitable hardware items that shall be in vendor scope of supply.
- (7) Cables shall be laid over the cable trays and neatly dressed using appropriate cable ties etc.
- (8) Cables from AC side of PCU coming out from control room shall be laid over ladder type cable trays up to LV side of 2700 KVA inverter transformer.
- (9) 7RX1Cx300 sq.mm cables per phase are routed from control room to transformers in switchyard on cable trays through openings in the walls of control room. These openings shall be closed sealant or foam to prevent entry of rain water and rodents.

5.14 Power cable terminations on DC side of PCUs

- (1) On DC side, for each PCU, vendor shall carry out the required number of cable terminations for 9 positive and 9 negative inputs connections by unsleeving, crimping and connecting.
- (2) BHEL shall supply the cables (1CX300 sq.mm Aluminum, armored, XLPE insulation, PVC sheath).
- (3) All cable glands, cable lugs, bolts, nuts and washers required for termination on DC side of PCU shall be supplied by the vendor. Qty of lugs required ~108 Nos.
- (4) All tools and accessories required to carry out the termination shall be within scope of vendor.

5.15 Power cable terminations on AC (LT) side for PCUs and transformers

- (1) On AC side, 3-phase 3-wire power cable interconnections shall be made between PCUs and transformers using 7 runs of 1Cx300mm² Aluminum, armored, XLPE insulated cable per phase. Supply of this cable is in BHEL's scope.
- (2) For AC cable terminations at PCU end transformer end, vendor shall supply the required number of cable glands, cable lugs, bolts, nuts, plain washers, spring washers. Aluminum lugs with bimetallic washer (Al-Cu) shall be supplied. Bolts, nuts, plain washers shall be of SS304 type. Spring washers shall be zinc plated steel. Make of lug: Dowell's /3D / 3M or any other reputed equivalent as shall be approved by BHEL. Quantity of lugs required ~ 252 Nos.
- (3) BHEL will furnish the exact diameter of the cable at an appropriate time during the period of execution. Vendor shall make suitable size cut-outs using hole—saw cutters in the gland plates of the transformers for entry and exit of cables.
- (4) Vendor shall make the measurements between the equipment, cut the cables to the required lengths, fix them with glands, unsleeve them at the ends, crimp them with the lugs and terminate them at the respective bus bar provisions within the panels.
- (5) All tools and accessories required to carry out the termination shall be within scope of vendor.



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- (6) Cable tray supporting structure shall be installed between control room wall and LV side of transformer using ISA angles of minimum 75x6 arranged in vertical and horizontal orientations and joined using welding. The level of structure shall be at a minimum height of 400 mm above the ground level. Adequate number of horizontal angles shall be provided to minimize gap between two angles so that cable sagging is avoided. Vertical angles shall be grouted using concrete foundation with depth of minimum 400mm. PCC layer 1:3:6 of 100mm thick shall be used. Cross section of foundation shall be minimum 200x200mm. All items required for the structure shall be in vendor scope of supply. Cable shall be laid on ladder type cable trays. Structure shall be painted using red oxide and BHEL approved black paint. Suitable arrangement, such as fixing perforated cable trays in inverted position, shall be provided to cover the laid cables. Drawing of cable supporting structure shall be submitted to BHEL for approval.
- (7) Quantity of cable support structure with cover =6 sets.
- (8) Supply of cable trays and tray support structures is in the scope of vendor.

5.16 Installation of 2700kVA, 11KV /350-350V transformers supplied by BHEL

- (1) Transformers are located in switchyard adjacent to control room.
- (2) Construction of RCC foundations of transformers shall be in BHEL scope.
- (3) Transformer and its accessory parts such as radiators, cable boxes, hardware etc. as supplied by BHEL shall be moved from storage yard and positioned on foundation pedestal. All parts and hardware shall be assembled as per guidance at site provided by BHEL / transformer vendor.
- (4) Vendor shall provide all necessary support and assistance to the representative of transformer manufacturer during installation:
 - (a) Oil filling in all transformers.
 - (b) Measurement of parameters: insulation resistance, Winding resistance etc.
 - (c) Connections to marshalling box

5.17 Installation of Isolators, Lightning arresters, metering CTs and metering PTs on four pole structures in outdoor switchyard at Control Room

Outdoor switchyard at control room shall consist of two four pole structures one each for 5MW and 2.5MW feeders.

Each four pole structure shall consist of following items:

- 1. 11 KV Outdoor LA (3 Nos)
- 2. 11 KV Outdoor single-phase metering CTs (6 Nos)
- 3. 11 KV Outdoor single-phase metering PTs (6 Nos)
- 4. Outdoor ABT metering panel with main and check ABT meters (1 Set)
- 5. RSJ poles (4 Nos)
- 6. 11KV GOS Isolators with earth switch (2 Nos)
- 7. GI Support channels, ACSR conductor, pin/disc insulators, clamps and hardware etc. as required.

Supply and installation of all these items including civil works required for four pole structure are in the scope of vendor. Vendor shall submit general arrangement and detailed drawings with bill of materials/quantities of the four pole structure set as per relevant TANGEDCO/CEA standards, with individual item description, quantity, make, specs / ratings etc. for BHEL approval.

Metering panels shall be installed near to four pole structures on concrete platforms as per TANGEDCO guidelines.



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Vendor shall submit GTPs and GA drawings of all the items such as LA, CT, PT, ABT meters, metering panels, ACSR conductor, GOS, insulators, RSJ poles etc. Note: All metal parts of Four pole structures shall be galvanized. All 11KV panel and switchyard works shall be carried out by a licensed electrical contractor as per TANGEDCO/ CEA regulations. 5.18 Cable trench and laying of HT power cables (1) Output from inverter transformers shall be connected to incoming feeders of indoor HT Switchgear panels. (2) From outgoing feeders of HT panels, HT cable shall be laid up to four pole structures located in outdoor switchyard adjacent to control room. (3) Vendor shall construct underground cable trench for laying HT cables in switchyard as listed below. Trench shall be constructed: (a) Between the inverter transformers and incoming HT panels (1 run of 3CX240 sq-mm cable) – 3 sets (one set for each transformer). (b) Between outgoing HT panels to four pole structures (1 run of 3CX240 sqmm cable) -2 sets (one set for each outgoing HT panel). (4) Supply of HT cable shall be in the scope of vendor. Quantity required ~500m. (5) Specification for HT cable: 11KV (UE), 3CX240 sq.mm, Aluminum Conductor, XLPE insulated, Armored, PVC sheathed as per IS 7098 (Part-2). (6) Vendor shall lay these cables layer wise providing adequate separation as per the relevant IS standards. Vendor shall indicate the IS standards employed. (7) Half-cut RCC hume pipes shall be provided over HT cables in switchyard. (8) Trench layout and trench drawings shall be submitted to BHEL for approval. 5.19 Power cable terminations on AC HT side (11KV) (1) Vendor shall carry out HT power cable terminations on HV side of 2700 kVA transformers (3 sets), on all feeders of HT panels (5 sets) and on four pole structures (2 sets). HT termination kits and all necessary hardware shall be within vendor scope of supply. HT termination kits shall be indoor / outdoor type suitable for 11KV, 3CX240 cable. Make: Raychem, 3M or reputed equivalent as shall be approved by BHEL. (2) Quantity of termination kits required shall be 8 sets of indoor type for 11KV 3Cx240 sq-mm cable, 2 sets of outdoor type for 11KV 3Cx240 sq-mm cable. Quantity indicated above is the exact requirement. Vendor shall ensure procurement of additional quantity of termination kits, if required at no additional cost to BHEL to tide over any contingencies during installation. (3) All tools and accessories required to carry out the termination shall be within the scope of vendor. (4) Since no cable glands are provided for these cases, vendor shall apply suitable grade of bitumen, RTV or any other sealant as shall be approved by BHEL, for sealing the gap around the cable at the cable entry of transformers and HT panels. (5) Vendor shall provide support mechanism using clamps and GI pipes for HT cables wherever required so that the connecting terminals are not damaged due to mechanical load of cable. Supply and installation of FCBC, Battery banks 5.20 One set of 110V, 20A Float cum boost charger and 110V, 100AH, VRLA type battery bank required for breaker panels shall be supplied and installed at control room by the vendor. Battery bank shall be rated at 10 hours discharge rate. Vendor shall submit, GA and GTP of battery and charger for approval. FCBC shall have minimum of five outgoing feeders.



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5.21 Supply and installation of ACDB Panel

One number ACDB shall be supplied and installed by the vendor in the control room for internal loads of solar plant. Vendor shall submit the single line diagram, GA drawing showing the details of feeders for HT panels, transformers, internal lighting, module cleaning pumps, FCBC, Air conditioner, periphery lighting and other loads in the plant. Vendor shall ensure equal loading in all the three phases. The number of feeders and their capacity shall be decided during detailed Engineering stage.

CONSTRUCTION FEATURES: The ACDB panel shall be made of CRCA sheet steel of 2mm thick and shall be fully dust and vermin proof, providing a degree of protection of IP-20. Panel shall be provided with hinged doors with handle and locking facility for switch on interlock of doors. Doors shall be gasketted all round with Neoprene gaskets. The DB shall have two earthing terminals on either side for earthing.

The required cable glands for the cables shall also be supplied with DBs. The incoming MCCB of rating 100A shall be hand operated, air break, quick make and quick break type with short circuit breaking capacity of not less than 50kA.

The Outgoing MCBs shall conform to IS-8828 (latest edition) and shall have a minimum interrupting rating of 10 kA. The ACDB shall be provided with of 3-phase, 4 wire, 0.5 class Multi-Function Meter (MFM) for measuring auxiliary power consumption. The MFMs shall have a RS-485 Modbus communication port to communicate with the central PC system (SCADA).

5.22 Supply and installation of UPS

Vendor shall supply and install 1No. 5KVA UPS in the control room for auxiliary supply to PCUs, SCADA panels, PCs and emergency lighting. Vendor shall supply battery for UPS with a backup of 2 hours. Vendor shall submit the sizing calculations for battery considering design margin, temperature correction factors and safety margins for approval.

5.23 Supply, installation of weather monitoring station

Vendor shall supply and install Weather monitoring Station (WMS) on top of control room. Exact location shall be decided by BHEL during execution. WMS shall consist of Pyranometer (1 No.), Anemometer (1 No.), Module temperature sensor (1No.) and Ambient temperature sensor (1 No.).

All the sensors of WMS shall be provided with output of 4-20mA signal. Converters if any required for conversion of sensor output to 4-20mA shall be in the scope of vendor.

All necessary communication/ signal cables required for termination of WMS sensors in SCADA panel shall be in the scope of vendor. Supply and installation of Galvanized Mounting structure for WMS along with pedestal is in the scope of vendor.

Approved makes: Kipp & Zonen/ Campbell Instruments / Aeron Systems / Dynalab / Metone / Hukeflex or any other reputed make as shall be approved by BHEL. BHEL approval shall be obtained for make and GTP prior to procurement.



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Detailed technical specifications of the equipment are given below. **PYRANOMETER:** I. Spectral Response- 300 to 2800 nano meters. 2. Sensitivity- 8 to 20 µV/W/m2 3. Operating temperature range: 0 deg to +70 deg. 4. Resolution: Min +1W/m2 5. Output: Analog form 4-20 mA 6. Standard: ISO 9060 -second class or equivalent. 7. Maximum operational irradiance: 2000W/m2 8. Response Time (95%): <30s 9. IP rating: IP65(minimum) Pyranometer shall be supplied with necessary cables. Sample calibration certificate with calibration traceability to World Radiation Reference (WRR) World Radiation Centre (WRC) / IMD shall be furnished along with the offer. **ANEMOMETER:** Anemometer shall be 3-cup tubular stainless steel type. Velocity range shall be up to 45 m/s and accuracy limit of 0.5 m/s up to 10 m/sec. AMBIENT TEMPERATURE SENSOR: PT100 sensors mounted inside a radiation shield, communication cable of adequate length, temperature range: -40 to +60 degC with accuracy of +/- 0.2 degC. **MODULE TEMPERATURE SENSOR:** Module temperature sensor shall be fixed to one of PV modules using heat conducting tape and output shall be connected to nearest SMB. Temperature range: 0 to +80 degC with accuracy of +/- 0.2degC. 5.24 Power cable terminations at ACDB panel (1) Auxiliary power of approx. 30KW shall be provided by BHEL up to control room using LT power cable of suitable size. Supply and laying of this cable shall be in BHEL scope. (2) Vendor shall carry out termination on input and output side of ACDB. Cable glands, cable lugs, bolts, nuts, plain washers and spring washers shall be within vendor scope of supply. 5.25 Erection of switchyard fencing with gate Supply, installation including civil works of Switchyard fencing with gate is in BHEL

5.26 Switchyard leveling, jelly spreading

- (1) After installation of switchyard equipment such as transformers and four pole structures vendor shall level the ground with an appropriate magnitude and direction of slope to facilitate draining of rain water away from switchyard. Accordingly, to prevent stagnation of water within switchyard, vendor shall, wherever necessary, fill up the land with suitable soil and compact the filled-up portions either manually or with rollers, as applicable, as per site conditions, to achieve required slope.
- (2) Stone jellies of 20mm or 40mm shall be spread uniformly with a layer of minimum 100 mm thick throughout the switchyard area.

scope.



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5.27 Support and assistance for SCADA integration for the power plant

- (1) SCADA of power plant comprises of data station panel and PC based control desk with software to collect, store, process and report the data parameters of power plant as follows:
 - (a) String monitoring boxes in solar array field: string current, voltage, box temperature, module temperature, status of SPD and load break switch in SMRs
 - (b) Weather monitoring equipment: solar irradiation, ambient temperature, wind velocity.
 - (c) Power conditioning units: DC input /AC output parameters of inverters, grid data, fault status and events logged, etc.
 - (d) HT panels: status of breakers, status of protection relays of transformers, Multi Function meters.
 - (e) Transformers: oil/winding temperatures
 - (f) Energy export to the grid from ABT meters etc.
- (2) Vendor shall carry out following activities:
 - (a) Formation of underground cable trenches and cable laying and termination for data communication cables from SMBs to SMBs (daisy chain) and from end SMB of each loop to SCADA, from transformers, VCB panels to SCADA.
 - (b) Data cable laying from PCUs, VCBs, ACDB panels to SCADA.
 - (c) Data cable terminations at PCUs, ACDB panels, transformers and VCB panels.

5.28 Cable trenches for laying data communication cables (RS485) from SMBs to SMBs and control room.

- (1) 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, RS485 cable shall be laid to the SCADA panel in the control room. Communication Cables shall be laid in HDPE DWC pipes of minimum ID 25mm.
- (2) Supply of this RS 485 communication cable shall be in BHEL scope. Supply of DWC pipes shall be in vendor's scope.
- (3) These data cables shall be laid underground using separate cable trench. In other words, these cables shall not be laid along with power cables. A minimum distance of 500mm shall be maintained between the data cable trench and power cable trench to avoid EMI interference.
- (4) Underground laying shall be ensured even within the daisy-chain looping between adjacent SMBs.
- (5) Cable trench shall be as per details below:
 - (a) Trench depth = 600mm minimum
 - (b) Trench width shall be 200mm minimum
 - (c) Bottom layer shall be sand as per IS: 383 with 100mm layer thickness.
 - (d) Data cable shall be laid over the sand.
 - (e) Another layer of sand, 100 mm thick, shall be laid.
 - (f) A single layer of brick, class-2, 75mm thick, shall be laid over the sand.
 - (g) Trench, then, shall be filled up with refill soil and compacted.

5.29 Data & Control cable terminations in control room and switchyard

Vendor shall carry out following data cable terminations at 2700 kVA transformers, VCB panels, ACDB panels and PCUs.

- (1) Terminations at marshalling box of 4 sets of 2700kVA transformers (Buchholz relay, pressure release valve, low oil level, WTI, OTI, Analog 4-20mA signals of OTI and WTI etc).
- (2) Terminations at VCB panels (Buchholz relay, pressure release valve, low oil



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level, WTI, OC/EF relay, OV/UV relay, MFM etc) for SCADA. RS485 cable for MFM and numerical relay to SCADA shall be supplied by BHEL.

- (3) Terminations at 8 PCUs of 1250kW for RS485 MODBUS communication over TCP/IP cable connections using LAN cables. Supply of LAN cable is in BHEL scope.
- (4) Terminations at ACDB panel.
- (5) All the cables required for the above terminations except for PCUs shall be within vendor scope of supply. Cable specification as follows: Cable, 1.1kV grade, copper conductor, stranded, PVC type-A insulation, twisted pair, overall shielded with aluminium backed mylar sheet, inner sheath of extruded PVC type ST1, Galvanized steel strip / round wire armoured as per IS, outer sheath of extruded FRLS PVC type ST1, conforming to IS:1554 / part-1 with latest amendments up to date.
- (6) Vendor shall submit the cable schedule for data, control and communication cables. Control cables shall be 2.5 sq-mm minimum, copper conductor, PVC, armoured. Communication cables shall be 0.5 sq-mm minimum, copper conductor, PVC, armoured.
- (7) Supply and termination of control cables from VCB panels to transformer: 12core X 2.5 sq-mm ~150m.
- (8) Vendor has to lay the control cable from each transformer to VCB panel with 12Cx2.5 sq.mm cable. Cable Specification is as follows: Cable, 1.1kV grade, copper conductor, stranded, PVC type-A insulation, ATC drain wire of 2.5 sq.mm, inner sheath of extruded PVC type ST1, Galvanized steel strip / round wire armoured as per IS, outer sheath of extruded FRLS PVC type ST1, conforming to IS: 1554 / part-1 with latest amendments up to date.
- (9) Make of cables: Polycab, Advanced cables, Lapp, KEI or any other reputed equivalent as shall be approved by BHEL.
- (11) Cable lugs and all hardware required for making the above terminations shall be in vendor scope of supply.

Note: Along with the above activities, DC/AC power supply cable laying and terminations shall be also be carried out for transformers and VCB panels using 2Cx2.5 sq-mm copper, armoured, PVC cables which is in vendor scope of supply. Cable shall be laid from FCBC (for DC) and ACDB panel (for AC).

5.30 Earthing of solar array structures

- (1) Vendor shall interconnect solar array structures using welding of min. 25x3 mm GI strips.
- (2) Every row of such interconnected structures shall be terminated in a earthing electrode of 3000 mm long, hot dip galvanized and metal coated for rust proof, OD of minimum 50 mm shall be supplied by vendor.
- (3) Vendor to ensure that every earthed structure is provided with two alternate paths to earth. Accordingly, vendor shall provide suitable number of earth pits and ensure that the earth resistance of all earthed structures is less than 1 ohm.
- (4) Earth pit shall be drilled and earthing electrode shall be placed in the pit, filled with back filling chemical compound all around the electrode as per manufacturer's datasheet/installation instructions.
- (5) Earth chambers of brick masonry shall be constructed. All items of earth chambers, including lid, shall be in vendor scope of supply.
- (6) Earth chambers shall be interconnected in the solar array field, using min. 25x6 mm GI strip that shall be laid underground.
- (7) Terminations at the electrode end shall be made using bolting method. Welding shall not be applied at electrode end. For this purpose, a separate link with multiple mounting holes shall be used at the electrode end. This way, GI strips (25x3 mm) running from structure leg and the GI strips (25x6mm) from



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adjacent electrodes shall be terminated at this link, which shall, in turn, be connected to the electrode. Joining of 25x6 mm GI strips at intermediate positions, wherever applicable, shall be made using either welding or bolting method. Either way, the overlapping of the two strips shall be for a minimum length of 150mm. Welding shall be for the entire overlapping length. In case of bolting, minimum three bolt joints shall be used per overlap length. For each earth pit, necessary Test Point shall have to be provided.

- (8) All GI strips, earthing electrodes and all hardware (nuts, bolts, washers of SS304) shall be in vendor scope of supply.
- (9) Vendor shall provide calculations for earthing, layout drawings showing earth chamber locations during detailed engineering.
- (10) For SMB earthing, independent earth electrodes of min. 2000 mm length shall be provided separately for each SMB. SMB earthing shall not be interconnected with module mounting structure earthing. Quantity required ~54 Nos.
- (11) Power SPD inside SMB shall be earthed using min. 16 sq.mm copper cable and communication SPD shall be earthed using min. 2.5 sq.mm copper cable as per SMB recommendations which will be finalized during drawing approval.

5.31 Earthing lines for control room panels – PCUs, Battery banks, FCBC charger, ACDB, SCADA panels, etc.

- (1) 50x4 copper strips shall be laid in the cable trenches of control room. Copper strips of required length shall be in vendor scope of supply.
- (2) Strips shall be covered by heat-shrinkable sleeves. Sleeves and Heater gun for heat-shrinking the sleeves over copper strips shall be organized by vendor.
- (3) Copper strips shall be anchored to the cable trench wall using insulation bush supports that will be in the scope of vendor.
- (4) Expansion bolts of appropriate size (Minimum M8) shall be used to fix the insulation bush supports.
- (5) Vendor shall provide the earthing line layout drawing along with calculations. Minimum one No. earthing pit shall be considered for each of control room panels such as PCUs, ACDB, battery charger etc. All the earth chambers shall be interconnected using 50X4 copper earth strip.
- (6) Copper strips shall be connected to the earthing terminals of all the control room panels except PCUs using min. 25 sq-mm copper, unarmoured, PVC cables that shall be supplied by the vendor. Cable lugs and hardware (bolts, nuts, washers etc shall be of SS304) required for connecting the 25 sq-mm cable to the earth terminals of panels and also to the copper strip end shall be in vendor scope of supply.
- (7) These chambers shall be located near the control room. Exact locations will be intimated by BHEL site engineer.
- (8) Connection between earth chamber and copper earthing strip shall be made using cable, 1Cx 25sq-mm, copper, unarmoured, 1100V, PVC cables as per IS:1554 (part-1) that shall be in vendor scope of supply.
- (9) For PCU earthing, min. 70 sq.mm copper cable shall be used as per PCU manufacturer recommendations. Quantity ~ 20 m.
- (10)Routing of 1Cx25 sq-mm cables to electrode earth chambers shall be using 1-inch CPVC pipes, joints, bends and elbows that shall be in vendor scope of supply. Routing shall be underground outside the inverter and control room, at a depth of ~450mm below the ground level. Required length of CPVC pipe shall be supplied. Number of CPVC joints and elbows shall be as applicable.
- (11)Expansion bolts, cable lugs and all hardware required for this activity shall be within vendor scope of supply.



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5.32 Earthing of switchyard equipment and fencing

Vendor shall install Ground mat for switchyard as per IS. The minimum quantity of earthing electrodes equipment wise is as below:

- (1) Inverter Transformers body earth 3x 2 Nos each = 6 Nos.
- (2) Inverter Transformers shield earth 3x 2 Nos each = 6 Nos.
- (3) 4P structure body earth 1 No each
- (4) Lightning arrestors 3 Nos per four pole
- (5) Switchyard fencing Quantity as required

Vendor shall submit earthing design calculation as per standards. GI strips of min. 50x6 mm shall be used for forming a grid for all the body earthing in order to achieve a good earth resistance value. Extra number of electrodes may be supplied and installed if the overall resistance in switchyard shall be more than 0.5 ohm. GI strips shall be laid underground at a depth of ~ 500 mm. Earth electrodes, GI strips, all hardware required for making the connections shall be within vendor scope of supply.

5.33 Lightning arrestors (ESE) type

- (1) Vendor shall supply and install Early streamer emission lightning arrestors as per standards: UNE 21186 and NF C-17 102, Make: Ingesco/ABB/equivalent as shall be approved by BHEL, with minimum protection radius of 100 m. with counters and earthing systems.
- (2) Quantity: As required to cover the entire area of the plant and control room building as per manufacturer recommendations.
- (3) Lightning arrestors shall be mounted on top of a mast of height 5m minimum above ground level using GI pipe of 100 mm minimum average diameter; Each mast shall be secured by three steel stay wires that are suitably grouted. Masts shall have appropriate steel base plate for mounting on an RCC concrete foundation pedestal of 450x450 mm size, 1m depth below ground level, 300mm minimum above ground level, PCC 1:4:8 as the bottom layer (~100 mm thick), steel rods of diameter 8mm minimum, concrete M25 with four J bolts (M16) of 750mm long, with nuts and washers.
- (4) Minimum two earthing chambers per lightning arrestor set using earthing electrodes shall be constructed as per manufacturer's recommendations.
- (5) All mechanical and electrical connections, cables, junction boxes, hardware etc shall be within vendor scope.
- (6) Vendor shall submit general arrangement and detailed drawings with bill of materials / quantities of the overall lightning arrestor arrangement including foundation pedestal details to BHEL for approval.

5.34 Yard lights for switchyard, approach roads and compound wall (periphery lighting):

- (1) Vendor shall supply and install required number of lights in switchyards, approach road and pre-cast type compound wall to maintain minimum LUX requirement of 20 LUX.
- (2) Light fitting, Bajaj/Havells/Equivalent make LED type shall be supplied and fitted on the GI bend pipes/poles/angles available in compound wall using necessary hardware.
- (3) Adequate spacing between the poles shall be provided to ensure the minimum lux requirement.
- (4) Underground armoured, PVC insulated, copper/ Aluminum cables of suitable size and required length shall be laid for power supply. Supply of these cables is in the scope of the vendor. Vendor shall submit cable sizing calculation for approval.



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rating along with junction box shall be provided for each pole. (6) The Junction box shall be made of stainless steel or FRP (IP65), Dust & vermin Proof and shall have suitable brass or copper made connector terminal, MCB (1A, single pole) of Schneider or reputed make, glands for incoming and outgoing cables. (7) The junction box, cable lugs, steel bracket for mounting the box on the lighting pole and all hardware items shall be in vendor scope.	
Proof and shall have suitable brass or copper made connector terminal, MCB (1A, single pole) of Schneider or reputed make, glands for incoming and outgoing cables. (7) The junction box, cable lugs, steel bracket for mounting the box on the lighting	
(1A, single pole) of Schneider or reputed make, glands for incoming and outgoing cables.(7) The junction box, cable lugs, steel bracket for mounting the box on the lighting	
outgoing cables. (7) The junction box, cable lugs, steel bracket for mounting the box on the lighting	
(7) The junction box, cable lugs, steel bracket for mounting the box on the lighting	
pole and an nardware items shall be in vehicor scope.	
(8) Provision for timer based ON/OFF control shall be made for yard lighting in	
ACDB.	
(9) Glands shall be located at the bottom side of Junction box.	
(10) Necessary underground cabling work is in the scope of the vendor.	
(11) Vendor shall submit the lighting layout, lighting illumination calculations, cable	
trench layout, shadow calculation, foundation pedestal details, detailed BOM for	
BHEL approval. (12) Vender shall ensure that equal leading is distributed in all the three phases	
(12) Vendor shall ensure that equal loading is distributed in all the three phases. (13) Supply of necessary hardware such as nuts, bolts, washers (SS304) is in the	
scope of vendor.	
(14) Vendor to ensure the lighting arrangement does not cast shadows on the PV	
modules.	
(15) All necessary tools and tackles shall be in the scope of vendor.	
5.35 Cable trench formation and laying of cables for yard lights	
Vendor shall construct the underground trench of required length for laying the	
cables for yard lights	
(1) Trench depth = 600 mm minimum	
(2) Trench width = 200 mm minimum	
(3) Sand as per IS: 383 of 100 mm layer thickness shall be laid at the bottom most level of trench.	
(4) Over the sand layer, cables shall be laid one adjacent to the other. Cables shall	
not be laid one over the other. In other words, only one layer of cables shall be	
allowed.	
(5) Over the layer of cables, one more layer of sand of 100mm shall be laid.	
(6) Then, a single layer of class-2 brick of 75 mm thickness shall be laid.	
(7) Trench shall then be filled up with refill soil.	
5.36 Cable terminations and supply of cables and CPVC pipes for yard lights	
(1) Cable termination:	
(a) Termination of cables, including unsleeving, crimping, connecting to the junction box and lamp shall be within scope of vendor.	
(b) Similarly, cables shall be terminated at the ACDB panel within the control	
room.	
(2) Vendor shall supply following cables of required length:	
(a) 4-core, Cu/Al, armoured, PVC cable from JB of one pole to JB of adjacent	
pole (size of cable shall be finalized based on cable sizing calculation to be	
submitted by vendor)	
(b) 2Cx 1.5 sq-mm Cu/Al, unarmoured, PVC cable from JB to light fitting	
(3) Vendor shall supply following 1-inch CPVC pipes of required length:	_
5.37 Water supply for O&M, electrical cabling and plumbing works.	
(1) BHEL will provide water outlet point near to plant boundary. Vendor shall lay	
pipe line from the outlet location to water storage tank to be located on the	
control room building.	
(2) Pressure pump of required capacity (3 phase) with all necessary electrical	
cabling up to the ACDB located in control room shall be provided from pumping	



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water storage tanks. Vendor shall submit the calculations for deciding pump rating and cable size.

- (3) Casing as required shall be provided for the pump.
- (4) Pump and the electrical cables shall be in vendor scope of supply. Cable (Armoured, PVC) of suitable size depending on pump rating and of required length shall be laid underground at a depth of ~600 mm, with sand layers below and above the cable (100 mm each). A brick layer, class-2, 75mm thick shall be laid over the sand layer. Trench shall, then, be closed with refill soil and neatly compacted.
- (5) Pump make: CGL, Suguna, Kirloskar, or other make for which BHEL approval shall be taken.

Vendor shall supply and install of PVC water storage tanks of 5000 liters capacity each on control room (2 Nos.).

5.38 SPV module cleaning system

- (1) Vendor shall lay 2-inch CPVC pipelines from overhead tanks to the solar array field with all necessary CPVC nipples, T-joints, reducers, bends, couplers etc. This forms the main header pipeline. Suitable valves such as brass valves of 2inch etc shall be provided for this main header line. For the branching out lines that spread into various rows of the solar array to provide water delivery points for module cleaning, 1-inch CPVC pipelines shall be used. Supply of CPVC pipe shall be in vendor's scope.
- (2) Centrifugal 3-phase booster pump of required capacity shall be supplied and installed at control room to draw the water from storage tanks to solar array field for solar PV module cleaning. Vendor shall furnish design/pressure calculations for selection of pump size.
- (3) Starter and DP switch shall be supplied and installed in control room for operating the pump.
- (4) Supply of electrical cables (with lugs, hardware) and wiring the pump up to the ACDB panel / starter in the control room shall be in vendor scope. Cable of required dimension, Cu, armoured, PVC cable shall be supplied and used.
- (5) CPVC pipelines shall be laid underground (at a depth of ~500 mm below ground level).
- (6) There shall be adequate nos of delivery points for module cleaning. At these delivery points, 1-inch riser lines shall be provided to tap the water from underground line to the delivery point ~300 mm above ground level. Ball valve forged steel type, 1-inch, with suitable nipple for connecting the hose pipe, shall be provided at each delivery point.
- (7) After installation and testing of water lines, excavated trenches shall be closed with refill soil. Further, the soil, all along the water lines, shall be suitably leveled and compacted.
- (8) Hosepipes (ribbed, flexible) of 50m long shall be provided for connecting the hose to the nearest ball valve/nipple. The other end shall be provided with nozzle/appropriate gun to direct the pressurized water on the module for cleaning.6 such sets shall be provided.
- (9) Vendor shall ensure adequate pressure of water is available for module cleaning.
- (10) Vendor shall submit detailed scheme with BOM etc. for module cleaning system from storage tank to solar array field.

5.39 Identification markings using paint and cable tags, as applicable to the individual cases and as approved by BHEL, shall be provided:

(1) String monitoring junction boxes: Identification marking by way of painting on nearby module structure.



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	(2) All equipment such as PCUs, transformers, VCB panels, CT, P			
	metering panels shall be provided with suitable identification ma			
	painting, with inscriptions as approved by BHEL.			
	(3) Cable sizes with arrow marks in switchyard (for HT cables) using painting.			
	(4) Identification markings for all the earth chambers (using pa	inting) with		
	inscriptions as approved by BHEL.			
	(5) Cable tags using aluminium plate of 1-2 mm thickness with suitable			
	as approved by BHEL for all the power cables of the electrical pa	inels such as		
	PCUs, LT panels, Batteries, FCBC chargers, ACDB panel etc.			
5.40	Cable markers			
	(1) Steel cable markers with suitable labels (DC cable, LT cable, HT			
	cable, CPVC water pipeline etc)and arrow marks (pointing t			
	destination) shall be supplied and installed along the cable	trenches at		
	appropriate locations for following cases:			
	a) For DC cable from string monitoring boxes to respective inverted			
	b) For data communication cables from string monitoring boxe	es to control		
	room			
	c) For cables of yard lights of solar array field, compound wa	iii/cnain-iink		
	fencing and switchyard fencing			
	d) For electrical cables of pump connectionse) For HT (11KV) cables within switchyard			
	f) For CPVC water pipelines			
	(2) Cable markers shall be suitably grouted with concrete foundati	on denth of		
	minimum 300 mm below the ground level. Cross section of foundations			
	minimum 200mm diameter.	ition shan be		
	(3) Cable markers shall have a minimum height of 300 mm above the g	round level		
	(4) Cable markers shall be suitably painted.			
5.41	Hoarding board for the solar power plant.			
	(1) 1 No. hoarding for the plant shall be made of 1500x1800x 3mm th	ick MS plate.		
	Approximate dimension of board 1500x1800 mm.			
	(2) Board shall be given a red oxide coat and painted background.	Colour for		
	background and letters shall be as approved by BHEL site in-charge			
	(3) Board shall be fixed on a frame constructed using ISA 50x50x8 angle	es. Diagonal		
	supports shall also be provided. The frame shall be supported by	two vertical		
	legs of ISA 75x75x8 that is grouted with concrete foundation.			
	(4) Depth of foundation shall be 600 mm below ground level, with 1			
	PCC layer 1:4:8 of 400x400mm, M25 concrete of 300x300mm	, foundation		
	pedestal of 200mm height above ground level.			
	(5) Bottom level of board shall be at a height of 1.8 m above the ground			
	(6) Vendor shall submit the drawing of hoarding arrangement to BHEL for			
5.42	approval.			
3.42	Display boards and sign boards 1 Board displaying instruction chart for restoration of person	1 No		
		I NO		
	2 Board displaying instruction chart for artificial respiration	1 No		
	3 Board displaying dos and don'ts.	1 No		
	4 Board displaying dos and don'ts. 4 Board displaying fire extinguishers details and operations	1 No		
	5 "No smoking" board	5 No		
	6 Board showing list of O&M staff with name, qualification and	1 No		
	work responsibility	1140		
	7 Board showing list of contact details of BHEL, O&M team, O&M	1 No		
	security, police station, fire service, hospital, medical store etc			
	with names, address, mobile numbers etc			
L	The first factor and a cost mobile frame of a cost	J		



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		etails such as value of voltage etc			
		es, PCUs, LT panels, Transformers, l	HT required		
	panels, Four pole struct	ures in switchyard etc.			
	9 Identification boards, of	suitable sizes, within control room su	ch Qty as		
	as scada room, store roo	om, battery room, security room, gent	s / required		
		shall be supplied by vendor. BHEL v			
	provide the list.				
	provide the list.				
	(a) 5mm thick sun board wi	th LG make vinyl sticker (computeri	zed cutting and		
	pasting) shall be used for SI N		zea catting and		
		th design & printing shall be used.			
	(b) For others, nex barrier wi	tir design & printing shan be used.			
	Required number of danger a	notice plates shall be provided whe	rever necessary		
		r Notice plates shall be provided as			
		steel sheet and at least 2mm thic			
		s, and with inscription in signal red			
E 40		ons shall be in Tamil and English lang	лаус.		
5.43	Electrical insulation mat				
	(1) Vendor shall supply requi	red number of electrical insulating ma	ts as follows:		
		House Private Ltd or reputed equiva			
	approved by BHEL		icht as shan be		
	11				
	(b) Colour: Black.	1 1 1/1// 111/1/ donor din a co lo cotion			
		1.1 KV/ 11KV depending on location			
	(d) Marking of IS standard shall be there on the mat				
	(2) Test certificate shall be pr				
		s in front of electrical panels (PCUs, F	T panels, FCBC,		
	ACDB panels) in control re				
5.44		the cable trenches (a) behind the			
		nnels etc. in control room and also	(b) other open		
	areas of cable trench				
		install Checkered plate. Plate shall			
	handle (welded to the plat	te) to facilitate ease of lifting and move	ements.		
	(2) Plate thickness = 6mm mi	n.			
	(3) Width = 1000 mm max, to	tal length as required			
	(4) These width and length d	imensions are indicative. Actual dim	ensions shall be		
	based on site conditions.				
	(5) Plate shall be red oxide co	ated followed by black painting.			
		stained for overall arrangement of che	ckered plate.		
5.45	Air conditioner		1		
		all 1 No. Split air conditioners of 1.5	T capacity (min		
	BEE 3 star rating) with stabilizers in SCADA room. Make: LG, Videocon, Bluestar, Godrej or reputed equivalent that shall be approved by BHEL. Construction of				
	SCADA room and partitioning	• • • • • • • • • • • • • • • • • • • •	Construction of		
5.46	Tool kits and instruments	13 III the scope of BITEE.			
3.40		owing tool kits and instruments:			
	A. Measuring instruments				
	1 Digital Earth Resistance	Cambridge	1 Nos		
	Tester	Instruments/equivalent			
	2 Digital multimeter	Reputed make	2 Nos		
	3 AC-DC Clamp Meter		2 Nos		



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					17.02.12.1 0.1 0		
	5	Digital thermometer	Reputed Make	1 Nos			
		Megger – 5KV	Shanti Electric Instruments,	1 Nos			
			Nippen/equivalent				
	7	Electrical Tester	Reputed Make	4 Nos			
	Not	e: Make / model numb	er etc. shall be approved by BHEL pr	ior to			
	procurement.						
	B. Tool kits						
	1	<u>'</u>	nners of sizes 6mm to 32mm	1 Set			
	2	Ŭ İ	nners of sizes 6mm to 32mm	1 Set			
	3		box spanners of sizes 6mm to 32mm	1 Set			
	4	Screwdriver Set		2 Set			
	5		e range 50-400sq-mm cable, mechanic	al 1 Set			
	 	gear power, hand oper					
	6	Crimping tool up to 6 s		2 set			
	7		and operated, with bit size up to 20 mm		_		
	8	Measuring Tape, 5m		4 Nos 2 Nos			
	10	Measuring Tape, 50 m Allen Key set		2 Nos	-		
	11	Adjustable spanner 2-i	inch siza	2 No			
	12	Hammer	HICH SIZE	4 Nos	-		
	13	Rough file kit		2 Set	-		
	14	 	g range, 100g accuracy	1 No	-		
	15	`	g g g	4 Nos			
	16	U		4 Nos			
	17		dustrial type, for control room sweepir				
		/ cleaning.	, , , , , , , , , , , , , , , , , , ,				
	18	J		1 No.			
	19		ng of crimping plier, open end spanne	er 4 Sets			
	set, stripping plier, socket wrenches						
	Note: Prior to procurement, vendor shall obtain approval from BHEL for the			r the			
	mal	ce and specification of	the items.				
47	Ott:	6					
47	Om	ce furniture					
	Ven	dor shall supply and inst	all the following:				
	• • • • •	aor orian ouppry and mot	an the remetting.				
	1	Executive table, woode	en type with draws and side racks	1 No			
	2	Chairs, swivel type, wi	5,	6 Nos	7		
	4	PC table		1 No	7		
	5	Storage almirah		1 No	7		
	6	Filing cabinets		1 No	7		
	Mak	e: Godrej or reputed equ	uivalent as shall be approved by BHEL.	BHEL app	roval		
	shall be obtained, for the type of office furniture, for which catalog with			alog with m	nodel		
			s etc shall be submitted to BHEL.				
48	Fire	alarm system for cont	rol room:				
	(4)	Etas alama (h amada dakakan l				
		3	h smoke detectors, hooters, manual	•			
			Is and interconnection wiring shall be Notified (Payol or any other reputed or				
		installed. Make: Zicom/ Notifier /Ravel or any other reputed equivalent as shall be approved by RHEI					

be approved by BHEL.



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- (2) Control panels in sheet steel enclosure, power coated finish, shall be a microprocessor based system with central processing unit, input / output modules, power supply with battery and battery charger, control electronics and display mechanisms. The panel shall be a 4 zone system with audio-visual provisions (LED indications and beeps) for zone-wise annunciation. Individual detector-wise traceability / addressability is not required. It shall have provisions for acknowledgement of alarm and manual resetting. Batteries used shall be lead acid maintenance free type provided with connecting leads.
- (3) Smoke detectors shall be of conventional / optical / photoelectric type. It shall not be of ionization type that employs radioactive materials.
- (4) Electrical hooters shall sound the alarm upon detection of smoke by the detectors.
- (5) Manual call point shall be with high-gloss finish, alarm LED provision, breakable glass unit, hammer and chain.
- (6) All the system components shall be installed and commissioned using suitable wiring using copper cable, min. 2C x 1.5 sq-mm, armoured, fire retardant low smoke PVC, of required length, as approved by BHEL. Cable shall be laid in PVC conduit and fixed to the ceiling of control room.
- (7) Sufficient quantity of sensors, alarms, hooter, manual call points etc. shall be supplied and installed as per the necessary statutory requirements. Vendor should ensure the design of fire protection system in line with the regulations of the Fire Safety department of the state.
- (8) Vendor shall submit fire alarm layout/scheme along with the detailed BOM to BHEL for approval.
- (9) Fire alarm control panels shall have provision for RS-485 Modbus output so that status can be monitored in plant SCADA system.

5.49 Other safety related items

(1) Safety gadgets:

1	Gas Mask	2 Nos
2	First Aid Box with essential medicines and bandage cotton,	2 set
	antibiotic cream, Dettol, etc.	
3	Hand Gloves 11 KV for GOS operation	2 sets
4	Hand Gloves 1KV for Maintenance of SMB	2 sets
5	Discharge rod	2 Nos
6	Safety Helmet	5 Nos
7	Rain Coat	2 Nos

(2) Fire extinguishers and sand buckets, as per the regulations of the Fire safety department of the state, shall be supplied and commissioned at the power plant. BHEL approval shall be obtained for locations at which they shall be kept. Quantities mentioned below are minimum. Vendor to comply the requirements of statutory bodies.

1	Dry powder fire	Capacity: 9 Kg	6 Nos
	extinguisher	IS: 2171, IS:10658	
	(stored pressure	CM/L-7759096	
	type)	Suitability for Class A, B & C fire, related	
		to solid combustibles, flammable liquid	
		and gases.	



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	2	Carbon di-oxide (CO2) type fire extinguisher with trolley	Capacity: 9 Kg IS: 2878 Suitability for Class B&C fires Involving flammable liquids & gases, electronic equipment.	6 Nos	
	2	Sand buckets	GI fire buckets (as per IS: 2546) with suitable steel stand and cover arrangement. All items shall be painted with red oxide and BHEL approved red paint. BHEL approval shall be obtained for the overall arrangement. Each set of stand shall carry four sand buckets. A suitable cover shall be designed and provided to protect the buckets from rain.	4 sets	
5.50	-	to be supplied along w			
	,	AC4 Connectors – 130 Pa			
		ndoor type HT terminatio			
		Outdoor type HT terminal	non kit - i set em spares: Pyranometer-1 No., Anemome	tor 1 No	
	,	nd Temperature sensor -		ter-r ivo.,	
5.51			ns / checks / tests and coordination w	ith state	
			approvals and clearances for commi		
	synchr	onization with grid and	post-commissioning operation of the p	lant:	
	(B) Vendor shall carry out following minimum pre-commissioning checks:				
	(1) Verification of firmness of terminations in all electrical equipment: SMBs,				
	PCUs, VCB panels, transformers, 4Pstructure items (GOS, LAs etc), SCADA				
	stations, weather monitoring equipment and PV array earthing.				
	(2) Verification of earthing for all these electrical equipment. (3) Measurement and verification of parameters at string monitoring boxes at				
	(3) Measurement and verification of parameters at string monitoring boxes at solar array field: string current, voltage, combined SMB output current,				
	module temperature, SMB temperature.				
	(4)		cation of parameters on DC input side of	PCUs: DC	
		•	ndor shall support the PCU engineer on the		
	(5)		neasurements (megger tests) for all the	electrical	
	(/)	equipment of control roo		or during	
	(6)	the pre-commissioning t	CUs: Vendor shall support the PCU engine	er during	
	(7)		ests. Ansformer marshalling box:		
	(,)		power supply, (b) Responses of the relay	s at VCB	
	panels and corresponding indications at annunciation panel by simulating				
		•	nolz, PRV, WTI, OTI, LOLA at marshalling bo	•	
	(0)	Functional abades for VC	2D papala		
	(8)	Functional checks for VC (a) Availability of AC/	.B paneis: DC power supplies (b) VCB on/ off, (r) spring	
			ndications, (e) functioning of electromag		
		0 0	responses at VCB panels to operations fro		
		(g) indications on wi	indows, alarm accept/reset operations /SC	ADA.	
			rlock operations related to incomer and	outgoer	
	(0)	VCBs.			
	(9)	verification of paramet	ers at SCADA station: (a) DC/AC parame	ters from	



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SMBs, HT panels, ACDB panels, Metering panels, (b) status of ACB/VCB breakers and transformer protection relays, (c) weather monitoring parameters.

- (10) Functional checks on SCADA software: mimic diagrams, trend graphs, remote accessibility etc.
- (11) Earth resistance measurements at the electrode chambers for solar array, control room panels and switch yard equipment.
- (C) Pre-commissioning tests on transformers, CTs, PTs, Lightning arrestors, GOS switches, vacuum circuit breaker, relays, etc:
 - (1) Usually performed tests are indicated as below. However, exact type of tests required to be conducted at site prior to commissioning shall be in line with STATE ELECTRICITY SUPPLY & TRANSMISSION BOARDS/CEIG/SECI etc., requirements.
 - (a) Transformers: IR tests, ratio tests, excitation current measurement, magnetic balance test on HV, short circuit test, excitation test LV side, vector group test.
 - (b) 11KV vacuum circuit breaker panels: IR tests and continuity tests for panels, IR values for CTs/PTs, excitation test on CTs, primary injection tests for CTs, ratio test for PTs
 - (c) Relays in VCB panels: open/close, tripping, primary injection tests.
 - (d) Lightning arrestors: IR tests
 - (e) GOS switches: IR and contact resistance tests.
 - (2) Appropriate testing agency shall be arranged for the tests.
 - (3) Vendor shall coordinate / liaison with concerned STATE ELECTRICITY SUPPLY & TRANSMISSION BOARDS/MRT departments to fix up test schedules and witness by their representatives.
 - (4) Vendor shall prepare and submit the reports to STATE ELECTRICITY SUPPLY & TRANSMISSION BOARDS/MRT/CEIG/SECI and obtain their approval through necessary liaison activities.
- (D) Vendor shall coordinate and liaison with STATE ELECTRICITY SUPPLY & TRANSMISSION BOARDS/CEIG etc., prepare and submit the applications with necessary enclosures on behalf of BHEL and obtain their approval:
 - (a) Approval for BHEL drawings
 - (b) Approval for synchronization of plant with grid.
 - (c) CEIG inspection of power plant
 - (d) Provisional CEIG clearance to proceed with commissioning
- (E) Vendor shall take approval of BHEL for appointing Electrical consultant for the entire SPV plant and switch yard to comply with CEIG norms and getting approvals.
- (F) Vendor shall implement corrective steps on the observations of CEIG, follow-up with them and obtain final clearance for licensed operation of the plant on a continuous basis.

Note: Scope of coordinating with state departments such as STATE ELECTRICITY SUPPLY & TRANSMISSION BOARDS, CEIG to get the clearances / approvals for licensed / statutory operation of the power plant on a continuous basis includes all transactions required for successful liaison and clearances. Application fees and renewal fees (say, in the form of DD) to be enclosed with application / renewal documents and all other expenses in the above process shall be in the scope of vendor.

6.0 Tests at manufacturer / sub-vendor works and witnessing by BHEL

6.1	BHEL shall witness routine / acceptance tests performed at manufacturer works for			
	following items.	Vendor shall accordingly provide inspection call to BHEL, with		



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submission of quality assurance plan to BHEL in advance.

- 1) Lightning Arrestors
- 2) CTs and PTs
- 3) Gang operated switch with earth switch
- 4) ACSR conductor
- 5) All cables under vendor scope (LT, data, control and communication cables)
- 6) Earthing electrodes & earth strip
- 7) Lightning arrestor (ESE)
- 8) Fire alarm system
- 9) ACDB
- 10) FCBC, Battery bank
- 11) UPS with battery

Note: In case the item is 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 for procurement of the item from dealers.

7.0 General conditions applicable during installation and commissioning phase

- 4	TAN 11 100 C 1110	
7.1	All machinery such as cranes, hydra, JCBs, forklifts, transport trucks, trolleys etc	
	necessary for movement of materials shall be organized by the vendor.	
7.2	All necessary tools and tackles such as crimping tool (including heavy duty tools for	
	crimping cables), screw driver set, power screwdrivers, 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 for RCC works, spade, shovel, hammer etc shall be organized by the	
	vendor.	
7.3	All necessary measuring instruments such as digital multimeters, electrical testers,	
	meggers (1kV, 2.5kV, 5kV), lamp load testers for solar array string measurements,	
	earth resistance meters, weighing machines, water level indicators etc shall be	
	organized by the vendor.	
7.4	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.	
7.5	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, BOCW act etc for their	
	labour deployed at site.	
7.6	Vendor shall maintain updated labour register, with name, age, qualification, salary,	
	attendance details etc at the site. Vendor has to satisfy all the statutory	
	requirements as per the labour law regulations in the state.	
7.7	Vendor shall use danger boards, wherever required, to ensure safety of the persons	
	during the work at site.	
7.8	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.	
7.9	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.	
7.10	Vendor shall carry out the work without causing inconvenience to other contract	



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	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.	
7.11	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	
710	COST.	
7.12 7.13	No child labour shall be employed for execution of the present contract.	
7.13	Any miscellaneous materials, which are found essential for technical	
	completion of the contract as per regulations/standards 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.	
7.14	In certain cases, approximate quantities are only mentioned. This is for the	
7.14	purpose of providing guidance to vendors and are as per BHEL estimation.	
	Such quantities shall, therefore, be considered only indicative. Vendor shall,	
	however, take into account the exact quantities that shall be required to meet	
	the functional requirements of I&C activities as per clause 5.0.	
7.15	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.	
7.16	Any deviations shall be discussed with BHEL site engineers and implementation	
	shall be taken up only after approval from BHEL.	
7.17	Vendor shall submit periodic status report, on daily as well as weekly consolidated basis, to BHEL on the progress of the contract.	
7.18	Vendor has to design all the foundations required as per this specification based on	
	the soil report and site conditions and to be submitted to BHEL for approval before	
	construction. However, minimum requirements are specified in this specification	
	for ready reference. Soil report will be made available to vendor after placement of	
	PO upon request.	
7.19	Supply and installation of all auxiliary supply cables from ACDB to various plant	
	equipment viz., FCBC, building lighting etc., shall be in the scope of the vendor which	
	will be intimated from time to time.	
7.20	All cable terminations shall be done in such a way that bending radius of the cable is	
	strictly as per IS: 1255	
7.21	In case project is not completed as per BHEL scope due to reasons arising out of	
	materials from BHEL end/vendor's end, contractor has to complete the job at later	
	stage without any extra charges. No overrun charges shall be paid in case of	
7.55	extension of project schedules	
7.22	Vendor shall prepare and submit as-built drawings after execution of works.	

8.0 Defect Liability Period

8.1	Date of commencement of defect liability period: Zero date for defect liability period shall be the actual date on which the complete 7.5 MW capacity is commissioned with synchronization / export of power to 11kV grid and completion of all the works in the scope of the vendor.	
8.2	Work during defect liability period: Vendor shall post competent person/s at site on daily basis to attend the problems that may arise in the plant during defect liability period within 24 hours.	



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
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
9.0 Documents to be submitted for BHEL approval after receipt of purchase order

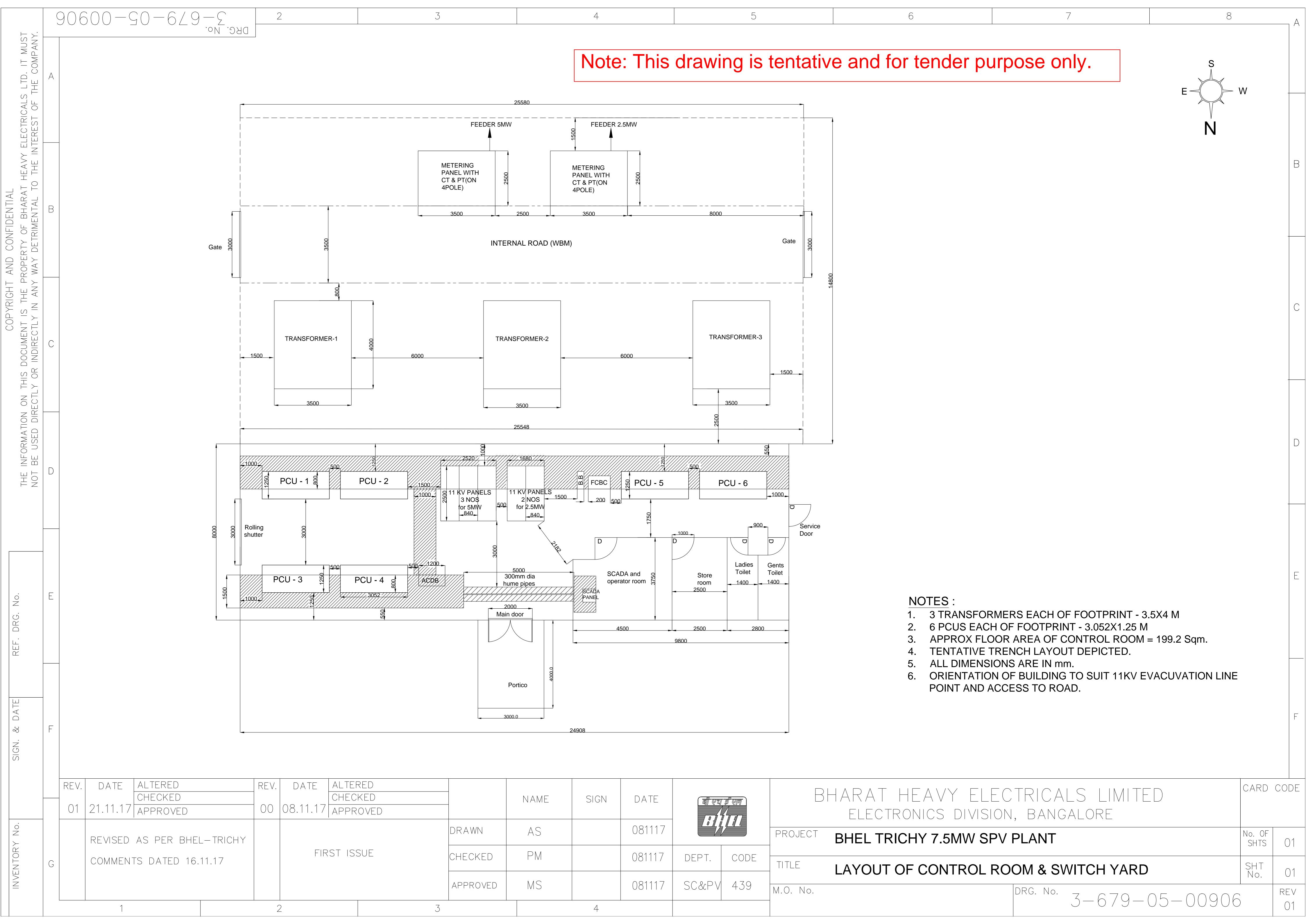
9.1	BHEL approval shall be obtained for the following technical documents, which shall be submitted to BHEL in phased manner based on priority sequence of activities. However, it shall be ensured that all documents are submitted within 14 days from date of purchase order.	
9.2	Vendor, make, model number / part number, specification / sizes / dimensions / drawings / datasheets of all the vendor supplied items.	
9.3	General arrangement drawings / schemes / layouts etc with bill of materials / quantities shall be submitted for the following (list is indicative and not limited to): (1) SMB Mounting structure (2) Cable trench layout in array yard, switchyard (3) GTP and drawings of Switchyard equipment – GOS, LA, ACSR, CT, PT (4) Details of power, control, communication cable (5) ESE Lightning arrestor arrangement with foundation details (6) Yard lights –switchyard, compound wall, approach road. (7) Water pipeline layout from storage tank to solar array field for module cleaning system with pressure calculations (8) Fire alarm system scheme / layout (9) Cable support structures and cable ladders within control room (10) Cable support structure for LT cables between inverters and transformers	
9.4	Quality assurance plans for items listed under clause 6.0	
9.5	Detailed activity-time chart for project implementation.	
9.6	Detailed manpower deployment schedule.	


10.0 Codes and Standards:

IS:7098 (Part -II)	Specification for XLPE insulated PVC sheathed cables. Part-I: For working voltages from 3.3 KV up to and including 33 KV	
IS:1554 (Part-I)	Specification for PVC insulated cables for working voltages upto and including 1100V	
IS: 3975	Low Carbon Galvanized steel wires, formed wires and tapes for armouring of cables	
IS: 4905	Methods for random sampling	
IS: 5831	PVC insulation and sheath of electrical cables	
IS:8130	Conductors for insulated electrical cables and flexible cords	
IS: 10418	Specification for drums for electric cables	
IS: 10810	Methods of tests for cables	
IS: 1255	Code of practice for installation and maintenance of power cables up to and including 33 KV rating	

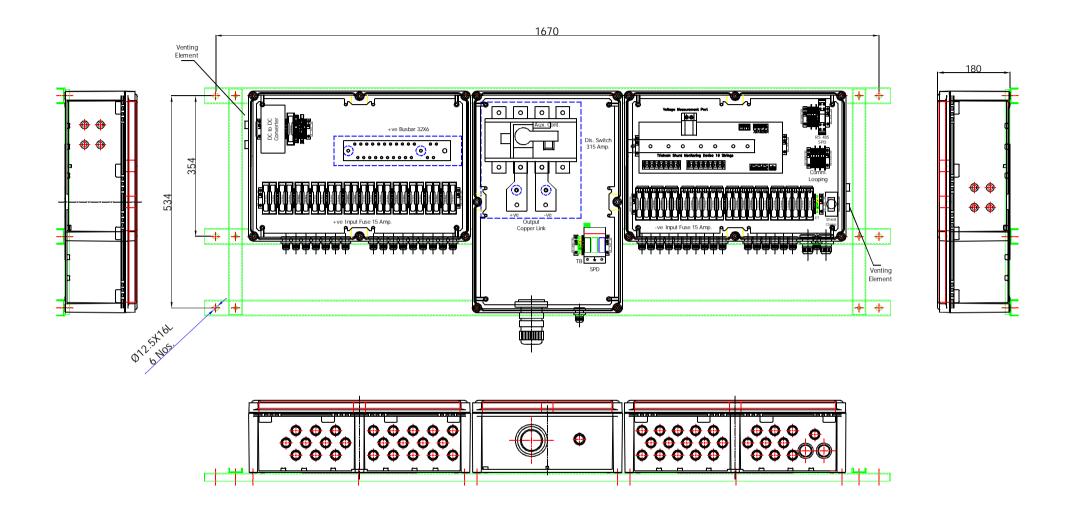








TENTATIVE DRAWING OF SMB



Note: This drawing is tentative and for tender purpose only.