

REQUEST FOR QUOTATION



BHARAT HEAVY ELECTRICALS LIMITED
Electronics Division
PB No. 2606, Mysore Road Bangalore - 560026
INDIA

RFQ NUMBER:
UPK0000978

RFQ DATE :
24.JAN.2017

Due Date
06.FEB.2017
Time: 13:00 HRS

VENUE :
NEW ENGG. BLDG

MMI:PU:RF:003

e-Tender

Bids shall be submitted through
e-Procurement portal
<https://bheleps.buyjunction.in> of
M/s. Mjunction Services Limited

PURCHASE FILE COPY

(for all correspondence)

Purchase Executive : UPENDER KUMAR
Phone : 2698 9572
Fax : 00918026742498
E-mail: upender@bheledn.co.in

Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
1	PS0679065024 Supply of MC4 ,Cable tie,HDPE pipe etc. Supply of MC4 connectors, Y-connectors, cable ties, HDPE DWC pipes with couplers/joints/bends etc for 1Cx10 cable, HDPE pipes for RS485 cables, GI pipes for road crossings, cable lugs, cable glands, ferrules, cable termination hardware etc as per clauses 6.1 - 6.10 of PS-439-1109. Test Certificate	1	ST	1	01.MAY.2017
2	PS0679065032 Supply of earthing items for array,SMBet Supply of earthing items for solar array structures/ SMBs/ inverter & main control room equipments, 33kV transformer yards etc: electrodes with chemical compound, GI strips/flats, copper cables, termination hardware, earth chamber items including lids, SMB/SPD earthing cable etc as per clauses 6.11, 7.13 of PS-439-1109. Test Certificate	1	ST	1	01.MAY.2017
3	PS0679065040 Supply of ESE lightning arrestors etc Supply of lightning arrestors (ESE) along with masts, counters, test links, down conductors, earth chamber items including lids, stay/guy wires, all other related accessories and hardware etc as per clause 6.12 of PS-439-1109. Test Certificate	1	ST	1	01.MAY.2017
4	PS0679065059 Supply of items for module cleaning etc Supply of items of bore wells and module cleaning system such as submersible pumps, surface pumps, pressure regulating tanks, UPVC pipes/ couplers/joints, hume pipes at road crossings, valves of different types, hose pipes, pressure gauges, electrical cables with cable accessories, all related fittings/hardware as per clauses 8.2, 8.3 of PS-439-1109. Test Certificate	1	ST	1	01.MAY.2017
5	PS0679065067 Supply of control cables & accessories Supply of control cables, cable installation accessories such as cable trays/ cable ties/ casing / capping/ glands/ lugs/ trefoil clamps etc, DC/LT/HT/control cable termination hardware, HT cable termination kits, LT/HT straight through jointing kits, HDPE DWC conduit pipes, hume pipes below plinth etc as per clauses 7.2-7.4, 7.6 of PS-439-1109.	1	ST	1	01.MAY.2017

For and On behalf of BHEL.

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Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
	Test Certificate				
6	PS0679065075 Supply of Aux transformer & accessories Supply of auxiliary transformer, ACDB panel, DB boards of all types with MCBs, UPS panels, FCBC/battery banks with all related accessories/hardware etc as per clauses 7.7-7.9 of PS-439-1109.	1	ST	1	01.MAY.2017
	Test Certificate				
7	PS0679065083 Supply of plant lighting system etc Supply of items for plant lighting system such as street light poles, bend pipes, luminaires, lamps, junction boxes, cable conduits, foundation items and all related accessories, hardware etc as per clause 8.1 of PS-439-1109.	1	ST	1	01.MAY.2017
	Test Certificate				
8	PS0679065091 Supply of cable ties,markers etc Supply of miscellaneous items such as ABT metering panels (33kV side side), cable tags, cable route markers, hoarding board, sign boards, danger boards, display boards, electrical insulation mat, checkered plates, air conditioners, tool kits, measuring instruments, office furniture, items for remote connectivity of SCADA, items for sump tank to OH tank connection etc as per clauses 7.10, 7.12, 8.8-8.16 as per PS-439-1109.	1	ST	1	01.MAY.2017
	Test Certificate				
9	PS0679065105 Supply of safety related items etc Supply of safety related items including fire alarm systems for buildings, fire extinguishers, sand buckets, safety gadgets etc as per clauses 8.4-8.5 of PS-439-1109.	1	ST	1	01.MAY.2017
	Test Certificate				
10	PS0679065113 Supply of CCTV system Supply of CCTV system as per clause 8.6 of PS-439-1109.	1	ST	1	01.MAY.2017

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Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
	Test Certificate				
11	PS0679065121 Supply of spare items .. Supply of spare items as per clauses 13.1,13.2 of PS-439-1109. Test Certificate	1	ST	1	01.MAY.2017
12	PS0679065130 Supply of Weather monitoring station Supply of Weather monitoring system as per clause 7.11 of PS-439-1109. Test Certificate	1	ST	1	01.MAY.2017
13	PS0679065148 Supply of items for security room etc Supply of items for security room and watch cabins as per clause 8.7 of PS-439-1109. Test Certificate	1	ST	1	01.MAY.2017
14	PS0679065156 I&C Interconnection of SPV modules I&C:Interconnection of SPV modules,foundation/erection of SMB mounting structures and SMBs,laying/termination of solar array 1Cx10 cable including related underground trench/conduit works as per clauses 6.1-6.7.NOTE:1AU=activity equivalent to 1.5MW measured pro-rata on total quantity of SMBs for 8.3MW.	7	AU	7	23.FEB.2017
15	PS0679065164 I&C underground cbl trench for DC cbl I&C:Underground cable trench works for DC power 1Cx300 cable and RS485 cable from SMBs to Inverter rooms as per clause 6.8 .NOTE: 1AU=activity equivalent to one inverter room measured pro rata on total quantity of two rooms.	2	AU	2	23.FEB.2017
16	PS0679065172 I&C Laying of DC power 1Cx300,RS485 etc I&C:Laying/termination of DC power 1Cx300 cable at SMB and PCU ends, laying of RS485 cable from SMBs to SCADA panels in inverter rooms (excluding underground cable trench works) and their terminations at both ends as per clauses 6.8-6.10. Note: 1 AU=activity equivalent to one inverter room measured pro rata on total quantity of two	2	AU	2	23.FEB.2017

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Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
	rooms.				
17	PS0679065180 I&C Earthing system for solar array etc I&C: Earthing system for solar array MMS structures and SMBs including laying of underground earth mat and interconnection to MMS structures,SMB earthing,earth chamber construction ,earthing terminations etc as per clause 6.11 of PS-439-1109. NOTE: 1AU=activity equivalent to one IR room measured pro rata for total two rooms.	2	AU	2	23.FEB.2017
18	PS0679065199 I&C UG cbl trench & laying Aux AC/DC cbl I&C: Underground cable trenches and laying of cables for Aux AC/DC power cables, HT (33kV) cables, control/ data /instrumentation/ OFC cables as per clause 7.6 of PS-439-1109. Note: 1 AU = 25% of total work as certified by BHEL site in-charge.	4	AU	4	23.FEB.2017
19	PS0679065202 I&C erection of indoor elec panels I&C: Erection of indoor electrical panels (PCUs, VCB panels, DB boards of all types, UPS/ FCBC/ battery bank, SCADA panels etc) in the individual inverter rooms including grouting of panels, laying/fixing of cable trays, routing/terminations of cables at the electrical panels and up to LV side of transformers in the switchyard as per clauses 7.1-7.4 of PS-439-1109 . 1 AU = Work proportionate to one of two inverter rooms.	2	AU	2	23.FEB.2017
20	PS0679065210 I&C erection of 33kv transformer yards I&C: Erection of 33kV transformer yards (attached to individual inverter rooms) with necessary land leveling within switchyard, laying of underground earth mat grid, foundation/ erection of transformers, underground cable trenches, laying/termination of 33kV/ LT / data / control / SCADA cables between yard and the inverter room panels, stone jellies, fencing and gate for switchyard, drains/ drain pipes etc	2	AU	2	23.FEB.2017

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Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
	as per clause 7.5 of PS-439-1109. Note: 1 AU = Work proportionate to one of the two inverter rooms.				
21	PS0679065229 I&C:Erection of indoor electrical panels I&C: Erection of indoor electrical panels (VCB panels, AC/DC DB boards/panels, UPS system, FCBC/ battery banks, SCADA panels, ABT metering panels etc) in the main control room including grouting of panels, laying/fixing of cable trays, routing/terminations of LT/HT power/control cables to the electrical panels and to 33kV side of 12.5MVA transformer in switchyard etc as per clauses 7.1-7.4 of PS-439-1109.	1	AU	1	28.FEB.2017
22	PS0679065237 I&C of 33kv portion of 33/132kv SY I&C: Erection of 33kV portion of the 33/132kV switchyard (attached to main control room) with erection of aux transformer (including foundation), laying/termination of 33kV cables between 12.5MVA transformer and VCB panels, laying/termination of 33kV/LT cables between aux transformer and control room panels as per clause 7.5 of PS-439-1109.	1	AU	1	23.FEB.2017
23	PS0679065245 I&C of SCADA system I&C: Installation and commissioning of SCADA system by integrating the data cables from all the electrical and weather monitoring equipments of the power plant at the data logger/ PLC panel / HMI computer control desk at main control room etc as per clause 7.12 of PS-439-1109.	1	AU	1	23.FEB.2017
24	PS0679065253 I&C of aux AC/DC system. I&C: Erection of aux AC/DC system: ACDB panel, DB boards, UPS panels,	1	AU	1	23.FEB.2017

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	FCBC/ Battery banks including cable interconnections as per clause 7.8 of PS-439-1109.				
25	PS0679065261 I&C of earthing for IR,CR,Xmer yard etc I&C: Earthing system for inverter rooms, main control room and 33kV transformer yards including laying of underground earth mat grids, earth chambers with lids, laying/termination of earthing strips from all electrical equipments to earth mat grid etc as per clause 7.13 of PS-439-1109.	1	AU	1	23.FEB.2017
26	PS0679065270 I&C lightning arrestors etc I&C:Lightning arrestors (ESE) including earth chamber construction as per clause 6.12 of PS-439-1103	1	AU	1	23.FEB.2017
27	PS0679065288 I&C of borewells and associated works I&C: Construction of bore wells including hydro survey,water analysis,electrical cabling,plumbing works as per clause 8.2 of PS-439-1109.	1	AU	1	23.FEB.2017
28	PS0679065296 I&C of module cleaning system etc I&C: Module cleaning system including underground water tanks, underground trenches/laying of UPVC pipes / couplers/joints/valves etc,erection of submersible pumps/surface pumps,pressure regulated tanks,pressure guages,electrical cabling works etc as per clause 8.3 of PS-439-1109.	1	AU	1	23.FEB.2017
29	PS0679065318 I&C of security rooms and watchman cbn I&C of security room and watchman cabins as per clause 8.7 of PS-439-1109	1	AU	1	23.FEB.2017
30	PS0679065326 I&C misc & safety items etc I&C of miscellaneous and safety items such as ABT metering panels, cable tags, cable markers, hoarding board, sign boards, danger	1	AU	1	23.FEB.2017

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	boards, display boards, electrical insulation mat, checkered plates, air conditioners, office furniture, fire extinguishers, fire alarm system, Nitrogen injection fire protection system for 12.5 MVA transformer, weather monitoring system, items for remote connectivity of SCADA, connection from sump tank to OH tank, identification markings using painting etc as per clauses 7.10-7.12,8.8-8.16 of PS-439-1109.				
31	PS0679065334 I&C of CCTV system I&C of CCTV system as per clause 8.6 of PS-439-1109.	1	AU	1	23.FEB.2017
32	PS0679065342 I&C of markings,pre comm. insp etc I&C: Identification markings and pre commissioning inspections/checks/tests,MRT tests, coordination/liaison with state/central departments/CEIG etc for necessary approvals/clearances for commissioning , synchronisation with grid/plant commissioning as per clauses 12.1,12.2 of PS-439-1109.	1	AU	1	23.FEB.2017
33	PS0679065350 Operations and Maintenance Operations and Maintenance per month as per clause 15.0 of PS-439-1109.	40	AU	40	15.FEB.2017

Total Number of Items - 33

Please note that the tender will be opened in the presence of the bidders or his authorised representatives (maximum two per organisation) who choose to be present with authorisation letters. Refer annexure for the terms and conditions.

Preference will be given to vendors who accepts our standard payment terms i.e.100% payment - 30 days after receipt of material at our works subject to acceptance.

Please specify Terms of delivery, Excise duty, sales tax, Ex-BHEL, Ex-works surcharge, Insurance,P&F, Freight and other taxes very clearly .

For evaluation,exchange rate(TT selling rate of SBI) as on scheduled date of tender opening (Part-I bid incase of two part bid) shall be considered.

The offers of the bidders who are on the banned list as also the offer of the bidders, who engage the services of the banned firms, shall be rejected.The list of banned firms is available on BHEL web site www.bhel.com

- i). This is only RFQ not an order.
- ii). In all correspondence quote RFQ No. & due date.
- iii). In Quotation BHEL material code / RFQ Sl. No. should be mentioned clearly.
- iv). Quotation Envelope / Fax not superscribed with RFQ No.and due date is liable for rejection.
- v). Quotation should remain valid for a minimum peiod of 90 days from due date.
- vi). In case of non-receipt of Quotation or regret letter for 3 consecutive RFQs you are liable to be removed from our vendors list.
- vii). All Prices should be written in words and numbers.
- viii). Excise Chapter Heading should be mentioned for all items where VAT is applicable .

Vendors list to whom RFQ has been sent:

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1. BHEL, Electronics Division (X563699) - 6400075729			

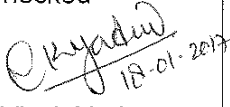
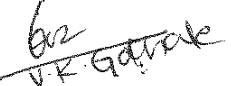
For and On behalf of BHEL.

	Technical specification for Design, supply, installation and commissioning of 10MW (AC) solar PV plant at Ordnance Factory Bolangir Odisha	PS-439-1109
		Rev No: 00
		PAGE : 1 OF 109

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Technical specification
for
Design, Supply, Installation, Commissioning of
10MW (AC) Solar Photovoltaic Grid-connected Power plant
at
Ordnance Factory, Badmal village, Saintala Taluk, Bolangir district, Odisha

Revision details: R00	Prepared / Checked  18-01-2017 NV Rajesh / Vivek Yadav	Approved:  VK Gokhale	Date: 14.01.2017
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	Technical specification for Design, supply, installation and commissioning of 10MW (AC) solar PV plant at Ordnance Factory Bolangir Odisha	PS-439-1109
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7.3	Supply, laying, termination of LT/HT/aux supply cables in inverter/ main control rooms
7.4	Supply, laying, termination of Control / data / instrumentation / OFC cables
7.5	Erection of 33kV transformer yards attached to inverter rooms and aux transformer
7.6	Underground cable trenches and laying of HT/LT/Control/Instrumentation/OFC cables

	Technical specification for Design, supply, installation and commissioning of 10MW (AC) solar PV plant at Ordnance Factory Bolangir Odisha	PS-439-1109
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11.0	General civil works	
12.0	Pre-commissioning inspections / checks / tests	
13.0	Spares	
	13.1	Spares on DC side for O&M purpose
	13.2	Spares on AC side to be supplied along with main consignment
14.0	General conditions applicable during supply, installation and commissioning phase	
15.0	Operations and Maintenance	
16.0	Documents to be submitted for BHEL/BEL approval during detailed engineering	

	Technical specification for Design, supply, installation and commissioning of 10MW (AC) solar PV plant at Ordnance Factory Bolangir Odisha	PS-439-1109
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1.0 Introduction

1.1 Project outline of 10MW (AC) solar photovoltaic power plant

Bharat Heavy Electricals Limited (BHEL), Electronics Division, Bangalore is setting up a 10 MW (AC) solar photovoltaic (SPV) power plant for Bharat Electronics Limited (BEL), Bangalore at Ordnance Factory OFBL, Badmal village, Saintala taluk, Bolangir district, Odisha with the overall project scope comprising of three major portions as follows:

Solar PV modules generate DC electricity that is inverted to 3-phase AC in the range 300-400V. 5MW AC output of each of the two inverter room blocks is stepped up to 33kV. Both the outputs are combined to 10MW AC at the main control room and further hooked up to 33kV transmission line through a CT/PT metering yard placed next to the room. Power generated at the plant is transmitted to the substation that is ~6 Km away from the solar plant. 33kV transmission poles are erected to run the overhead conductor from the solar plant to the substation.

At substation, the 33kV level is stepped up to 132kV. Prior to stepping up, a 33kV switchyard bay is constructed using necessary outdoor equipments viz CT/ PT/ LA/ Isolator/ Earth switch/ VCB breaker etc. Similarly, after stepping up, the power is hooked up to main/ transfer buses presently available at substation through an outdoor 132kV switchyard to be constructed using necessary equipments viz CT/ PT/ LA/ Isolator/ Earth switch/ SF6 breaker etc.

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

Note: Whereas project scope includes construction of the full 10MW capacity on AC side, it includes construction of only ~8.40MWp capacity on the DC side. Balance DC capacity to be added by the customer in future.

1.2 Scope of this tender specification

Vendor scope includes supply, installation, testing, commissioning of certain identified DC and AC side activities of the solar photovoltaic power plant up to the 33kV connecting point to the metering yard at the solar PV plant. This scope includes activities but not limited to design, engineering, drafting of drawings, obtaining approval from BHEL/BEL for the drawings, manufacture/ testing/ inspection at manufacturer's works, packing, supply, transportation, transit insurance, delivery/unloading at site, storage, civil works, installation, pre-commissioning tests, clearance from Transco/ CEIG etc, commissioning as identified under this specification.

Scope also includes operations and maintenance, for a period of 10 years, of the portion of the solar power plant right from solar array up to the point of connection to the 33kV metering yard attached to the main control room.

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Vendor shall have capability for design of systems such as underground trenches for DC/LT/HT/Control/OFC cables, RCC cable trenches, cable laying/ terminations, water washing system for SPV modules, lightning arrestors (ESE), earth mat grids, RCC foundations for inverter transformers, peripheral lighting system etc as envisaged under this specification.

If vendor does not have design/drafting capability, they shall tie up with competent design consultants. In such a case, vendor shall submit the credentials of the proposed consultants to BHEL after receiving purchase order from BHEL. Subsequent to approval by BHEL, vendor shall award the work on the consultants. All drawings/ design documents shall be originated by the consultants, endorsed by the vendor clearly stating the name of the project, names of clients (BHEL/BEL), drawing/document number, revision number, number of sheets etc. Details of drawings/ design documents to be submitted are brought out under sections 5.1 and 16.0 of this specification.

All civil related works shall be tested as per BHEL/BEL-approved FQP that will be issued during the course of project execution. All third party testing shall be carried out only at NABL accredited laboratories (or) Government laboratories.

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 Location/ address of power plant:

10MW (AC) Solar Photovoltaic Power Plant
Ordnance Factory OFBL
Badmal village
Saintala taluk
Bolangir district
Odisha 767 070

2.0 Enclosures to this specification (only for tender purpose)

1	Overall map of project site
2	Single line diagram of overall Solar PV power plant
3	Typical site layout with solar array, inverter/control rooms, switchyards
4	Typical layout of main control room
5	Typical layout of inverter room
7	Tentative drawing of SPV module mounting structure (MMS)
8	Datasheet of solar PV module
9	Soil report
10	Request for Quotation with instructions, terms and conditions, formats for filling-up etc.

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3.0 Scope of work

3.1 Vendor scope – breakup of supply, I&C, O&M

The table below briefly outlines the vendor scope of work. Vendor shall submit the offer (in two part bids) as per this list and quantity.

#	Vendor scope of work (as briefly outlined)	Qty
1	Supply of MC4 connectors, Y-connectors, cable ties, HDPE DWC pipes with couplers/joints/bends etc for 1Cx10 cable, HDPE pipes for RS485 cables, GI pipes for road crossings, cable lugs, cable glands, ferrules, cable termination hardware etc as per clauses 6.1 – 6.10.	1 set
2	Supply of earthing items for solar array structures/ SMBs/ inverter & main control room equipments, 33kV transformer yards etc: electrodes with chemical compound, GI strips/flats, copper cables, termination hardware, earth chamber items including lids, SMB/SPD earthing cable etc as per clauses 6.11, 7.12.	1 set
3	Supply of lightning arrestors (ESE) along with masts, counters, test links, down conductors, earth chamber items including lids, stay/guy wires, all other related accessories and hardware etc as per clause 6.12.	1 set
4	Supply of items of bore wells and module cleaning system such as submersible pumps, surface pumps, pressure regulating tanks, UPVC pipes/ couplers/ joints, hume pipes at road crossings, valves of different types, hose pipes, pressure gauges, electrical cables with cable accessories, all related fittings/hardware as per clauses 8.2, 8.3.	1 set
5	Supply of control cables, cable installation accessories such as cable trays/ cable ties/ casing / capping/ glands/ lugs/ trefoil clamps etc, DC/LT/HT/control cable termination hardware, HT cable termination kits, LT/HT straight through jointing kits, HDPE DWC conduit pipes, hume pipes below plinth etc as per clauses 7.2-7.4, 7.6.	1 set
6	Supply of auxiliary transformer, ACDB panel, DB boards of all types with MCBs, UPS panels, FCBC/battery banks with all related accessories/ hardware etc as per clauses 7.7-7.9.	1 set
7	Supply of items for plant lighting system such as street light poles, bend pipes, luminaires, lamps, junction boxes, cable conduits, foundation items and all related accessories, hardware etc as per clause 8.1.	1 set
8	Supply of miscellaneous items such as cable tags, cable route markers, hoarding board, sign boards, danger boards, display boards, electrical insulation mat, checkered plates, air conditioners, tool kits, measuring instruments, office furniture, items for remote connectivity of SCADA, items for sump tank to OH tank connection etc as per clauses 7.11, 8.8-8.16.	1 set

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9	Supply of safety related items including fire alarm systems for buildings, fire extinguishers, sand buckets, safety gadgets etc as per clauses 8.4-8.5.	1 set
10	Supply of CCTV system as per clause 8.6.	1 set
11	Supply of spare items as per clauses 13.1, 13.2.	1 set
12	Supply of weather monitoring system as per clause 7.10.	1 set
13	Supply of items for security room and watch cabins as per clause 8.7.	1 set
14	I&C: Interconnection of SPV modules, installation of SMBs, laying/ termination/ ferruling of solar array 1Cx10 cable including related underground trench/conduit works as per clauses 6.1-6.7. Note: 1 AU= activity equivalent to 1.2MW measured pro-rata on total quantity of SMBs for 8.40 MW.	7 AU
15	I&C: Underground cable trench works for DC power 1Cx300 cable and RS485 cable from SMBs to inverter rooms as per clause 6.8. Note: 1 AU= activity equivalent to one inverter room measured pro-rata on total quantity of two rooms.	2 AU
16	I&C: Laying/ termination of DC power 1Cx300 cable at SMB and PCU ends, laying of RS485 cable from SMBs to SCADA panels in inverter rooms (excluding underground cable trench works) and their terminations at both ends as per clauses 6.9-6.10. Note: 1 AU= activity equivalent to one inverter room measured pro-rata on total quantity of two rooms.	2 AU
17	I&C: Earthing system for solar array MMS structures and SMBs including laying of underground earth mat and interconnection to MMS structures, SMB earthing, earth chamber construction, earthing terminations etc as per clause 6.11. Note: 1 AU= activity equivalent to one inverter room measured pro-rata on total two rooms.	2 AU
18	I&C: Erection of indoor electrical panels (PCUs, VCB panels, DB boards of all types, UPS/ FCBC/ battery bank, SCADA panels etc) in the individual inverter rooms including grouting of panels, laying/fixing of cable trays, routing/terminations of cables at the electrical panels and up to LV side of transformers in the switchyard as per clauses 7.1-7.4. 1 AU = Work proportionate to one of two inverter rooms.	2 AU
19	I&C: Erection of 33kV transformer yards (attached to individual inverter rooms) with necessary land leveling/ grading within the yard, foundation/ erection of inverter transformers, stone jellies, fencing/ gates, RCC cable trench/ cable trays, drains/ drain pipes etc as per clause 7.5. Note: 1 AU = Work proportionate to one of the two inverter rooms.	2 AU
20	I&C: Erection of indoor electrical panels (VCB panels, AC/DC DB boards/panels, UPS system, FCBC/ battery banks, SCADA panels etc) in the main control room including grouting of panels, laying/fixing of cable trays, routing/terminations of LT/HT power/control cables to the electrical panels and upto 33kV connecting point at metering yard etc as per clauses 7.1-7.4.	1 AU

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21	I&C: Erection of aux transformer (including foundation), laying/termination of 33kV/LT cables between aux transformer and control room panels as per clause 7.5.	1 AU
22	I&C: Underground cable trenches and laying of cables for Aux AC/DC power cables, HT (33kV) cables, control/ data /instrumentation/ OFC cables as per clause 7.6. Note: 1 AU = 25% of total work as certified by BHEL site in-charge.	4 AU
23	I&C: Installation and commissioning of SCADA system by integrating the data cables from all the electrical and weather monitoring equipments of the power plant at the data logger/ PLC panel / HMI computer control desk at main control room etc as per clause 7.11.	1 AU
24	I&C: Erection of aux AC/DC system: ACDB panel, DB boards, UPS panels, FCBC/ Battery banks including cable interconnections as per clause 7.8.	1 AU
25	I&C: Earthing system for inverter rooms, main control room and 33kV transformer yards including laying of underground earth mat grids, earth chambers with lids, laying/termination of earthing strips from all electrical equipments to earth mat grid etc as per clause 7.12.	1 AU
26	I&C: Lightning arrestors (ESE) including earth chamber construction as per clause 6.12.	1 AU
27	I&C: Construction of bore wells including hydro survey, water analysis, electrical cabling, plumbing works etc as per clause 8.2.	1 AU
28	I&C: Module cleaning system including underground water tanks, underground trenches/ laying of UPVC pipes/ couplers/ joints/ valves etc, erection of submersible pumps/ surface pumps, pressure regulated tanks, pressure gauges, electrical cabling works etc as per clause 8.3.	1 AU
29	I&C of plant lighting system including outdoor cable laying, cable terminations at poles/lights as well as DB boards of inverter rooms / main control room etc as per clause 8.1.	1 AU
30	I&C of security room and watch cabins as per clause 8.7.	1 AU
31	I&C of miscellaneous and safety items such as cable tags, cable markers, hoarding board, sign boards, danger boards, display boards, electrical insulation mat, checkered plates, air conditioners, office furniture, fire extinguishers, fire alarm system, weather monitoring system, items for remote connectivity of SCADA, connection from sump tank to OH tank, identification markings using painting etc as per clauses 7.10, 7.11, 8.8-8.15.	1 AU
32	I&C of CCTV system as per clause 8.6.	1 AU
33	I&C: 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 as per clauses 12.1, 12.2.	1 AU

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34	Operations and Maintenance as per clause 15.0 (1 AU = 3 Months)	40 AU
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3.2 BHEL scope

For the sake of clarity to the vendor, activities within BHEL scope are listed below.

1	Supply and erection of solar array module mounting structures (MMS)	~ 1356 sets
2	Supply and erection of solar PV modules (20 per MMS set)	~ 27,120 Nos
3	Supply of DC array cable 1Cx10 Cu, XLPO insulation/sheath, unarmoured as per TUV 2Pfg 1169/08.2007: from SPV modules to string monitoring boxes (SMB).	As required
4	Supply of DC power cable 1Cx300 Al, XLPE insulation, PVC sheath, armoured as per IS: 7098: from SMBs to PCUs in inverter rooms	As required
5	Supply of RS485 cable (unarmoured): from SMBs to SCADA	As required
6	Supply of string monitoring boxes	90 Nos
7	Supply of PCUs 1250kW with ducts/ fans, cable glands/ lugs/washers for DC/AC of PCUs	6 sets
8	Supply of LT 1.1kV cable, 1Cx300 Al, XLPE insulation, armoured, PVC sheath as per IS: 7098: from PCUs to Inverter transformers; 8 runs x 1C x 300 per phase;	As required
9	Supply of HT 33kV cable, 1Cx300 Al, XLPE insulation, armoured, PVC sheath as per IS: 7098: for all 33kV connections from Inverter transformers up to metering yard at plant end, including aux transformer HV side; 1 Run x 1Cx300 per phase	As required
10	Supply of RS485 cables (unarmoured): from relays, MFM/TVM/ABT meters, weather monitoring system etc to SCADA	As required
11	Supply of Ethernet cables: from PCUs to SCADA	As required
12	Supply of OFC cables along with termination kits and also, the cable termination activity at SCADA panels of inverter/ main control rooms (Note: supply of PLB HDPE pipe and laying of the OFC cable in HDPE pipes shall be in vendor scope)	As required
13	Supply of inverter transformer ~2.9MVA, 33kV/~350-350 V, ONAN/ ONAF	4 Nos
14	Supply of indoor 33kV breaker panels with VCBs, CTs, PTs, numerical relays, MFM meters etc: (2 i/c + 1 o/g) x 2 inverter rooms; 2 i/c + 1 main o/g + 1 aux o/g, 1 Bus PT in main control room	11 panels
15	Supply and erection of ABT metering panels: two at plant end, 1 at substation; (Note: Three ABT meters at plant outgoing 33kV; Two at 132kV substation)	2 + 1 Nos
16	Supply of SCADA: 2 panels in inv room, 1 in main control room; HMI/PC system	1 set
17	Supply of GPS time synchronization master clock to interface with ABT meter	1 No

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18	Supply and erection of metering yard at plant end, 33kV transmission poles from solar plant to substation, 33kV/132kV switchyards at substation including 12.5MVA 33/132kV power transformer	1 Set
19	Supply of spares: SPV modules and items related to SMB, PCU, inverter transformer, HT 33kV VCB panels, metering yard, 33kV/132kV switchyards, 12.5MVA 33/132kV power transformer	1 Set
20	Construction of RCC inverter rooms, main control room	2 + 1 rooms
21	Construction of infrastructure civil works such as approach roads, pathways, drains, overall plant boundary fencing, soak pit, septic tank	1 Set
22	Site offices for BHEL/BEL, unloading/storage/security for BHEL supplied items until start of O&M	1 Set

4.0 Instructions to vendors on bid submission

4.1	Offer shall be submitted in two-parts (Two part-bid). Both parts shall be in separate sealed envelopes as per instructions in tender. The individual envelopes shall be enclosed in a common bigger envelope with markings (address etc) on the envelope as per instructions provided in tender.
4.2	First-part shall be techno-commercial bid. Following details shall be furnished: 1. Technical offer with covering letter expressing acceptance to BHEL tender specification 2. Separate list clause-wise in case of deviations, if any 3. Filled-up enclosures as per BHEL formats (meant for first-part) provided in tender
4.3	Second-part shall be price bid with filled up enclosures as per BHEL formats provided in tender.
4.4	In addition to the above instructions, tender document provides detailed instructions for bid submission. Vendor shall submit the bid based on instructions in tender document.

5.0 Technical specification for design/drafting and logistics

#	BHEL specification Note: Design and drafting and logistics vide this section 5.0 is not a separate billing item. Charges for all these activities shall be deemed to be absorbed in the related supply and I&C items.
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5.1	Design and drafting Vendor shall either have in-house design/drafting expertise (or) shall outsource consultancy in case of inadequacy of internal expertise. Vendor/ their consultant shall carry out electrical/ mechanical / civil design computations wherever applicable. Typical design/drafting areas are as listed below: (1) Auxiliary AC/DC supply SLD, sizing calculations for MCCBs/ MCBs/ fuses (2) Load calculations for sizing of Auxiliary transformer (3) Sizing calculations for FCBC charger/ battery bank system (4) Sizing calculations for UPS/ battery bank system (5) Computation of cable drop, power loss, rating etc for LT aux power cables (6) Sizing/ selection basis computations for control, instrumentation cables (7) Outdoor/underground cable trench layouts/cross sections: DC/LT/HT/Control/OFC cables (8) Earth mat/grid calculations for DC solar array (9) Earth mat/grid calculations for inverter room, main control room, transformer yards (10) Layout of lightning arrestors (ESE) with area coverage / protection calculations (11) RCC foundation for lightning arrestor masts: design calculations (12) Water cleaning system for SPV modules with pressure/discharge/sizing calculations (13) Sizing/ design of sump storage tank, OH storage tank (14) Sizing calculations for bore wells/ submersible pumps (15) Sizing calculations for surface/ booster pumps (16) Illumination lux calculations and layout design for plant lighting poles (17) RCC cable trench in transformer yards: sizing/design calculations (18) RCC foundation for inverter transformers and auxiliary transformer: design calculations (19) RCC foundation for security room, watch cabins: design calculations The above list is indicative and not exhaustive. Wherever BHEL/BEL finds it relevant and applicable, vendor shall carry out design and submit documents viz. GA drawings / datasheets / GTP / MQP/ type test reports etc for BHEL/BEL/Transco approval.
5.2	Temporary site office for BHEL and BEL use Vendor shall make necessary office arrangement with two Nos. porta cabins each with split AC of min. 1.5 Ton, fans, furniture, electrical points/ fittings etc at site during the period of project execution. The porta cabin should be at site within 15 days of issue of P.O.
5.3	Electrical power / water for construction/ drinking water (a) Vendor shall organize, on their own, necessary electrical power supply such as DG sets etc required for construction activities and also for porta cabin offices meant for their use. (b) Vendor shall also establish, on their own, water source such as bore wells, water tankers etc for construction activities. (c) Vendor shall arrange drinking water for their own use.
5.4	Construction of yards/sheds for safe storage of vendor supplied items (a) Vendor shall, at a suitable location at site, as decided based on discussions with BHEL site

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	engineer, construct closed sheds for safe storage of vendor-supplied indoor items such as ACDB panels, FCBC chargers, battery banks, UPS panels, all kinds of distribution boards, room electrical items such as ceiling fans/ exhaust fans/ lights/ switchboards/ cables etc and other miscellaneous items such as tools, measuring instruments, cable glands/ lugs/ markers, safety gadgets, insulation mats, sign boards etc. (b) These sheds shall have suitable water-proof roof and side walls so to ensure that there are no pin holes or joints through which rain water entry is possible. Also, these sheds shall be designed to withstand heavy wind loads. Lockable door shall be provided to ensure safety of these items. (c) Separate closed shed shall be constructed for storage of civil construction items such as cement bags etc. (d) Similarly, open yards shall be constructed with suitable fencing all around and lockable gate for storage of vendor-supplied items such as stone aggregate, sand, bricks, steel materials such as GI chain link fence/ gate for transformer yard, checkered plates etc. (e) Area of all storage yards/sheds shall be selected based on sizes of items. Vendor shall, at the time of starting their activities at site, submit drawings/ sketches/ dimensions etc to obtain approval from BHEL. (f) Wherever applicable, suitable raised platforms / arrangements shall be provided to ensure that the items are not affected by water at the ground level during rain, storm, flood etc. (g) Storage yards/sheds shall be provided with adequate clearance (within the yard) to facilitate movement of concerned transportation vehicles/ equipments such as forklifts, hydra, trucks etc as applicable. (h) Safety of all the vendor-supplied items shall be within vendor scope. Accordingly, vendor shall ensure adequate security watch and ward for these items round the clock.
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5.5	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 vendor-supplied items received at site and subsequent movement to storage yards/sheds. (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 registers/ files/ records of invoices, LRs, delivery challans, material receipt certificates etc. Also, proper records shall be maintained to keep track of material entry (for storage) and material issue (for construction). (4) All such documents shall be suitably preserved for further handing over to BHEL. (5) Safety of vendor-supplied items shall be in vendor scope. Accordingly, suitable watch and ward shall be deployed 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 and other vendors. (2) However, movement of those items related to vendor scope of I&C 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.
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6.0 Technical specification for DC side design, supply and installation

6.1	Series interconnection of SPV modules to form strings Supply of SPV modules is in BHEL scope. Type of module: L24270P (~310Wp) as per BHEL drawing enclosed with tender. Total quantity = ~27,120 Nos Vendor shall interconnect the SPV modules as follows: - Each module is fitted integrally with a junction box having positive and negative polarity cables (4 sq-mm). - 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. - This way, 20 modules shall be connected in series. Each set of connections is called as a series string. Thus, a total of 1,356 strings shall be connected to achieve $1356 \times 20 \times \sim 310\text{Wp} = \sim 8.40 \text{ MWp}$. - 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.
6.2	Installation of string monitoring boxes - Supply of string monitoring boxes (SMB), 90 sets plus spares, is in BHEL scope. These are 16-in/ 1-out type. This way, on input side of SMB, there are 16 series strings connected in parallel. - Vendor shall install the SMBs on the MMS structures using the fixture items such as angles, channels/brackets, fasteners etc that shall be supplied by BHEL. - All necessary labour, tools, machinery etc for erection work shall be in vendor scope.
6.3	Interconnection of SPV module strings to 1Cx10 cable - Vendor shall connect each series string of 20 SPV modules to SMB using 1Cx10 cable supplied by BHEL. - SPV module is provided with positive and negative cables 1Cx4 having male and female parts of MC4 type connectors. - Vendor shall supply plug connectors of MC4 type, each set having a pair of male and female parts, to join both the 1Cx10 and 1Cx4 cables. - MC4 connectors shall have rating of 1000VDC (IEC), rated current of 30A, Type approved by TUV Rheinland for product safety. - Make: Multicontact, Bizlink, Sunlont or other reputed equivalent subject to BHEL/BEL approval during detailed engineering. - Total quantity of MC4 connector sets required = 1,600 sets (each set having a male and a female part) that include (a) 1,356 sets to complete the installation, (b) 244 sets as commissioning and O&M spares. Vendor shall ensure that there shall not be any shortage

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	during execution time. (7) Two sets of tool kits (with box enclosure) shall be supplied. This shall include crimping plier MC4, open end spanner set MC4, stripping plier MC4, socket wrench insert to tighten, socket wrench insert to secure, inserts for both 1Cx4 and 1Cx10 (of both pliers).
6.4	Ferruling for 1Cx10 cable 1) For 1Cx10 DC solar array cable, vendor shall provide UV resistant ferrules printed with source/destination identification of cable connection. Printing details shall be submitted for BHEL/BEL approval during detailed engineering. Printing shall be of appropriate size to ensure readability. 2) Ferrules shall be provided on both the termination ends: module end, SMB end. 3) Supply of ferrule shall be in vendor scope. Make shall be reputed brand. Approval for make/ type/ colour/ dimension etc shall be obtained from BHEL/BEL prior to procurement.
6.5	Routing of 1Cx 10 cable below the SPV modules (1) 1Cx10 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 that shall be in vendor scope of supply. (2) Spacing between two adjacent cable ties shall be so chosen as to ensure that there is no loose hanging of cables. (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. Make: 3M, Phoenix contact, Weidmuller, Hellermannntyton, Panduit or other reputed equivalent subject to BHEL/BEL. Width of the cable ties shall be minimum 4.5 mm. Length shall be so chosen as to ensure that the bunched cables are held firmly to the MMS structure. During detailed engineering, BHEL/BEL approval shall be obtained for the selected brand and sizes of cable tie.

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6.6	Routing of 1Cx10 cable in pipes underground between the rows of solar array (1) Where 1Cx10 cables run between two adjacent rows of structure, HDPE double walled corrugated (DWC) pipe shall be provided to route the cables underground from one row to the other. In such a case, the pipe shall also be laid vertically to cover the distance from MMS purlin to the ground on either ends. Vertical arrangement shall be firmly tied to the MMS structure using suitable cable ties. (2) HDPE DWC pipe together with necessary HDPE couplers/joints (T-joints, elbows, bends etc) shall be within scope of vendor supply. Vendor shall submit the bill of materials and the drawing showing the details of routing for BHEL/BEL approval during detailed engineering. (3) Specification of HDPE DWC pipe: As per IEC 61386 part 1-4; ID shall be selected to accommodate the number of 1Cx10 cables to be guided. ID shall be minimum 63mm. 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/BEL approval during detailed engineering. (4) Cables with HDPE DWC pipe (and couplers/joints etc) shall be directly buried underground as per IS: 1255. - Trench depth = 750 mm minimum - Trench width = As per size and number of pipes - Bottom layer shall be sand as per IS: 383 with 75mm minimum thick. - HDPE DWC pipes/couplers/joints with cables shall be laid over the sand layer. - Another layer of sand as per IS: 383 with 75 mm minimum thick. - Single layer of brick as protective cover - Trench shall, then, be filled with refill soil and compacted (5) Bending radii for cables shall be as per IS: 1255. (6) At pathway/road/drain/trench 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/ BEL approval during detailed engineering. It shall be ensured that a maximum of 60% of inner space of GI pipe shall be occupied by cables. (7) All the exposed cable entry openings of HDPE DWC pipes, after laying/ termination of the cables, shall be sealed using appropriate sealant (single component thermoplastic insulating compound) to ensure water proof tightness. Make, item description, part number etc shall be submitted for BHEL/BEL approval during detailed engineering.
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6.7	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. Whereas single strings shall be connected to the 14 inputs, double strings shall be connected to the last two input terminals 15th and 16th. For this purpose, 360 Nos of Y-connectors shall be provided by the vendor. Y-connectors shall have female/male parts of MC4 type suitable for 1Cx10 cable. The corresponding matching parts of MC4 connectors (360 x 3 = 1080 Nos) shall also be provided by the vendor for crimping to the connecting cables 1Cx10. (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 of cable lugs required shall be appropriately selected by the vendor. (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, crimping tool etc shall be within vendor scope.
6.8	Underground cable trenches and laying of 1Cx300 and RS485 cables in solar array field DC power cable 1Cx300 (from SMB to PCU) and data cable RS485 (from SMB to SCADA) shall be laid underground by way of direct burying as per IS:1255. RS485 cable shall be routed through HDPE pipe. Supply of both the cables shall be in BHEL scope. Typical trench details/dimensions are below only for tender purpose. During detailed engineering, cable trench layouts and cross section drawings as per IS: 1255 shall be submitted for BHEL/BEL approval. (a) Total trench depth = 750 mm minimum (b) Trench width = As per number of cables/ HDPE pipes (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 thick. 2. 1Cx300 cable shall be laid over the sand layer. 3. Another layer of sand of 75 mm minimum thick. 4. Single layer of brick as protective cover 5. Layer of sand of IS:383 with 75mm minimum thick 6. RS485 cable (unarmoured) shall be laid within HDPE pipe 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

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	1. RS485 cable shall be laid in daisy chain loop configuration. For tender purpose, 1 loop shall be considered to be connected to 10 SMBs. RS485 cables shall be routed through HDPE pipe of PE63 grade, pressure rating PN6, nominal diameter 32mm minimum as per IS: 4984 (1995). It shall be ensured that a max of 60% of inner space shall be occupied by the cables. HDPE pipe shall be in vendor scope of supply. Vendor shall submit GTP/ make/ part number of the HDPE pipe, accessories and tools for BHEL/BEL approval during detailed engineering. 2. Bending radii for cables shall be as per IS: 1255. At pathway/road/drain/trench 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/BEL approval. It shall be ensured that a maximum of 60% of inner space of GI pipe shall be occupied by cables. Vendor shall take utmost care in laying the cables in order to prevent damages on outer sheath and inner insulation. In case cables found to be damaged/ cut after the laying in trenches, vendor shall remove the damaged portion and join the cut pieces using appropriate cable jointing kit that shall be in vendor scope of supply.
6.9	Laying of 1Cx300/RS485 cables in inverter rooms and terminations at PCU/SCADA (1) 1Cx300 cables (Al conductor, XLPE insulation, armoured: BHEL scope of supply) and RS485 (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 of cable trays shall be in vendor scope. Refer relevant clause of this specification for cable tray details. Vendor shall route/lay/dress the cables neatly on the trays. Cable ties, which shall be in vendor scope of supply, shall be of 4.5mm minimum thickness and with adequate length for tying. (2) Vendor shall carry out drilling of holes in cable gland plates of the PCUs for the 15 positive and 15 negative DC inputs of 1Cx300 cable. Similarly, holes for entry of RS485 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. Checking records for the respective cable IDs shall be maintained at site. In case any cable found defective, vendor shall implement suitable corrective action such as cable jointing, replacement/relaying 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 1Cx300 cable terminations for the 15 positive and 15 negative DC inputs that include tasks such as unsleeving, crimping, connecting to the tinned copper bus bars, tightening using torque wrench etc. Glands (metallic, double compression), bimetallic cable lugs (Cu/Al), SS304 bolts/nuts/plain washers and Zinc/epoxy coated spring washers shall be in BHEL scope of supply. Vendor shall arrange torque wrench of

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	appropriate range. Torque setting shall be as per the bolt size and property class. For the torque setting, approval shall be obtained from BHEL site engineer. (6) Vendor shall carry out the RS485 cable terminations at SCADA end that include tasks such as unsleeving, crimping, connecting to the terminals. Shield of the cables shall be properly earthed at SCADA end. Cable glands (metallic, single compression), cable lugs (appropriate type/size), SS304 bolts/nuts/plain washers and Zinc/epoxy coated spring washers etc as applicable shall be in vendor scope of supply. (7) Vendor shall submit details of cable glands/lugs/ties/hardware (Make, part number, size, quantity etc) for BHEL/BEL approval during detailed engineering. Glands shall be of COMET make or other reputed equivalents subject to BHEL/BEL approval. Cable lugs shall be of Dowell/ 3D/ Braco or other reputed equivalents subject to BHEL/BEL approval. (8) All tools/accessories such as crimping tools etc required to carry out the termination shall be within scope of vendor.
6.10	Termination of 1Cx300 DC power cables and RS485 cables at SMBs (1) Cables of 1Cx300 (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 cable glands that are also supplied by BHEL along with SMBs. (3) Cable lug shall be bimetallic (Cu/Al) and shall be in vendor scope of supply. Make shall be Dowell, 3D, Braco or equivalent subject to approval of BHEL/BEL during detailed engineering. (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. Cable glands 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/BEL approval during detailed engineering. Shield of the RS485 cables shall be suitably earthed at SMB end.
6.11	Earthing for solar array MMS structures and SMBs The solar array MMS structures, SMBs and various electrical equipments installed by the vendor shall be provided with appropriate earthing for protection against faults as guided by IEC 60364. The earthing system shall be designed with consideration of the soil resistivity of the project site. Unless otherwise specified, earthing system shall be in accordance with IS: 3043 and IEEE 80, Indian Electricity Rules, Codes of practice and regulations existing in the location where

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the system is being installed.

The permissible system fault power level also shall be kept in consideration while designing the earthing system. Each array structure of solar PV yard, string monitoring boxes, other electrical equipments of module cleaning system viz pumps/ switchboards etc and all other metallic bodies shall be grounded properly as per IS 3043-1987 and Indian electricity act / IE Rules.

The earthing electrodes for solar array shall be of 3m minimum long, 50 mm minimum diameter, perforated GI pipe, chemical compound filled, double walled. Each electrode shall be connected to the solar array earth mat grid. For each electrode, earth chamber shall be constructed using brick masonry. Electrodes shall be of reputed brand such as Ashlok, Balaji Metacast Industries or any other equivalent subject to BHEL/BEL approval during detailed engineering.

Earth chamber shall have features as follows:

- (a) Square sized with 450 x 450mm minimum inner opening. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc.
- (b) Brick wall thickness all around = 230mm minimum
- (c) Depth of chamber = 500 mm minimum below FGL.
- (d) Projection of chamber above FGL = 150mm minimum
- (e) Top of electrode shall have minimum clearance of 100 mm below cover plate.
- (f) Cover plate, cast iron of 5mm minimum thickness, square shaped to fit the opening of chamber, painted with red oxide and two coatings of black paint both sides.
- (g) Cover plate shall have suitable lifting hooks and padlocking arrangement.
- (h) Both the outer and inner walls of the brick wall shall be plastered and painted as per relevant clauses of “General civil works” of this specification.
- (i) Supply and installation of all materials 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. Backfilling soil to be placed over buried conductors shall be free from stones and harmful mixtures. Backfilling shall be carried out in layers of 150 mm. Backfilled surface shall be well compacted.
- (2) Outer grid shall be with GI flat 25x3 mm minimum
- (3) Inner branches (along the solar array rows) with GI flat 25x3mm minimum
- (4) Inner branches shall be welded to outer grid
- (5) Electrode shall be bolted to a horizontal GI flat 25x3 that in turn bolted (M10 minimum) to two GI flat 25x3 raisers on either side of horizontal flat. Raisers shall be connected to outer grid of earth mat by way of welding.

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	(6) Number of electrodes for solar array shall be decided based on earth mat design to obtain interconnected grid earth resistance less than 1 Ohm in solar array field alone. (7) Earth mat design/ calculations as per IS: 3043 and IEEE 80, Indian Electricity Rules along with layout drawing for complete solar array shall be submitted for BHEL/BEL approval during detailed engineering. 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 interconnected one another using GI flat 25x3 mm minimum. Both ends shall be bolted (M10 minimum). Earthing of SMBs shall be as follows: (a) Body of SMB structure shall be earthed using GI flat 25x3 mm minimum; Bolting on SMB structure end (M10 minimum) and welding on inner branch of earth mat grid. (b) 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. General points: (a) All items related to earthing viz electrodes, GI flats, hardware etc shall be in vendor scope of supply. (b) GI bolts, nuts, plain washers shall be used. Spring washers shall be zinc/epoxy coated. (c) Welding for GI flats shall be carried out 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. (d) Resistance of welded joint shall not be more than that of GI flat. (e) Welds shall be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection. (f) 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. (g) Other applicable standards: - IS: 2629: Recommended practice for hot dip galvanizing of iron and steel - IS: 2633: Method for testing uniformity of coating on zinc coated articles - IS: 6745: Methods for determination of mass of zinc coating on zinc coated iron and steel articles. - IS: 513: Cold rolled low carbon steel sheets and strips - IS: 3063: Fasteners single coil rectangular section spring washers In compliance to Rule 11 and 61 of Indian Electricity Rules, 1956 (as amended up to date), all
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	non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.
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6.12	Lightning arrestor (ESE) system for protection of solar array/ inverter/control rooms/ plant boundary fencing Supply, installation and commissioning of lightning arrestor (ESE) system for protection coverage of solar array, inverter rooms, main control room and plant boundary fencing shall be in vendor scope. A. Lightning arrestor (ESE) with mast, counter and test link 1) Solar array shall be protected from direct lightning stroke with Early Streamer Emission (ESE) air terminal as per NF C 17-102 (latest revision). Vendor scope of lightning protection coverage shall also include inverter rooms, main control room and the complete boundary fencing. 2) Location and layout of ESE terminal (mounted on masts of appropriate size/height) shall be in such a manner that it does not cast shadow on the PV Modules during 08:30 AM to 04:30 PM. Quantity and locations of ESE air terminals (masts) shall be decided during detailed engineering. Make shall be ABB/ LPI Stormaster or other reputed equivalent subject to approval of BHEL/BEL approval. Design calculations for protection coverage, drawing showing layout with arrestor locations/ protection coverage/ bill of materials for the complete system shall be submitted for BHEL/BEL approval. 3) ESE air terminal shall be type tested in any national/international approved lab for advance triggering time (ΔT). Lightning Impulse current test and type test report shall be submitted for BHEL/BEL for approval. 4) Each ESE air terminal shall be provided with separate earthing termination and test link for equipotential bonding of lightning protection system as per OEM guidelines/ NFC 17 - 102. Each ESE air terminal shall be equipped with lightning stroke counter to be fixed at suitable height in serial on the down conductor. 5) Mast of ESE air terminal shall be erected on isolated RCC foundation. Suitable stay/guy wires shall be used to support the mast of ESE terminal against the wind. Drawing of foundation with design load calculations shall be submitted for BHEL/BEL approval. B. Down Conductors 1) Down conductors of GI 25x6 mm minimum shall be used. These shall be as straight as practicable and shall follow a direct path to earth electrode. 2) Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be inaccessible to interference. Other than the direct connection to the earth electrode, no other connections shall be made below a test point. 3) All joints in the down conductors shall be welded type.
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	4) Lightning conductors shall not pass through or run inside GI Conduits. 5) Testing link shall be made of galvanized steel of size 25x6 mm. 6) Pulser system for lightning shall not be accepted. C. Earthing electrodes and chambers for lightning arrestors: 1) Electrode shall be chemical earthing type of Ashlok or Balaji metacast or any other reputed equivalent. These shall be the same type as those used for solar array earthing. 2) Three earth chambers shall be provided for each lightning arrestor. 3) Earth chamber shall have features as follows: (a) Square sized with 450 x 450mm minimum inner opening. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc. (b) Brick wall thickness all around = 230mm minimum (c) Depth of chamber = 500 mm minimum below FGL. (d) Projection of chamber above FGL = 150mm minimum (e) Top of electrode shall have minimum clearance of 100 mm below cover plate. (f) Cover plate, cast iron of 5mm minimum thickness, square shaped to fit the opening of chamber, painted with red oxide and two coatings of black paint both sides. (g) Cover plate shall have suitable lifting hooks and padlocking arrangement. (h) Both the outer and inner walls of the brick wall shall be plastered and painted as per relevant clauses of “General civil works” of this specification. (i) Supply and installation of all materials shall be in vendor scope. D. General points: The lightning conductor must ensure three zone protection level.
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7.0 Technical specification for AC side design/ supply/ installation and plant commissioning

7.1	Installation of electrical panels within inverter rooms and main control room (1) Panel installation within the two inverter rooms: Vendor shall organize necessary resources such as labour, cranes, hydra, forklifts, transportation trucks / trolleys and other accessories for movement and positioning of the panels as below (Quantities mentioned are per inverter room): (a) 1250kW PCU panels with external ducts/ fans : 2 sets (b) 33kV VCB panels: 2 incomers + 1 outgoer (c) Distribution boards (wall mounted): SDB (AC supply), IRDB (room utilities), UPSDB AC, UPSDB DC, LDB (plant lighting): 1 No each + any extra boards as required (d) SCADA panel: 1 No (e) UPS with battery bank: 1 Set (f) Fire alarm system: 1 set (2) Panel installation within main control room: (a) 33kV VCB panels: 2 incomers + 1 outgoer + 1 Aux outgoer + 1 Bus PT (b) ACDB main panel: 1 set (c) 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 (d) SCADA panel: 1 No (e) HMI SCADA control desk with PCs and accessories: 1 set (f) UPS with battery bank – 1 Set (g) FCBC battery charger – 1 No (h) Battery bank for FCBC backup – 1 No (3) 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 vendor drawings approved by BHEL/BEL during detailed engineering. (4) PCUs, VCB panels shall be placed on cable trench of inverter/ main control rooms, with cable entry openings in the panels to match the cable trench provisions. (5) PCUs shall also match the position of PCU ducts/fans. (6) 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.
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7.2	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 inverter rooms/ main control room for laying DC/ LT/ 33kV HT/ control/ instrumentation/ OFC cables etc as per “Cable installation methodology” section of this specification. Cable trays shall be ladder type with horizontal corner bend pieces. Trays shall have 750mm minimum width, 3mm minimum thickness and appropriate height. Drawings/ make/ part number of these shall be submitted for BHEL/BEL 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/ OFC 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 DC/LT/HT/control/OFC category wise. At the cable entry point, RCC hume pipes of NP3 grade as per IS: 458 (2003) of appropriate diameter and length shall be fixed below the plinth beam of the room so as to route the multiple cable bunched. (2) Such hume pipes shall be in vendor scope of supply. Vendor shall make appropriate assessment of size of hume pipe considering 50% max allowed filling of the pipe by the cables and cable conduit pipes. Layout drawings of hume pipes shall be submitted for BHEL/BEL approval during detailed engineering. Fixing of hume pipes below the plinth level is in BHEL scope. (3) Cables (DC, LT, HT, control, instrumentation, OFC etc) shall be laid on cable trays in separate tiers with appropriate spacing as per IS: 1255. (4) Control/ data/ instrumentation cables that run from inverter rooms to marshalling box of inverter transformers shall be routed through HDPE DWV conduit pipes of appropriate size. These pipes shall in turn be routed through the above hume pipes below plinth level. (5) Cables shall be dressed using appropriate cable ties at appropriate intervals to ensure firmness of their position over the trays. (6) 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
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	of cables. (7) All cable entry openings of conduit pipes, after laying/ termination of the cables, shall be sealed using appropriate sealant to ensure water proof tightness. (8) All cable accessories such as RCC hume pipes, cable conduits/pipes, cable ties, trefoil clamps, sealants etc for the above purpose shall be in vendor scope of supply. (9) 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/BEL during detailed engineering.
7.3	Supply, laying, termination of LT/HT/aux supply cables in inverter/ main control rooms (1) For all electrical panels viz PCUs/ VCB panels, UPS/ battery bank /DB boards and inverter transformers of the inverter rooms, laying and termination of DC/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 banks / DB boards of main control room, laying and termination of LT/HT/Aux power cables within the room and up to the point connecting to the outdoor metering yard shall be in vendor scope. Also, for connecting to the outdoor auxiliary transformer in vendor scope. (3) All cables other than those listed under section “BHEL scope” of this specification shall be in vendor scope of supply. (4) All aux cables shall be in vendor scope of supply. Sizing shall be as per design calculations. Vendor shall submit the make/ GTP etc for BHEL/BEL approval during detailed engineering. (a) Aux transformer to ACDB panel in main control room: 3.5 Core, 1.1kV, Al, XLPE insulation, armoured, PVC sheath, FRLS as per IS: 7098. (b) ACDB panel of main control room to SDB boards of main control room/ inverter rooms: 3.5 core, 1.1kV, Al, XLPE insulation, armoured, PVC sheath, FRLS as per IS: 7098. (c) All other aux power cables: Cu or Al as applicable, PVC insulation, armoured, PVC sheath, FRLS, IS: 1554. Refer section “Auxiliary AC/DC power supply system” of this specification. (d) Lengths of all above cables shall be assessed by vendor based on indicative layouts of inverter room/ main control room enclosed with the tender. (5) Cable glands, cable lugs, 33kV HT cable termination kits (indoor/ outdoor types as applicable), bolts, nuts, washers etc shall be in vendor scope of supply. Exception: cable glands, cable lugs, nuts and washers for PCU DC/AC sides in BHEL scope of supply. (6) For power terminations of Inverter transformer LV side, bimetallic (Cu/Al) lugs shall be provided by the vendor. Other lugs shall be Cu or Al as applicable. (7) Make of cable lugs: Dowell/ 3D / Braco or any other reputed equivalent subject to approval of BHEL/BEL. (8) Glands shall be nickel plated brass double compression for transformer power cables. For

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	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/BEL. (9) 33kV HT termination kits (indoor/ outdoor as applicable) shall be 3M/ Raychem or reputed brand subject to BHEL/BEL approval. HT termination shall be carried out by certified jointers. Credentials / certification of experience from 3M/ Raychem etc for the proposed jointers shall be submitted for BHEL/BEL approval during detailed engineering. (10) 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. (11) 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 torque settings prior to tightening. (12) All resources such as labour, machinery, tools and accessories to carry out the above electrical works shall be in vendor scope. (13) 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.
7.4	Supply, laying and installation of Control / data / instrumentation / OFC cables 1. BHEL shall supply the following SCADA related data communication cables (a) PCUs to SCADA panels in respective inverter/ control rooms (Ethernet/LAN cables) (b) Protection relays of VCB panels to SCADA in inverter/control rooms (Ethernet/LAN) (c) MFM meters of VCB/ACDB/FCBC panels to SCADA (RS485, 2Px0.5) (d) LAN cables within SCADA network (e) OFC cable from SCADA panels of inverter rooms to SCADA panel in main control room 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. All the other cables such as (i) control cables from inverter transformer marshalling boxes to relay circuits in VCB panels (transformer trip signals), (ii) control cables from inverter transformer marshalling boxes to SCADA (transformer alarm signals), (iii) control cables from SCADA panels to relay circuits in VCB panels (VCB on/off status, VCB close/open command signals), (iv) instrumentation cables from inverter transformer marshalling boxes to SCADA panels (4-20mA signals, WTI/OTI values) shall be in vendor scope of supply.

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	Control and instrumentation cables: - Control cable shall be 2.5 sq-mm minimum, copper conductor, PVC, armoured. Instrumentation cable shall be 0.5 sq-mm minimum, copper conductor, PVC, armoured. - All the cable installation accessories such as cable trays, cable conduits, cable glands, cable lugs, bolts, nuts, washers etc shall be in vendor scope of supply. - Cable laying and cable terminations shall be in vendor scope. Make shall be reputed brands subject to BHEL/BEL approval. - Design calculations for cable selection together with GTP/datasheet particulars, make etc shall be submitted for BHEL/BEL approval. Similarly, number of cores, length requirements shall be appropriately assessed by the vendor. - All necessary resources such as labour, tools and accessories required to carry out laying and termination works etc shall be within scope of vendor. OFC cable along with termination kits shall be in BHEL scope of supply. - Vendor scope includes (i) supply of permanently lubricated HDPE pipe of OD/ID = 32/26 mm minimum along with accessories (couplers, PP ropes, end caps, cable sealing plugs) and tools (cutters, spanners) for routing the OFC cable and (ii) laying of the pipe with the cable underground from inverter room SCADA panels to main control room SCADA panel. It shall be ensured that (i) only a max of 60% of inner space of the pipe shall be occupied by the cable, and (ii) appropriate installation method shall be adopted at site for routing the cable inside the pipe. - Vendor shall submit GTP/ make/ part number of the PLB HDPE pipe, accessories and tools for BHEL/BEL approval during detailed engineering. - Terminating the cables at both the ends shall be in BHEL scope. Vendor shall provide all necessary coordination/ assistance support required for this activity at site. 3. Vendor shall lay and terminate the RS485 cables to SCADA panels in inverter / main control rooms from (a) String monitoring boxes in solar array field, (b) MFM meters of VCB panels, (c) MFM meters of ACDB panel, (d) Trivector meters of ACDB panel, (e) ABT meters (3 Nos: main, check, standby) at 33kV evacuation end of plant side, (e) Fire alarm panels and (f) Weather monitoring station. These cables shall be laid between the panels of respective inverter/ main control rooms. RS485 cables shall be routed through HDPE pipe of PE63 grade, pressure rating PN6, nominal diameter (OD) 32mm minimum as per IS: 4984 (1995). It shall be ensured that a max of 60% of inner space shall be occupied by the cables. HDPE pipe shall be in vendor scope of supply. Vendor shall submit GTP/ make/ part number of the HDPE pipe, accessories and tools for BHEL/BEL approval during detailed engineering.
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	4. Vendor shall lay and terminate the Ethernet cables between PCUs and SCADA in inverter rooms. 5. 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.
7.5	Erection of 33kV transformer yards attached to inverter rooms and auxiliary transformer (1) Each of the two inverter rooms is provided with an outdoor 33kV transformer yard on either side of the room. Vendor scope includes erection of these yards. (2) Vendor shall erect the aux transformer 150kVA minimum, 33kV/433V at an appropriate location within the 33kV metering yard attached to main control room. Note: All other aspects of metering yard such as four-pole/ two-pole structures, CT/PT/LA/Isolators, yard fencing, gate, stone jelly/ gravel etc shall be in BHEL scope. (3) Vendor shall design and construct RCC foundations for the inverter transformers and auxiliary transformer as per relevant clauses of “General civil works” section of this specification, geotechnical investigation report (soil report), the transformer weight / dimensions etc. In addition, following points shall be taken into account. - Approximate total weight of inverter transformer ~9,000 Kg - Approximate total weight of auxiliary transformer ~ 1700 Kg - Soil report is enclosed with tender. - Foundation structure shall include appropriate layers of PCC, sand, boulders, RCC portions etc as per design requirements. - Foundation depth shall be as per design requirements. - Foundation pedestal height above the finished ground level 500 mm minimum. - Pedestal shall be finished with cement plaster and water proof cement paint of BHEL approved colour all around. (4) Individual pits of the transformer, oil collection pits, transformer track rails, stone gravels, fencing foundation, fencing posts, GI chain link fence, steel gates, finishing works such as plastering/ painting etc shall be as per relevant clauses of the “General civil works” section of this specification and as per relevant IS standards / CBIP/ CEIG requirements etc. All items shall be in vendor scope of supply. (5) Hardware arrangements (transformer track rails, angles, steel bolts, plates, nuts, washers etc), which will be part of foundation pedestal, shall be as per transformer GA drawing that will be provided by BHEL during detailed engineering. (6) Vendor shall erect the transformers on RCC foundation as per transformer GA details. Vendor scope of I&C of transformers shall include: - Movement of transformers and all accessory parts such as conservators, radiators, cable boxes, marshalling boxes, connecting pipes, hardware etc from storage yard.

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	b. Placement of transformer on foundation pedestal c. Assembly of transformer parts d. Cable laying and terminations at LV/HV/Marshalling boxes of transformers e. All activities applicable to oil filling and filtration including measurement of oil BDV and PPM in NABL accredited laboratory. Oil filtration shall be carried out at site to such an extent as to obtain the desired BDV (>60 kV) and PPM (< 15ppm) values. Filtering machine of appropriate heating/ vacuum/ oil circulation capacity shall be arranged at site. Credentials of filtration agency with above details of the machine shall be submitted for BHEL/BHEL approval during detailed engineering. f. Testing of transformers as per “pre-commissioning checks” section of this section. (7) Vendor shall construct RCC cable trench for laying of cables from inverter room panels to inverter transformers. Laying shall be in vertical tiers of ladder type GI cable trays of appropriate width/ thickness that shall be supported on MS angles (red oxide coated / black painted) that in turn shall be anchored suitably to the trench wall. RCC lids with lifting handles shall be provided. Lids shall have uniform width/ thickness so as to ensure proper aesthetic alignment. Top level of RCC trench (without lid) shall be 150mm minimum above the FGL (inclusive of stone gravels) to prevent water entry into the trench. Bottom surface of the cable trench shall be sloped down away from wall of inverter room/ main control room to prevent water stagnation. A water collection RCC pit of 1mx1m x 300mm depth shall be provided at the end of the RCC trench so as to facilitate removal of water by pump upon accumulation. All items shall be in vendor scope of supply. Cable entry from the room into the transformer yard shall be through RCC Hume pipes of NP3 grade and appropriate size to ensure filling of the pipe with cable only up to a max of 60%. (8) Such RCC trench, GI cable trays, MS supports etc for routing the LV/HV/control cables from main control room to aux transformer and also to metering yard CTs/PTs shall be in BHEL scope of supply and erection. However, laying of the cables on the cable trays shall be in vendor scope. Cable ties for dressing the cables on the trays shall be in vendor scope of supply. Also, RCC hume pipes of NP3 grade and appropriate size for entry of cables from the room into the cable trench shall be in vendor scope of supply. (9) After installation of transformers at the 33kV yards of inverter/ main control rooms, 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 cutting/ 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. Also, hume pipes shall be provided at appropriate locations along the periphery of transformer yard fencing for draining out water from the yard. RCC Hume pipe of NP3 grade and appropriate size shall be in vendor scope of supply. (10) Vendor shall provide applicable earthing connections to the transformers, fence / gates/
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	cable trays etc in the yard as per relevant clauses under the “Earthing system” section of this spec. (11) 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. (12) Vendor shall submit (a) GA drawings / design calculations of transformer foundations/ pits/ oil collection pits, (b) GA/layout/scheme of transformer yard (with appropriate overall size/ dimensions), (c) GA/BoM of fence, (e) GA/BoM of gate, (f) GA for layout/ cross section of RCC cable trench with cable trays, (g) design calculations of aux transformer foundation, (h) GA for location/layout of aux transformer etc for BHEL/BEL approval during detailed engineering.
7.6	Underground cable trenches and laying of HT/LT/Control/Instrumentation/OFC cables Applicable/relevant clauses under “Cable installation methodology” section of this specification shall be adopted for burying the cables underground. Accordingly, following cables shall be laid underground by way of direct burying using appropriate layers of sand (75mm each layer), brick layers, refill soil etc to appropriate excavation depth below the ground level as per relevant Indian standards (IS:1255), Indian Electricity rule, CEIG/CBIP norms etc related to cable installation practices and procedures. HT cable shall be at 1000mm minimum depth from ground level, whereas LT cables in middle layer, and control/ instrumentation/ OFC cables in top layer. 1) AC aux supply cables from ACDB panel in main control room to DB boards in inverter rooms. 2) AC aux supply cables from DB boards of the nearest inverter/ main control room to (i) the plant lighting poles, and (ii) submersible bore well pumps / booster pumps. 3) AC aux supply / Instrumentation / data communication cables, as applicable, from weather monitoring station data logger to SCADA room in main control room. 4) OFC cables (in PLB HDPE pipes) from SCADA in main control room to SCADA panels of inverter rooms. 5) HT cables (33kV) from inverter rooms to main control room 6) Any other cables (other than the above) to meet the underground cable laying requirements. Vendor shall avoid jointing of cut pieces of LT/HT cables to form the required length between two termination ends. However, in case of unavoidable situations due to longer routes, vendor shall join the cut pieces using LT/HT straight through joints of appropriate size. Jointing shall be carried out by certified jointers whose credentials shall be submitted for BHEL/BEL approval during detailed engineering. Make of jointing kits shall be 3M/ Raychem or reputed equivalent subject to BHEL/BEL approval. Make/ GTP/ Model number shall be

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	submitted for BHEL/BEL approval. Also, cable trench layouts and cross section drawings shall be submitted to BHEL/BEL for approval.																																																	
7.7	Specification of auxiliary transformer 200kVA, 33kV/433V, Dyn11, Outdoor, ONAN 1.0 Technical parameters and specifications: <table border="1"> <thead> <tr> <th>#</th><th>Technical parameter</th><th>Specification</th></tr> </thead> <tbody> <tr> <td>1</td><td>Transformer type</td><td>Outdoor, oil-immersion type</td></tr> <tr> <td>2</td><td>IP class</td><td>Transformer, including cable box and marshalling box shall be of IP55</td></tr> <tr> <td>3</td><td>Type of cooling</td><td>ONAN</td></tr> <tr> <td>4</td><td>Governing Standard</td><td>IS: 2026</td></tr> <tr> <td>5</td><td>Rating in KVA</td><td>150 kVA minimum (Exact rating requirement to be determined by the vendor based on auxiliary load calculations and to be approved by BHEL/ BEL during detailed engineering).</td></tr> <tr> <td>6</td><td>No. of phases</td><td>3</td></tr> <tr> <td>7</td><td>Frequency</td><td>50 Hz, +/- 3%</td></tr> <tr> <td>8</td><td>HV winding</td><td>33kV, 3-Ph, with Delta connection</td></tr> <tr> <td>9</td><td>LV windings</td><td>433V, 3-Ph, with Star connection</td></tr> <tr> <td>10</td><td>Winding material</td><td>Electrolytic grade copper for both HV and LV windings</td></tr> <tr> <td>11</td><td>Winding Insulation</td><td>Class A</td></tr> <tr> <td>12</td><td>Neutral on LV side</td><td>Neutral terminal shall be brought out separately to facilitate earthing connections.</td></tr> <tr> <td>13</td><td>Vector Group</td><td>Dyn11</td></tr> <tr> <td>14</td><td>Short circuit withstand time (thermal)</td><td>2 sec.</td></tr> <tr> <td>15</td><td>% Impedance</td><td>4.5% as per IS: 2026</td></tr> </tbody> </table>		#	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: 2026	5	Rating in KVA	150 kVA minimum (Exact rating requirement to be determined by the vendor based on auxiliary load calculations and to be approved by BHEL/ BEL during detailed engineering).	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	4.5% as per IS: 2026
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	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. 3.5C, 1.1kV grade, aluminum conductor, armoured, XLPE insulation, PVC sheath as per IS: 7098 will be used. Cables and accessories in BOS vendor's scope. Cable size and no. of runs shall be decided by vendor.
	19	Cables and accessories	HV & LV Cables, termination kits (for HV), cable lugs (Dowell make), double compression nickel plated brass cable glands (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 BOS vendor.
	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.

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	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 ⁰ C, 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 ⁰ C, UPF	Minimum 98.5% at full load (100%). Efficiencies at 75% and 50% loads to be indicated by vendor.
	30	Regulation at full load, 75 °C	< 2 % for UPF For 0.8 PF lagging, to be indicated by vendor.
	31	Harmonics	Shall be designed to suppress harmonics especially 3 rd & 5 th .
	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

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	39	Constructional features	As per relevant clause of this specification
	40	Fittings and accessories	As per relevant clause of this specification
2.0 Constructional features and details of transformer components			
2.0	Transformer shall be constructed in accordance with IS: 2026 and IS: 3639 or equivalent international standard. All materials / components used shall be of best quality and most suitable for working under the conditions specified. These shall withstand the variations of temperature and atmospheric conditions, overload, over-excitation, short-circuits as per specified standards without distortion, deterioration, without development of stresses in any part and also without affecting strength and suitability of the various parts for the work that they have to perform.		
2.1 Tank			
2.1.1	The transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and cover shall be of welded construction and there should be provision for lifting by crane.		
2.1.2	Suitable inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided in the tank cover. The inspection hole(s) shall be sufficient size to afford easy access to the lower ends of the bushings, terminals etc.		
2.1.3	The exterior of tank and other steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather-resistant nature, preferably of distinct colour from the priming and finish coats. The final coat shall be of a glossy, oil and weather resistant non-fading paint of specified shade.		
2.1.4	The interior of the tank shall be cleaned by sand blasting and painted with two coats of heat resistant and oil insoluble paint.		
2.1.5	Steel bolts and nuts exposed to atmosphere shall be galvanized. All bolted connections to the tank shall be fitted with suitable oil-tight gaskets that shall give satisfactory service under the operating conditions for complete life of the transformer, if not opened for maintenance at site.		
2.1.6	The tank together with radiators, conservator, bushings and other fittings shall be designed to withstand the following conditions without permanent distortion: (i) Full vacuum of 760 mm of Hg, for filling with oil by vacuum. Internal gas pressure 0.35 Kg/cm² (5 lbs/sq.in) with oil as at operating level.		

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	(ii) The transformer shall have conservator tank of adequate capacity to accommodate oil preservation system and volumetric expansion of total transformer oil. The conservator shall be bolted into position so that it can be removed for cleaning purposes. (iii) The conservator shall be of single compartment type. The top of the conservator shall be connected to the atmosphere through a transparent type silica gel breather. (iv) The tank cover shall be suitably sloped so that it does not retain rain water. The material used for gaskets shall be cork, neoprene or approved equivalent.	
2.2 Core		
2.2.1	The magnetic circuit shall be of core type. The core shall be constructed from non ageing, cold rolled, super grain oriented silicon steel laminations (CRGO equivalent) to M4 grade steels or better.	
2.2.2	The insulation structure of the core to clamp plates shall be such that it withstand voltage of 2kV (rms) for one minute in air.	
2.2.3	Adequate lifting lugs will be provided to enable the core & windings to be lifted.	
2.3 Windings		
2.3.1	Windings shall be of electrolytic grade copper free from scales and burrs.	
2.3.2	Windings shall be subjected to a shrinking and seasoning process so that no further shrinkage occurs during service.	
2.3.3	Windings shall have uniform insulation.	
2.3.4	Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.	
2.3.5	The completed core and coil assembly shall be dried in vacuum and shall be immediately impregnated with oil after the drying process to ensure elimination of air and moisture within the insulation.	
2.3.6	Windings shall be made in dust proof and conditioned atmosphere. Vendor shall indicate those details of facilities (as available at the winding works) that will ensure meeting the requirement.	
2.4 Internal earthing		

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	2.4.1	The frame work and clamping arrangements of core and coil shall be securely earthed inside the tank by copper strip connection to the tank.	
	2.5 Bushings		
	2.5.1	Bushings shall be designed and tested to comply with the applicable standards. Bushings rated for 400A and above shall have non-ferrous flanges and hardware. Bushings shall be supplied with terminal connector clamp suitable for connecting the cables.	
	2.5.2	Neutral bushings of the star-connected LV winding shall be brought out to separate bushing terminals. The neutral bushings shall be provided on the tank at such a location that facilitates connecting earth conductor down to the ground level. Tank-mounted type support insulators shall be provided for supporting the neutral earthing bar in the specified section, along its run from the neutral bushing to ground level.	
	2.6 Cables boxes and disconnecting chambers		
	2.6.1	Cable boxes shall be supplied with gland plates having holes to suit cables provided.	
	2.6.2	Cable boxes / disconnecting chambers shall be provided with body earth terminals.	
	2.6.3	LV cable boxes shall be provided with necessary LV bushings, bus bars, bus bar supports for making cable terminations.	
	2.6.4	HV cable boxes shall be provided with necessary HV bushings and terminals for making cable terminations.	
	2.6.5	Cable boxes shall be provided with suitable gaskets to ensure the specified protection class requirement (IP55).	
	2.6.6	Cable boxes / disconnecting chambers shall be provided with necessary arrangements to prevent entry of rain water into the same.	
	2.6.7	Disconnecting chambers: (1) Disconnecting chambers shall be provided to enable the transformer to be removed without unsealing the cables or draining oil from the main tank. (2) Disconnecting chamber shall be air insulated and complete with seal-off bushings, removable flexible connectors / links and removable covers. (3) Phase-to-phase and Phase-to-ground clearances within the chamber shall be such as to enable either the transformer or cable to be subject separately to HV test. Clearances shall be subject to BHEL approval.	
	2.7 Transformer oil		



2.7.1	Transformers shall be supplied complete with transformer oil. The new insulating oil before pouring into the transformer shall conform to the requirement of IS: 335. No inhibitors shall be used in the oil. The oil samples taken from the transformer at site shall conform to requirements of IS: 1866.
2.7.2	10% extra oil, in non-returnable sealed containers, shall be sent along with main consignment to avoid any shortage of oil at the time of topping up of oil at the site. This oil quantity shall be over and above the specified mandatory spares requirement.

2.8 Fittings and accessories

Following fittings per transformer shall be provided. Vendor shall indicate compliance (Yes / No) for each line item. In case of non-compliance or deviation, vendor shall indicate and provide comments.

#	Nomenclature of fitting / accessory	Qty
1	Oil conservator with equalizer pipe and drain plug	1 set
2	HV cable box	1 set
4	LV cable box	1 set
6	Off circuit tap changing switch (OCTC) with operating knob, tap position marking and locking facility, with warning plate "Tap switch to be operated only with the transformer de-energized".	1 set
7	Neutral bushings for earthing of LV winding	1 No
8	Earthing terminals for cable boxes, tank etc.	2 Sets
9	Radiators (detachable type) with drain value at the bottom, relief valve at the top, air plug, shut-off valves at every point of connection to the tank and lifting lugs.	4 sets
10	Silica gel dehydrating breather with oil cup	1 set
11	Prismatic / toughened glass oil level gauge for transformer and tap changer chamber with min and max markings.	1 set
12	Explosion vent (double diaphragm) with sight glasses and equalizing pipe connection to conservator	1 set



13	Inspection window with cover	1 set
14	Cover lifting lugs / eyes	2 Nos
15	Tank lifting lugs / eyes for the entire transformer	4 Nos
16	Bi-directional flat rollers	4 sets
17	Base channel with towing holes / lugs	2 sets
18	Air release hole with plug	1 No
19	Oil filling hole with cap	1 No
20	Top filter valve with threaded male adapter (blanking plug)	1 No
21	Drain cum sampling valve	1 No
22	Rating and diagram plates made of stainless steel or anodized aluminium.	1 No
23	Terminal marking plates	1 Set
24	Stem type thermometer mounted on top of tank	1 No

3.0 Inspection and testing of transformers at vendor works

3.0	Vendor shall provide inspection call to BHEL for the type and routine tests. Prior to the call, vendor shall submit the routine test results as per Manufacturing Quality Plan (MQP) for scrutiny of BHEL/BEL/SECI.
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4.0 Tests

4.1	Routine Tests: As per IS: 2026.
4.2	Type Tests (a) Temperature rise test as per IS: 2026 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/BEL/SECI. In case extra charges are required, the same shall be indicated separately in the offer on per-transformer basis. This temperature rise test shall be carried out at a tap corresponding to maximum losses as per IS: 2026. Test report shall be furnished to BHEL. (b) Valid type test report for other type tests on similar rating transformers shall be submitted during detailed engineering.

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	5.0 Documents to be submitted after receipt of purchase order	
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7.8	Auxiliary AC/DC power supply system Vendor shall establish an auxiliary AC supply system for (a) various utility power consumption purposes such as inverter room / main control room lights, ceiling fans, exhaust fans, bore well pumps, booster pumps, plant lighting, air-conditioner, other electric appliances, auxiliary power supply to PCUs, VCB panels, transformers etc and also, for (b) powering the battery chargers that in-turn charge the battery banks for 110V DC supply. Vendor shall submit detailed SLD diagram of Aux AC/DC system with ELR/CBCT, MCCB, MCB types (TPN, DP, SP)/ Amp/kA ratings for incoming/ outgoing feeders for various electrical loads/ utilities for BHEL/BEL approval during detailed engineering. The system shall comprise of following items: (a) An auxiliary transformer (1 No) 150kVA minimum , 33kV/433V, Dyn11, Outdoor, Oil-	

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	immersion / ONAN type shall be installed in the 33kV metering yard attached to main control room. Supply and installation of aux transformer including RCC foundation, erection of transformer, all necessary cable terminations, cable installation and cable interconnections with VCB panel (on HV side) and with ACDB panel (on LV side) shall be in vendor scope. Both the HV (33kV) and LV cables shall be in vendor scope of supply. (b) ACDB floor-mounted panel, 1 No (fed by 3ph, 4-wire 433V auxiliary transformer supply) distributes the AC power to various utility applications in main control room and inverter rooms. The panel shall be supplied, installed and commissioned in main control room by the vendor. It shall have incoming feeder supply from aux transformer and outgoing feeders for main control room utility and inverter rooms. Incoming feeder as well as each of the outgoing feeders shall have separate MFM meter with RS485 communication feature to facilitate SCADA connections. (c) Battery bank, Float-cum-boost charger, UPS in main control room: Vendor shall supply, install and commission 1 No each of Battery bank, Float-cum-boost charger, UPS in main control room. 1. Battery bank shall be VRLA/MF stationery, sealed type, 110V DC, ~100Ah at 8 hours rate of discharge, IS 1651-1979, performance as per IS:8702, nominal cell voltage 2V, 55 cells, plastic resin/ ABS/ PP container, epoxy coated exhaust fans to remove the gas emissions, suitable battery rack/stand with painted steel sections. Battery bank is for backing up the FCBC panel. Exact Ah sizing shall be finalized during detailed engineering for which calculations shall be submitted for BHEL/BEL approval. 2. Float-cum-boost-charger with boost current (25A) and boost voltage (135V): Battery charger as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC Batteries while supplying the DC loads. The chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C. Battery chargers shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost charging. During automatic boost charging, the Battery chargers shall operate on constant current mode. Charger shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. LED indications with alarm annunciation on the panel for Mains ON, Float charger AC ON, Float charger DC ON, Boost charger AC ON, Boost charger DC ON, AC Mains Fail,
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	Float charger DC fail, Boost charger DC fail, DC earth fault, SCR fuse fail, Filter fuse fail, Blocking diode fail, Battery under-voltage, Battery over-voltage, Charger DC overload. LED indications for various parameters: 3-ph AC input voltage, boost/float/trickle currents, charge/discharge currents, DC output voltage/current, Battery leakage current etc. Selector switches for Float Auto/Manual, Boost Auto/Manual, Float/ Boost/ Auto-boost selector switches. Also, Voltmeter / Ammeter selector switches as applicable. Constructional features of the panel shall be as per clause “LT switchgear panels” Feeders as below: (i) Incoming feeder – 3ph from ACDB panel in control room (ii) Outgoing feeders - To DCDB board - To CRDB board - To LDB board - To PDB board - To UPS panel 5kVA - At least two spare feeders - 3. UPS panel, 5kVA with VRLA battery back up - Incoming feeder – from either ACDB panel or Battery charger panel - Outgoing feeder – To UPSDB board - At least one spare feeder - Make shall be Hitachi, Consul Neowatt or reputed equivalent subject to BHEL/BEL approval - Constructional features of the panel shall be as per clause “LT switchgear panels” (d) UPS/BC/Battery bank panel : 1 set each for the two inverter rooms: Vendor shall supply, install and commission UPS/BC/Battery bank panel 5kVA with VRLA battery bank ~100Ah minimum at C₈ rate with 2 hours backup. Exact Ah sizing shall be finalized during detailed engineering for which calculations shall be submitted for BHEL/BEL approval. - Incoming feeder – from main supply DB (SDB) of inverter room - Built-in outgoing feeders for both AC (230V) and DC (110V) Note: In case DC output features are not available, separate AC-DC converter pack with input 230V/ output 110V DC shall be provided. - Outgoing AC feeder to be connected to UPSDB board - Outgoing DC feeder of UPS (or) AC-DC converter to be connected to DCDB
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	board - Construction features of the panel shall be as per clause “LT switchgear panels” (e) Following DB boards (1 No each, wall mounted) for application in main control room shall be in vendor scope of supply, installation and commissioning: 1. DCDB for 110V DC supply to 33kV VCB breaker panels 2. UPS DB for 230V AC UPS supply to SCADA, ABT metering panels (BHEL scope), weather monitoring system, fire alarm system, emergency loads 3. CRDB (Control room DB) 230/415V for room utilities including SCADA room air conditioner 4. LDB (Lighting DB) 230V/415V for outdoor plant lighting system (street lights) 5. PDB (Power DB) 230V/415V for submersible/ booster pumps, CCTV system, 33kV metering yard, 33kV VCB breaker panels (f) Following DB boards (1 No each per room, wall mounted) for the two inverter rooms shall be in vendor scope of supply, installation and commissioning: 1. SDB (main supply DB) with incomer feeder supply from ACDB of main control room, outgoing feeders for PCU duct fans (4 Nos), UPS/BC/Battery panel, Inverter transformers (2 Nos), IRDB, PDB, HT panels, submersible pumps / booster pumps etc 2. IRDB (Inverter room DB) 230/415V for room utilities 3. UPSDB 230V UPS supply for PCU control circuits (4 Nos), SCADA panel, fire alarm system panel, emergency loads 4. DCDB for 110V supply for 33kV VCB breaker panels 5. LDB (lighting DB) for outdoor plant lighting system (street lights) Note: AC/DC DB boards shall be designed considering availability of space/ footprint requirements. (g) 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. Further, any extra DB boards to meet functional requirements of Aux AC/DC system shall be provided by the vendor. (h) Detailed constructional specification of the panels viz: ACDB panel, UPS/FCBC, DB panels/boards etc shall be as per separate clause “LT switchgear panels”. Where standard product is proposed for wall-mounted board, approval for the reputed brand such as Legrand, Siemens, Schneider etc shall be obtained from BHEL/BEL. (i) DB boards shall be provided with incoming/ outgoing ELR with CBCT / ELMCB/ CBCTMCCB/ MCB of types TPN/ DP/ SP as applicable (based on rating and load requirements) with spare feeders as shall be approved by BHEL/BEL.
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	(j) Design, supply and installation of all the above items including all necessary cable terminations/ installation shall be in vendor scope. (k) Vendor shall submit the design calculations (battery, FCBC, UPS sizing etc), GA drawings, GTP particulars, Bill of materials, Make, Model / Part number etc for all the above items as per relevant IS/IEC standards for BHEL/BEL approval during detailed engineering.
7.9	LT switchgear panels The LT switchgear panels (ACDB, DCDB etc wherever applicable) shall be designed as per the relevant IS codes and as per the approved design for the panel. All the parts of the panels must be rated as per the relevant rated voltage level. All the panels must have multifunction meters (MFM) flushed with the surface of the panels. The ACDB panels in main control room shall be rated for the maximum output of the Aux transformer feeding the system. Similarly, ACDB/DCDB boards in inverter rooms shall be rated for the respective capacity on pro-rata basis. The short circuit withstand rating (1 sec) at rated voltage of the switchgear shall be relevant to the existing electrical system short circuit ratings. (1) LT switchgear panels (Construction) (i) Single front / compartmentalized, modular design, degree of protection IP52 with provision of extension on both sides. (ii) Incomer feeders: mains incomer - Electrically operated draw out type Air Circuit Breakers (ACBs)/ Vacuum Circuit breakers (VCBs), as applicable. (iii) Outgoing feeders: Moulded Case Circuit Breakers (MCCBs)/ electrically operated draw out type Air Circuit Breakers (ACBs) / Vacuum Circuit Breakers (VCBs), as applicable. (iv) The colour finish shade of switchgear enclosure for interior shall be glossy white & for exterior it shall be light grey, semi glossy shade 631 of IS: 5. if a different exterior shade is desired by the Employer, the same shall be intimated to the supplier. (v) The LT switchgear panel shall be fabricated out of CRGO sheet steel; 2 mm thick for the outer shall all-round. The internal walls and separators shall be of 1.6 mm thick CRGO sheet steel (vi) The gland plates shall be 3 mm thick (2) Control Circuit a) Air Circuit Breaker spring charge motor – 230 V AC, 1 phase b) Moulded Case Circuit Breakers – 230 V AC, 1 phase c) Space heater, sockets, etc. – 230 V AC, 1 phase d) Control supply for breaker closing / tripping - 110V DC e) Indications, annunciation – 110V DC

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	(3) Bus Bar & Cable Cavity (a) The material for main bus bars and tap off bus bars shall be electrolytic grade aluminium with properly colour coded HR PVC sleeved insulation. (b) Bus bars shall be suitable for short circuit rating and current suitable for all connected load. (c) Cable entry for incoming and outgoing cables shall be from Bottom. (d) A suitable gland plate shall be supplied for termination of power, control and instrumentation cables. (e) Whenever feeders are housed in multi-tier configuration, these tiers shall be segregated by sheet metal barriers. (f) Earthing: Earthing bus bar shall be terminated at both ends of the switchgear to suit the connections to outside earthing conductor. All components inside the module are required to be earthed individually and are to be looped and connected to the horizontal earth bus. All the non-current carrying parts of the panels, e.g., enclosure, must be connected to earth as per the regulations. (4) Terminals (a) CT circuit - Isolating link type terminals with shorting facility (b) PT circuit – clip on type terminals (c) Spare contacts shall be wired up to terminal block. 10% spare terminals shall be provided for each module (5) Specific requirements (a) All ACBs/ MCBs, as applicable, shall be 4 pole, electrically operated, draw-out type, with closing coil, spring charge motor, trip coil, TNC switch for close and trip, manual closing and tripping push buttons, door I/L, test and service position micro switches, emergency P.B., safety shutters, etc. The circuit breaker shall be provided with anti-pumping feature. (b) ACBs/ VCBs, as applicable, shall be complete with microprocessor release and shall be provided with over current, short circuit and earth fault protections. (c) Minimum 10% spare feeders of each rating shall be provided in the switchgear. (d) All current transformers shall have 5/1A secondary and all meters shall be suitable for 5/1A operation. (e) All indicating lamps shall be of LED cluster type. ACB feeders shall be provided with ON, OFF, AUTOTRIP, SPRING CHARGED, TEST, SERVICE, TRIP CIRCUIT HEALTHY indications (f) All indicating instruments, including MFM, shall be flush mounting, Digital type and of standard size. (g) Window annunciator with hooter and accept, test, reset button shall be provided.
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	(h) Necessary auxiliary relays for contact multiplication shall be provided in the panel. (i) The maximum temperature of the bus bars, droppers and contacts at continuous current rating under site reference ambient temperature of 50° C shall not exceed 105° C. (j) Instrumentation: Switchgear instrumentation shall be provided as follows: 1. Mains Incomer – Voltmeter with selector switch 2. Ammeter with selector switch 3. Power Factor meter 4. Frequency meter 5. TVM + MD meter 6. Potential indicating lamps 7. Outgoing Feeders 8. Ammeter with selector switch on all feeders (6) General Technical Specifications (LT Switch gear Panel) (a) The panel shall be self-supporting, free standing, floor mounted, modular type with construction having degree of protection of IP 54 as per IS 2147. (b) The panel shall be fabricated from 14 SWG CRCA sheet steel for frame & load bearing surfaces. Partitions may be fabricated from 16 SWG CRCA if no components are mounted on them. (c) The panel shall be painted with 2 coats of primer after pre-treatment and 2 coats of Polyurethane / epoxy paint with shade as decided by the Owner (d) Stiffeners shall be provided at corners & between modules to make panel rugged. The stiffeners will necessarily be required for relay compartments or doors where heavy components are mounted. (e) The openable covers will be provided with lift off type hinges, quarter turn door locks and flexible copper wire for earth connection. (f) The panel shall be dust and vermin proof. Synthetic or neoprene gaskets shall be provided at all openings. (g) The panel shall be of dead front construction suitable for front operated and back maintained functioning. (h) Panel shall be provided with fluorescent lamp of 20W capacity operated by door operated limit switch. Panel shall also have space heaters and thermostat arrangement. (i) Panel shall be provided with 3 pin switch socket combined unit of 5 Amp capacity. (j) Lifting hooks shall be provided at the top of the panel. (k) The hardware components used in the panel shall be hot dipped galvanized. (l) The control components shall be fixed on mounting plate by drilling & tapping. (m) Al anodized legend plates shall be provided for all the components. For components mounted on front face, legend plate from inside shall also be provided. (n) Pre-treatment by 7 tank process shall be done before painting / powder coating the
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	panel. (o) Panel shall have provision of drawing pocket. (p) The panel shall be designed to ensure maximum safety during operation inspection, connection of cables and maintenance. Inside panel, checking and removal of components shall be possible without disturbing other units. (q) Cable entries will be from bottom. The opening of cable entry shall be covered by 3 mm thick gland plates. (r) The panel shall be provided with all necessary components / devices and instruments as per the recommended schematic diagram and functional requirements. (s) The components such as protective relays, auxiliary relays, push buttons, switches, instruments shall be flush mounted on the front side of a panel. (t) The control wiring shall be done with PVC insulated flexible copper wire. For CT secondary circuits 2.5 sq.mm wire shall be used. For control wiring 1.5 sq.mm wire will be used. (u) Earthing bus bar of suitable cross section shall be provided throughout the length of panel. (v) The panel shall be fully wired all the terminals shall be brought out for cable connections. 10% spare terminals shall be provided on each terminal block. Separate terminal block shall be provided for different voltages. All wire shall have P.V.C. ferrules as per wiring diagram. (w) Proper shrouding to incoming and outgoing terminals shall be provided to ensure safety during operation, inspection and maintenance. (x) Indicating lamps shall be with multiple LEDs & shall be suitable for the voltage specified. (y) All the components in the panel shall be properly labeled. The labels shall be made of non-rusting metal or engraved PVC material properly fixed by screws. (z) The panel layout shall be made in such a way that it will always facilitate easy removal and reconnection of control cables without disturbing other wiring. (aa) Centre lines of control switches, push buttons and indicating lamps shall be matched so as to give neat appearance. Similarly top lines of indicating instruments and relays shall also be matched. (bb) The panel shall be provided with electrolytic grade Al bus bar of suitable cross section so as to maintain max current density of 0.8 AMP/ Sq.mm. (cc) Bus bars shall be provided with colour coded heat shrinkable insulating sleeves. (dd) Bus bars shall be supported by high quality epoxy insulators provided at specified distances so as to withstand to the given fault level. (ee) The bus bar chambers shall be provided with suitable ventilation arrangements so as to limit the maximum temperature of 85°C while carrying rated current. (ff) Proper clearance of minimum 25 mm shall be maintained between phase bus bars and between bus bars. (gg) The panel shall be inspected at manufactures works before dispatch to site at the
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	discretion of Employer. (hh) All routine tests shall be carried out on the panel in presence of Employer or their representative or its representative. These tests shall include following: (i) Verification of components ratings and operation. (ii) High voltage measurement test. (iii) Insulation Resistance measurement. (iv) Control testing
7.10	Supply and installation of weather monitoring system 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, aux power supply cables. RS485 cables shall be in BHEL scope of supply. Scope of vendor shall also include supply and erection of all the mounting arrangements including all necessary civil works/ foundations etc. RS485 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 (either) on the roof-top (or) in the vicinity 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/BEL/SECI approval during detailed engineering. Pyranometer (4 Nos) Vendor shall provide 2 Nos of pyranometers for measuring incidental solar radiation at horizontal and 2 Nos for measuring the radiation at an angle equal to inclined plane of array.



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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	0 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 the other for SPV module temperature measurement). The thermometers shall be RTD/ semiconductor type measuring instrument. Instrument shall have arrange of 0 oC to 80 oC. The instrument shall have valid calibration certificate.

Anemometer

Vendor shall provide one anemometer with wind vane of rotating cup type. Anemometer shall be mounted on a mast of height 10m minimum without shadowing on SPV modules.

1) Velocity range with accuracy limit	+/- 0.11 m/s up to 10.1 m/s +/- 1.1% of true when more than 10.1 m/s
2) Wind direction range with accuracy limit	0 to 360 deg with accuracy +/- 4 deg.

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7.11	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 equipments at the segments as follows: (a) String monitoring boxes (90 Nos) in solar array field (b) Weather monitoring equipment: Pyranometers for solar irradiation (4 Nos), thermometer for ambient temperature (1 No), thermometer for module surface temperature (1 No), anemometer for wind speed and direction (1 No). (c) Power conditioning units (6 Nos): DC input / AC output parameters of inverters, grid data, fault status and events logged, etc. (d) Inverter transformers (4 Nos): Alarm/Trip signals, WTI/OTI temperature values. (e) 33kV VCB breaker panels (as per SLD, 11 panels): 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 (3 Nos): AC auxiliary utility consumption parameters (g) ABT metering panel (1 No with two meters main/check) at 33kV side outgoing of plant (h) ABT metering panel (1 No with one meter standby) at 33kV side outgoing of plant (i) Fire alarm system (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 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 the inverter rooms. (b) Control / instrumentation cables as mentioned in other clauses of this specification. (c) 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. (d) Vendor shall supply, install and commission necessary provisions/ equipments (Modem/ Router/ WiFi etc, broadband connection (BSNL etc)) to enable remote monitoring of SCADA from offices of BHEL/ BEL. Also, periodic payments (rental and

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	usage charges) towards broadband connections shall be borne by the vendor until completion of 10 years of O&M. (e) Vendor shall supply following furniture sets at SCADA room (cum office) of main control room at SPV plant end: ▪ PC table: 2 Nos ▪ Printer table: 1 No ▪ Executive table complete with draws/ side racks: 1 Set ▪ Chair, industry standard, revolving type, with wheels, arm rest, provisions for adjustment of height (hydraulic/ gas lift): 4 Nos ▪ Storage almirah: 1 No ▪ Filing cabinet: 1 No (4) Data signals for SCADA integration are described as below: Following is the list of signals from the five major segments of the power plant as above. 4.1 String monitoring boxes in solar array field: 90 Nos (a) RS485 Modbus (RTU) cables from string monitoring boxes of solar array field, whereby each box provides data signals viz. max 16 string currents, 1 box voltage, 1 box temperature, 1 load break switch status, 1 SPD status. And, 1 SPV module temperature shall be from any one of the string monitoring boxes. (b) Vendor shall draw appropriate number of such RS485 Modbus communication cables from solar array field to SCADA room, based on the daisy-chain grouping of string monitoring box RS485 Modbus (RTU) outputs. 4.2 Weather monitoring equipment – 7 Nos Analog signals from the weather monitoring equipment viz. pyranometer (4 Nos), anemometer (1 No), ambient temperature sensor (1 No), module temperature sensor (1No). 4.3 Power conditioning units (PCUs) 1250kW: 6 Nos RS485 modbus (RTU) signals from these PCUs comprising of DC /AC side / grid parameters such as current, voltage, frequency, phase, power factor, power (VA, Watt, Var), energy (VA-h, Watt-h, Var-h), fault details, other event logs with dates and times etc. 4.4 LT and HT equipments (Transformers, VCB panels, ACDB panel, ABT metering panel etc) a) Inverter transformer oil temperature value: 4-20mA analog signal. b) Inverter transformer winding temperature value: 4-20mA analog signal. c) Inverter transformer protection fault signals: Buchholz alarm, Low oil level alarm, PRD alarm, OTI alarm, WTI alarm: potential free NO contact, Digital. d) HT Panels: VCB On/Off status, open/command signals: potential free NO contact, Digital. e) Numerical relays of VCB panels of inverter room: Ethernet cables from relays to SCADA panel f) HT VCB panels: multifunction meters: RS485 data g) ACDB panel multifunction meters: RS485 data h) Aux transformer (1 No): OTI value, WTI value, Buchholz alarm, low oil level alarm, PRD
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	alarm, OTI alarm, WTI alarm: potential free NO contact, Digital. i) ABT meter at 33kV side (2 panels, 3 Meters in both panels put together): RS485 data (AC energy generation parameters) j) Fire alarm system: Status signals
7.12	Earthing system for inverter rooms, main control room, 33kV transformer yards (1) Vendor shall supply, install and commission appropriate earthing for protection against faults as guided by IEC 60364 for the inverter rooms, main control room, 33kV transformer yards. (2) Earthing system shall be designed with consideration of the soil resistivity of the project site. Unless otherwise specified, earthing system shall be in accordance with IS: 3043 and IEEE 80, Indian Electricity Rules, Codes of practice and regulations existing in the location where the system is being installed. Permissible system fault power level also shall be kept in consideration while designing the earthing system. (3) Design calculations and layout of the earth mat grid with electrodes, to achieve earth mat grid resistance value of less than 1.0 Ohm individually for the two inverter rooms and the main control room, shall be submitted for BHEL/BEL approval during detailed engineering. (4) Earthing electrodes shall be of 3m minimum long, 50 mm minimum diameter, perforated GI pipe, chemical compound filled, double walled. Bore holes of appropriate diameter shall be made on the earth for insertion of such chemical earthing electrodes with filling of mix of chemical compound and water around. Number of earth electrodes per room, spacing between them, GI flat layout etc shall be based on design calculation. Make of electrode shall be Ashlok, Balaji Metacast or any other reputed equivalent subject to BHEL/BEL approval. (5) Inverter rooms and main control room shall be provided with separate earth mat grids: (a) GI flats 65x8 minimum shall be laid underground cutting across the room from one end to the other and extending outward from both sides. These flats shall be at bottom level of internal cable trench. (b) GI flats 65x8 minimum shall be laid underground around the room and

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	interconnected to the above cutting-across flats. The interconnection shall be by way of welding with full width overlapping. (6) Earthing connections to electrical panels within the inverter rooms/ main control room: Flats GI 65x8 minimum or PVC insulated 1.1.kV copper cables of approximate sizing (as the case may be) shall be provided for double earthing of 33kV VCB panels, SCADA, UPS/ FCBC/ Battery banks, ABT metering panels, cable trays. For PCUs, copper flats 50x6 minimum or PVC insulated 1.1kV copper cables of equivalent sizing shall be provided. For all DB boards and any other metallic bodies, earthing shall be by way GI flats or PVC insulated 1.1kV copper cables of appropriate size. GI/Cu flats shall be bolted on panel end and overlap welded to earth mat grid running internally. In case of cables, both ends shall be crimped using lugs of appropriate sizing and further bolted for which the earth mat grid shall be drilled with matching holes. Cable glands (single compression nickel plated brass) of appropriate size shall be provided by the vendor at the panel end. Make of glands shall be COMET, Braco or any other reputed brand subject to BHEL/BEL approval. Matching holes in the gland plates of the panels shall be provided by the vendor using hole-saw cutters of appropriate size. (7) Earthing of inverter/auxiliary transformers in the 33kV yards of inverter rooms/ main control room: - 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, marshalling box, radiators etc. - Such interconnected local grid shall be double earthed to the main earth mat grid running underground through GI flats 65x8 minimum. - 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. - Shield earthing of inverter transformers shall be separate and connected to two earth pits using 50x6 copper conductor. - Neutral of aux transformer shall be connected to two earth pits using GI flat 65x8 minimum. - For both shield earthing and neutral earthing, heat-shrinkable insulation sleeve shall be provided around the earthing conductor. (8) 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. (9) 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. (10) Earth chambers shall be constructed around electrodes as per relevant IS standards. - Square sized, with 450 x 450mm minimum inner opening. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc. - Brick wall thickness all around = 230mm minimum
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	c) Depth of chamber = 500 mm minimum below FGL. d) Projection of chamber by 150mm minimum above FGL (for outside transformer yard) and, by 100mm minimum above stone jelly level (inside transformer yard). e) Top of electrode shall have minimum clearance of 100 mm below cover plate. f) Cover plate, cast iron of 5mm minimum thickness, square shaped to fit the opening of chamber, painted with red oxide and two coatings of black paint. g) Cover plate shall have suitable lifting hooks and padlocking arrangement. h) Both the outer and inner walls of the brick wall shall be plastered and painted as per relevant civil works clauses of this specification. i) Supply and installation of all materials shall be in vendor scope. (11) 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. (12) Interconnection of earth mat grids of inverter rooms, main control room and solar array: • Vendor shall interconnect the earth mat grids of inverter rooms and solar array at least at two nearest locations per inverter room. • Vendor shall also interconnect the earth mat grids of main control room and solar array at least at two nearest locations. General points: (h) All items related to earthing viz electrodes, GI/Cu flats, Cu cables, hardware etc shall be in vendor scope of supply. (i) GI bolts, nuts, plain washers shall be used. Spring washers shall be zinc/epoxy coated. (j) 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. (k) Resistance of welded joint shall not be more than that of GI flat. (l) Welds shall be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection. (m) 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. (n) Other applicable standards: - IS: 2629: Recommended practice for hot dip galvanizing of iron and steel - IS: 2633: Method for testing uniformity of coating on zinc coated articles - IS: 6745: Methods for determination of mass of zinc coating on zinc coated iron and steel articles. - IS: 513: Cold rolled low carbon steel sheets and strips - IS: 3063: Fasteners single coil rectangular section spring washers
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8.0 Technical specification for peripheral infrastructure systems of power plant

8.1	Plant Lighting System Vendor shall supply, install and commission plant lighting system (for areas listed below) that includes all necessary items such as luminaires, LED lamps, GI poles, bend pipes, junction boxes with MCBs/TBs/ glands/ provisions for earthing, conduit pipes for aux supply cables above ground level up to junction box for street light poles, conduit pipes for cables above ground level up to luminaire for wall mounted lighting, casing/capping wherever applicable, GI earth wires, aux supply cables (multicore, 1.1kV, Al/Cu, PVC, armoured, PVC FRLS as per IS:1554, appropriate sizing) up to junction box, cables (1.1kV, Al/Cu, PVC, unarmoured, unsheathed, as per IS: 694, appropriate sizing) from junction box to luminaires, cable glands, cable lugs, termination hardware etc. Scope also includes civil foundation works for street lighting poles. Cables shall be laid underground as per IS: 1255 with reference the section “cable installation methodology” of this specification. Cables shall be terminated at both the lighting end and LDB board end in respective inverter/ main control rooms. Spacing between poles/lamps shall satisfy the lux requirements of the respective areas. AC supply shall be from the LDB distribution boards from the inverter rooms/ main control room. Vendor shall submit lux calculations, lighting layout, single line diagram for aux supply from LDB boards, GA drawings of lighting poles/ wall-mounted/ column-mounted/ fence-mounted systems, GA drawings of civil foundation for street light poles, bill of materials with make/ GTPs/ model number/ part number/ rating/ applicable IS standards/ quantity etc for BHEL/BEL approval during detailed engineering. For all the items, reputed brand shall be procured after approval from BHEL/BEL. Cable schedule shall also be submitted. Vendor shall also supply 15-20W (230V) LED lamps for emergency purpose: (a) 4 Nos in electrical panel room of main control room, (b) 1 No each in battery room, office area, corridor. Areas of plant lighting systems for vendor scope: - Street lighting poles (10 lux minimum) - By the side of peripheral boundary fencing of SPV power plant - By the side of pathways from inverter rooms to main control room - Street lighting poles/ wall mounted/ column-mounted/ fence-mounted systems as applicable (20 lux minimum) - on pillars of main entrance gate of power plant - in front of main control room (from main gate to control room)
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- (c) for 33kV transformer yards of the inverter rooms
(d) for 33kV metering yard (~ 10m x 10m) near main control room

General technical requirements:

- (1) All LED luminaires shall be supplied with proper diffuser to avoid direct visibility of LED with proposer thermal management for longer life.
- (2) The lighting level shall take into account appropriate light output ratio of luminaires, coefficient of utilization maintenance factor (of 0.7 or less) to take into account deterioration with time and dust deposition.

(3) LED luminaires shall meet the following parameters

1	Input voltage	170-260V
2	Input frequency	50 +/- 1 Hz
3	Power factor	0.95 minimum
4	Power efficiency	>96%
5	LED efficacy	>130 lumens per watt
6	Dispersion angle	Minimum 120 deg
7	Usage hours	Dusk to dawn
8	Total harmonic distortion	<15%
9	Working temperature	-5 deg to +50 deg C
10	Working humidity	10% - 90% RH (preferably hermetically sealed unit)
11	Index of protection level	Minimum IP65
12	Lamp casing	Powder coated metal/ Aluminium
13	Life	> 50,000 Hrs
14	LED type	Power LEDs from reputed make
15	Colour temperature	2800 deg K / 3000 deg K
16	Colour rendering	>75
17	Junction temperature	< 60 deg C
18	Electrical connector	Lead wire with 2m long (or) as required by customer at site
19	Expected life of components	Passive electronic components life greater than > 1,00,000 hrs
20	Moisture protection in case of casing damage	IP 65 (preferably totally encapsulated)

(4) Control gear specification

EN 61347-2-13: Particular requirements for DC/AC supplied electronic control gear for LED module

EN 62384: DC/AC supplied electronic control gear for LED modules



(5) Luminaire EMC specification

EN 61000-3-2: Electromagnetic compatibility (EMC). Limits for harmonic current emissions (Equipment input current < 16 A per phase)

EN 61000-3-3: Limitation of voltage fluctuation and flicker in low voltage supply systems for equipment with rated current < = 16 A

(6) Additional information for LED luminaire

The LED luminaire housing, heat sink, pole mounting bracket, individual LED reflectors and front heat resistant tempered glass should be provided.

The LED luminaire housing should be made of non-corrosive high pressure die cast aluminium and the housing should be power coated grey, so as to ensure good weatherability.

Each individual LED source should be provided with asymmetrical distribution high reflectance aluminized reflector, which should ensure that the light distribution of the luminaire is suitable for road lighting applications (wide beam distribution) and should ensure high pole to pole spacing.

The luminaire should be provided with in built power unit and electronic driver. The luminaire should be so constructed to ensure that the gear and LED modules are replaceable, if required.

The luminaire should be suitable for both standard street light poles with a typical pole diameter of 50 mm – 60 mm and should be suitable for both side entry and bottom entry (post top).

(7) Junction Boxes, Conduits, Fitting & Accessories

Junction boxes for street lighting poles, lighting mast, wall-mounted, fence-mounted as applicable shall be deep drawn or fabricated type made of min 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55.

All switches and receptacles up to 16A shall be modular type. These shall be provided with pre-galvanized/ galvanized modular switchbox & plate.

Conduits, Pipes and Accessories Galvanized heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered.

Rigid steel conduits shall be heavy duty type, hot dip galvanized conforming to IS: 9537 Part-I

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	& II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside. Flexible conduit shall be water proof and rust proof made of heat resistant lead coated steel. Pull out boxes shall be provided at suitable interval in a conduit run. Boxes shall be suitable for mounting on Walls, Columns, Structures etc. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes used outdoor shall be weather proof type suitable for IP55 degree of protection and those used indoor shall be suitable for IP52 degree of protection. Pull out box & its cover shall be hot dip galvanized. (8) Lighting Poles Street Light system and peripheral lighting shall be designed generally in line with design guidelines. Height of the GI poles should be so chosen as not to affect working of Solar panels (shadow effects). The maximum height of pole shall be 8 meters. The poles shall be hot-dip galvanized as per relevant IS: 2629/ IS: 2633/ IS: 4759. The average coating thickness of galvanizing shall be min 70 micron. The system shall be capable of withstanding the appropriate wind load etc as per IS: 875 considering prevailing soil/ site condition considering all accessories mounting on pole. Street light poles shall have loop-in/ loop-out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB. (9) Earthing Lighting poles etc shall be earthed by two separate and distinct connections with earthing system. Distribution boards, junction boxes, lighting fixtures etc shall be earthed by means of separate earth continuity conductor. The earth continuity conductor 14 SWG GI wire shall be run along with each conduit run. Cable armours shall be connected to earthing system at both the ends.
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8.2	Bore wells including hydro survey, water analysis, electrical cabling and plumbing works (1) Hydrological survey shall be carried out for identification of right locations for bore wells. (2) Vendor shall estimate the water requirements for cleaning the SPV modules at least once in every week at the rate of 1.5L consumption per module during every cleaning cycle. (3) Minimum two bore wells shall be dug at locations as identified by hydrological survey report and as certified by BHEL/BEL. Exact number of bore wells shall be decided based on consumption of water for cleaning of SPV modules on daily basis, filling water in all storage tanks in addition to day-to-day utility requirements such as cleaning of inverter/ control rooms, toilets etc. (4) Bore wells shall be of necessary depth based on water table at the identified locations. (5) Water analysis shall be carried out at a reputed laboratory. Report on its constituents, potable quality etc shall be submitted for BHEL/BEL approval. (6) Bore wells shall be fitted with submersible AC centrifugal pump of appropriate capacity/ rating with all necessary electrical cabling up to ACDB panel of nearest inverter room. (7) Full depth casing shall be provided up to the pump. (8) All supply items required for installation and commissioning of bore wells shall be in vendor scope of supply. This shall include pumps of appropriate type/size/HP rating, outdoor type switch box with MCBs, plumbing items (pipes/ valves etc), electrical cables, cable glands/ lugs, bolts/ nuts/ washers etc. (9) Cables shall be of armoured type and directly buried as per IS: 1255. Details of cable (type, rating, size, applicable standard etc) shall be submitted for BHEL/BEL approval during detailed engineering. (10) Pump make: CGL, Suguna, Kirloskar, Grundfos or any other reputed equivalent as shall be approved by BHEL/BEL. (11) Complete layout/scheme of bore well water supply with supporting discharge / pressure calculations, sizing / selection of pumps/ valves etc, bill of materials shall be submitted for BHEL/ BEL approval. (12) Design shall take into account the features of the specification clause on “water washing system for cleaning of SPV modules”.
8.3	Water washing system for SPV modules (Module cleaning system) 1) Vendor shall supply, install and commission permanent arrangement for module washing in the SPV Plant taking into account all related site conditions. 2) Vendor shall estimate the water requirements for cleaning the SPV modules at least once in every week at the rate of 1.5L consumption per module during every cleaning cycle. 3) The system shall essentially include the following minimum components: a) Minimum two bore wells fitted with submersible pumps, electrical cabling etc as described under separate clause of this specification. b) Underground RCC sump storage tank near every bore well location. Total capacity all tanks put together: 15000 Litres minimum. c) Surface pump (booster pump) with pressure regulating tank of appropriate size/ rating

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	shall be installed at every tank location. Suitable RCC civil pedestal and housing chamber shall be constructed for this arrangement. Chamber shall have necessary canopy (for prevention of water entry), door/lock provision, steel sections/ steel sheets to withstand wind load etc, corrosion protection painting, fasteners etc. Vendor shall submit drawings for BHEL/BEL approval during detailed engineering. d) Vendor shall employ armoured electrical cables of suitable size/rating for all electrical connections. Cables with cable accessories (glands/ lugs/ termination hardware etc) shall be in vendor scope of supply and installation. Cabling to the pumps shall be from DB panels (BHEL scope) in the nearest inverter/control rooms. Cables shall be laid underground as per IS: 1255. All cable terminations including the ones at DB panels shall be in vendor scope. e) In addition to operating from inverter/control rooms, outdoor type switch box with MCB etc shall also be provided to switch ON/OFF the pump directly from solar field. Such components shall be suitably mounted within the housing chamber. f) Water pressure gauge of appropriate size/rating shall be installed at every tank location. g) UPVC pipes as per relevant IS standards, heavy duty, 6 Kg/sqcm: pump suction/ header pipes (40NB minimum), Feeder pipes (25NB minimum). h) UPVC elbows, Tees, bends, couplers as applicable, as per relevant IS standards, for jointing and leak-proof pressurized pipe fittings. i) UPVC pipes shall be directly buried in ground at least 300mm below FGL. GI/ Hume pipes (75NB minimum) shall be used at road and drain crossings. j) UPVC raiser pipes with ball valves (25NB minimum, metal body, IS marked) and reducer nozzles for fitting hose pipes, at every delivery point. Every raiser pipe shall be fixed in the soil using concrete (PCC) pedestal construction with foundation depth of 200mm minimum. k) Delivery points shall be made available in the space between every two rows of solar array with max 30m spacing between delivery points. Accordingly, number of delivery points shall be provided for cleaning of the entire solar array. l) Air release valve fittings (metal body, IS marked) for header pipes at appropriate locations. m) Air release valve fittings (metal body, IS marked) for feeder pipes at appropriate locations. n) Control gate valve for header pipes; for maintenance (IS marked) at appropriate locations. o) Control gate valve for feeder pipes; for maintenance (IS marked) at appropriate locations. p) Non-returnable valves (NRV) shall be provided wherever applicable. q) Hose pipes, heavy duty 25NB minimum: 10 rolls each of 50m (minimum) long r) All necessary hardware items such as GI clamps/ screws/ bolts/ nuts/ plain washers/ spring washers etc wherever applicable.
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	s) Any other items as required to complete the technical/ operational requirements of module washing system. 4) Underground RCC sump storage tanks shall be constructed at every bore well location to which the water pipes of module washing network shall be connected. Details of tank shall be as below: a) Vendor shall construct underground RCC water tank (of required capacity) with silting chamber for filtration of water before inlet which will match with invert level of storm water drain. Note: Storm water drain shall be in BHEL scope. Whereas minimum total storage capacity shall be 15000 Litres, this shall be met by way of minimum two tanks (one tank at each bore well location) as per the solar array layout taking into account discharge/ pressure calculations. b) Top of the RCC sump tanks shall be 250mm above FGL. c) Tanks shall have clear free board of 300mm above MWL. d) Tank bottom shall have a slope of 1:250 towards drainage sump (500x500x500 mm deep). Slope shall be provided either in structural slab or with screed concrete 1:2:4 neatly finished at top. e) Manhole (1000x1000 mm size) in roof slab of tank and 20mm GI rung ladder shall be provided for easy access to the storage tank and silting chamber for periodic cleaning. Manhole shall be covered with RCC precast cover. 50x50x6 mm MS angles shall be provided around precast cover along supporting edges for edge protection. f) Underground RCC tank shall be designed for following load conditions (i) External earth pressure + hydrostatic pressure due to ground water table to be considered at FGL for design purposes + Surcharge of 2 T/ Sqm and Tank Empty. (ii) Tank full up to MWL and no Earth pressure, Hydrostatic pressure due to ground water table and surcharge from outside. g) Design shall conform to IS: 3370 with maximum crack width of 0.1mm for Wall, bottom slab and roof slab. Min grade of concrete shall be M30 conforming to IS: 456. PVC water bars 230x8 mm thick, conforming to relevant IS shall be provided at all construction joints. Water proofing admixture conforming to relevant IS and of approved make shall be added to concrete. Vendor shall submit detailed load calculations and drawings of underground water tank for BHEL/BEL approval during detailed engineering. h) Underground water tank shall be tested for water tightness as per the provisions of IS 3370. In case any leakage is noticed, the same shall be repaired by injection of cement grout installing suitable nozzles around affected areas. (13) At road crossings and wherever heavy/impact load applicable, UPVC pipes shall be covered with higher diameter RCC hume pipes of NP3 grade for protection against such loads. (14) Vendor shall design and submit the piping and instrumentation diagram P&ID of water washing arrangement including the physical sequence of branches, reducers, valves, pressure gauge, delivery points and location of pumps and water storage tanks for
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	BHEL/BEL approval during detailed engineering. The diagram shall show locations of bore wells, pipelines, valves, delivery points etc as superimposed on the solar array layout, Bill of materials (item-wise description, type / rating, make, model number / part number, quantity) of water washing arrangement with necessary calculations of water flow / pressure / discharge etc for BHEL/BEL approval during detailed engineering. (15) All necessary labour, machinery, tools, instruments shall be in vendor scope.																																		
8.4	Firefighting / detection/ alarm systems 1. 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/BEL 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. - Hand portable pressurized water CO2 9 Ltr designed/tested IS: 15683, rubber hose, safety release valve, NRV and CE approved valve, throw of jet 6m. - 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: <table border="1"> <thead> <tr> <th></th><th>DCP type (ABC) 10 Kg</th><th>CO2 type Hand 9 Kg</th><th>Foam type hand 9 Kg</th><th>Hand portable pressurized water CO2 9 Ltrs</th><th>Sand buckets (sets) Each set consisting of a stand with 4 sand buckets</th></tr> </thead> <tbody> <tr> <td>Main control room CMCS</td><td>1</td><td>4</td><td>2</td><td>-</td><td>1</td></tr> <tr> <td>Each inverter room</td><td>1</td><td>2</td><td>2</td><td>-</td><td>1</td></tr> <tr> <td>Each transformer yard of inverter room</td><td>1</td><td>1</td><td>1</td><td>-</td><td>4</td></tr> <tr> <td>Transformer yard of</td><td>1</td><td>2</td><td>2</td><td>-</td><td>4</td></tr> </tbody> </table>						DCP type (ABC) 10 Kg	CO2 type Hand 9 Kg	Foam type hand 9 Kg	Hand portable pressurized water CO2 9 Ltrs	Sand buckets (sets) Each set consisting of a stand with 4 sand buckets	Main control room CMCS	1	4	2	-	1	Each inverter room	1	2	2	-	1	Each transformer yard of inverter room	1	1	1	-	4	Transformer yard of	1	2	2	-	4
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Transformer yard of	1	2	2	-	4																														



main control room					
Each security room	-	-	-	2	1

2. Microprocessor based fire alarm system for inverter/ main control rooms

Vendor shall provide intelligent microprocessor-based main fire alarm panels of modular construction complete with central processing unit, input and output modules, power supply module, supervision control and isolator modules with 10% spare provisions.

Fire detection alarm system shall include but not limited to the following items:

1. Fire alarm control panel
2. Multi sensor smoke detector
3. Hooter cum strobe
4. Manual call point
5. Hooter
6. Fault isolation modules
7. Control modules
8. Cables from sensors to fire panels
9. Digital output from fire detection system shall be integrated with SCADA (RS485 compatible)

Multi sensor type smoke detectors shall be provided below false ceiling areas of control room and inverter rooms. One sensor shall be provided for each 25 sqm of area.

Fire Alarm Control Panel Indication

- (a) Alarm conditions shall be immediately displayed on the control panel. Alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged, LED shall remain lit. A subsequent alarm received from another zone after acknowledgement shall illuminate the alarm LED and the panel display shall show the new alarm information.
- (b) During alarm condition, an alarm tone shall sound within the control panel until the alarm is acknowledged.
- (c) If the audible alarm signals are silenced for any reason, they shall automatically resound if another zone is activated.
- (d) All alarm signals shall be automatically "locked in" at the control panel until the operated device is returned to its normal condition and the control panel is manually reset.

Vendor shall submit integrated layout of fire detection/alarm system in the inverter rooms and main control room along with Bill of Materials (make, model number/ part number, quantity) etc for BHEL/BEL approval during detailed engineering. Make of the system shall be Hochiki/ Notifier or any other reputed brand subject to BHEL/BEL approval.

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8.5	Other safety related items Vendor shall supply the following safety related items. Make / part number of each item shall be submitted to BHEL/BEL for approval prior to procurement. <table><tr><td>1</td><td>Gas Mask</td><td>5 Nos</td></tr><tr><td>2</td><td>First Aid Box with essential medicines and bandage cotton, antibiotic cream, Dettol, etc.</td><td>1 set</td></tr><tr><td>3</td><td>Hand Gloves 33 KV for GOS operation</td><td>10 sets</td></tr><tr><td>4</td><td>Hand Gloves 1KV for Maintenance of SMB</td><td>10 sets</td></tr><tr><td>5</td><td>Discharge rod</td><td>5 Nos</td></tr><tr><td>6</td><td>Safety Helmet</td><td>20 Nos</td></tr><tr><td>7</td><td>Safety shoes</td><td>10 pairs</td></tr></table>	1	Gas Mask	5 Nos	2	First Aid Box with essential medicines and bandage cotton, antibiotic cream, Dettol, etc.	1 set	3	Hand Gloves 33 KV for GOS operation	10 sets	4	Hand Gloves 1KV for Maintenance of SMB	10 sets	5	Discharge rod	5 Nos	6	Safety Helmet	20 Nos	7	Safety shoes	10 pairs
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7	Safety shoes	10 pairs																				
8.6	CCTV system/ cameras a. CCTV cameras shall be supplied, installed and commissioned to capture movements/ entry/ exit activities (1) at main entry gate round the clock 24 hours (2 cameras), (2) along the complete plant perimeter (adequate cameras), (3) at electrical panel rooms within inverter/ control rooms (1 camera each room), (4) at store room of main control room (1 camera), (5) for weather monitoring system (2 cameras). Accordingly, to meet this requirement, number of cameras shall be proposed by vendor. Whereas the monitoring screen shall be installed in main control room office, the cameras shall be provided at exact locations that will be finalized by BHEL/BEL during detailed engineering. b. CCTV system shall be designed as a standalone IP based network architecture. System shall use video signals from different cameras at defined locations, process the video signals for viewing on monitors at control room and simultaneously record all video streams using latest compression techniques. c. Camera shall be colour, suitable for day and night surveillance (even under complete darkness) and network compatible. d. It shall be possible to control all cameras i.e., PTZ auto/ manual focus, selection of pre-sets, video tour selection etc. The software shall support flexible 1/2/4 windows split screen display mode or scroll mode on the display monitor for live video. e. The system shall support video analytics in respect of the following: 1. Video motion detection 2. Object tracking 3. Object classification																					

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	f. Camera server shall be provided with sufficient storage space to storage recordings of all cameras at HD mode for a period of 15 days. All recordings shall have camera ID, location, date and time of recording. g. Details of make, model number, part number, GTP, layout drawings showing camera locations, electrical scheme etc for BHEL/BEL approval during detailed engineering.
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8.7	Security room and watch cabins Vendor shall construct one security room and four watch cabins both of which shall be of prefabricated type. Details of these shall be as follows. Vendor shall submit GA drawings of both the security room/ watch cabin along with design calculations for foundation/superstructure, electrical layout/ bill of materials etc for BHEL/BEL approval during detailed engineering. 1) Minimum size of watch cabin shall be 1.2x1.8m and height 2.5m. 2) Watch cabins shall be located at strategic locations and at corners of the plot. 3) Security room shall be located near main gate. 4) Security room shall be of size 3mx3m and height 2.75m 5) Security room/ Watch cabin shall be prefabricated structures. Walls and roof of the building shall be fabricated with double skin permanently colour coated insulated sandwiched Al-Zn alloy coated high tensile steel metal panels (BMT- 0.6mm, Al-Zn alloy coating -150 GSM total on both sides). 6) Insulation shall be of PUF, density 40 kg/ cum with adequate thickness. 7) Roof shall be provided with suitable slope (preferably 100) for proper drainage of rain water and shall project 300mm beyond the walls. 8) Make and colour shade of the metal panels shall be subject to approval by BHEL/BEL during detailed engineering. 9) Security cabin shall be provided with 0.75m wide and 2.1m height AL glazed door on one face and shall have Aluminium glazed sliding windows with Aluminium grill, 1.2m wide with 1.0 m height, on remaining three sides for Security Room while there shall be 1 no. window on side face of watch cabin of size 0.8mx1.0m with 1.0 m height. 10) All glazing shall be of clear float glass with thickness of 4mm for window and 6mm for door panel. The door and windows shall be provided with all necessary fitting and fixtures like handles, tower bolts, mortise lock for door, stays etc. 11) All aluminium sections for doors and windows shall be anodized (40 microns) for protection against weather. 12) Civil foundation design calculations and drawings of both security cabin and watch cabin shall be submitted for BHEL/BEL approval during detailed engineering. 13) Foundation shall project 200mm beyond the walls. Special coated/ SS self-drilling screws/ fasteners conforming to class 3 as per ASTM: 3566.1 and 3566.2 shall be used. Anchor/ foundation bolts shall conform to IS: 5624 and relevant IS code. 14) Flooring shall be 40mm thick cement concrete (IPS) flooring 1:2:4, aggregate 10mm down conforming to IS: 2571, with 2mm thick heavy duty epoxy coating (industrial grade), with 10mm thick matching skirting of 100mm height. 15) Both the security room and watch cabins shall be provided with electrical works such as lights, fans, wiring, switch boards with MCBs/sockets etc. Vendor shall lay/terminate underground electrical cables from nearest inverter rooms/ main control room as applicable. All electrical items including cables/ cable accessories shall be in vendor scope of supply.
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8.8	Connection of RCC sump tank to Overhead water tank SPV plant shall have minimum two RCC underground sump tanks for storage of water from bore wells and further use for water cleaning of SPV modules and all utilities of power plant. Similarly, main control room shall have one syntax overhead (OH) tank of 1000L capacity placed on terrace. Whereas RCC underground sump tanks, as part of module cleaning system, are in vendor scope, OH tank shall be in BHEL scope of supply and I&C. Vendor shall make all necessary plumbing arrangements connecting these two facilities. Accordingly, vendor shall construct a 1HP pump house with suitable civil foundation, steel roof/walls, canopy etc near sump tank (~200m away from main control room) and make connections through GI pipelines of appropriate size with couplers/ joints/ bends, valves etc as applicable up to the OH tank. Similarly, electrical connections shall be made to the pump from main control room. All supply items in this regard shall be in vendor scope.
8.9	Identification marking of cables using cable tags 1. Cable tags shall be provided on 1Cx300 DC cables at both ends (SMB end, PCU end) just before entering the equipment enclosure. 2. Similarly, for RS485 cables at SMB end and SCADA end. 3. Cable tags shall be of rectangular shape. 4. 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. 5. 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. Vendor shall submit the technical details of cable tags, ID numbering scheme for BHEL/ BEL approval during detailed engineering.
8.10	Identification marking of electrical items 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/BEL approval during detailed engineering for the following. 1. Solar array structures: 1356 Nos 2. String monitoring boxes: 90 Nos 3. Size/ source/ destination of DC cable 1Cx300 with arrow mark (power flow direction) to be painted on SMBs and PCUs 4. Earth chambers for solar array, lightning arrestors 5. Lightning arrestors (ESE) 6. Module cleaning system items: bore wells, tanks, pumps, delivery points etc 7. PCUs front side: PCU ID number (1-12) with rating 1250kW, AC chamber/ DC chamber, Danger text/symbol.

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	8. PCUs DC chamber back side: SMB ID numbers, cable size (1Cx300 +,-) with upward arrow mark, danger text/symbol 9. PCUs AC chamber back side: Inverter Transformer ID, cable size (8Rx1Cx300 per phase) with downward arrow mark, danger text/symbol 10. 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. 11. For UPS/ FCBC/ SCADA/ ABT metering panels, all DB boards/ fire alarm panels, ID number shall be painted. Cable size/ destination/ arrow marks not required to be painted as cable tags shall be adequate. 12. For all the plant lighting poles of power plant, ID numbers shall be painted. 13. For earth chambers of inverter rooms and main control room, ID number shall be painted. 14. All switchboards shall be painted with ID number.																												
8.11	Cable route markers Cable route 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.																												
8.12	Display boards and sign boards <table border="1"> <tr> <td>1</td><td>Board displaying instruction chart for restoration from Electric Shock</td><td>4 Nos</td></tr> <tr> <td>2</td><td>Board displaying instruction chart for artificial respiration</td><td>4 Nos</td></tr> <tr> <td>3</td><td>Board displaying dos and don'ts.</td><td>4 Nos</td></tr> <tr> <td>4</td><td>Board displaying fire extinguishers details and operations</td><td>4 Nos</td></tr> <tr> <td>5</td><td>“No smoking” board</td><td>8 Nos</td></tr> <tr> <td>6</td><td>Board showing list of O&M staff with name, qualification and work responsibility</td><td>1 No</td></tr> <tr> <td>7</td><td>Board showing list of contact details of BHEL, O&M team, O&M security, police station, fire service, hospital, medical store etc with names, address, mobile numbers etc</td><td>2 Nos</td></tr> <tr> <td>8</td><td>Danger boards: 33000V with danger symbol in Hindi, Telugu, English</td><td>10 Nos</td></tr> <tr> <td>9</td><td>Identification boards, of suitable sizes, within and outside control room such as Inverter room 1, Inverter room 2, Main control room, Executive lounge, Store room, Gents toilet, Ladies toilet, SCADA room, Battery room, Pantry room etc. BHEL will provide list.</td><td>15 Nos</td></tr> </table> (a) 5mm thick sun board with LG make vinyl sticker (computerized cutting and pasting) shall be used for Sl Nos 5, 8 and 9. (b) For others, flex banner with design & printing shall be used. Note: In addition to the above, hoarding board for the overall power plant shall be fabricated in consultation with BHEL/BEL and installed at a suitable location near the main entrance gate of the plant.		1	Board displaying instruction chart for restoration from Electric Shock	4 Nos	2	Board displaying instruction chart for artificial respiration	4 Nos	3	Board displaying dos and don'ts.	4 Nos	4	Board displaying fire extinguishers details and operations	4 Nos	5	“No smoking” board	8 Nos	6	Board showing list of O&M staff with name, qualification and work responsibility	1 No	7	Board showing list of contact details of BHEL, O&M team, O&M security, police station, fire service, hospital, medical store etc with names, address, mobile numbers etc	2 Nos	8	Danger boards: 33000V with danger symbol in Hindi, Telugu, English	10 Nos	9	Identification boards, of suitable sizes, within and outside control room such as Inverter room 1, Inverter room 2, Main control room, Executive lounge, Store room, Gents toilet, Ladies toilet, SCADA room, Battery room, Pantry room etc. BHEL will provide list.	15 Nos
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8.13	Electrical insulation mat (1) Vendor shall supply electrical insulating mats as follows: (a) Reputed make as shall be approved by BHEL/ BEL (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/BEL/SECI during detailed engineering. (f) Colour: to be approved by BHEL/BEL (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.
8.14	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 suitable handle (welded to the plate) to facilitate ease of lifting. (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/BEL approval shall be obtained for overall arrangement of checkered plate.
8.15	Air conditioner (1) Air conditioner split type (3 Nos) for SCADA room, supervisor room, conference room (2) Size / capacity shall be selected based on the room size and shall be approved by BHEL/BEL. (3) It shall be of reputed make as shall be approved by BHEL / BEL.



8.16

Tool kits and instruments

Vendor shall supply the following tool kits and measuring instruments:

A. Measuring instruments

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

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

B. Tool kits

1	Double ended spanner Set of sizes 10-11, 12-13, 14-15, 16-17, 17-18	2 Nos each
2	Screwdriver Set	1 Set
3	Crimping tool with Dye range 50-400sq-mm cable, mechanical gear power, hand operated	1 Set
4	Crimping tool up to 6 sq-mm cable	1 set
5	Drilling machine AC, hand operated, with bit size up to 20 mm	1 set
6	Measuring Tape, 5m	2 Nos
7	Measuring Tape, 50 m	2 Nos
8	Allen Key set	1 Set
9	Adjustable spanner 2-inch size	1 No
10	Hammer	2 Nos
11	Rough file kit	1 Set
12	Platform balance, 50Kg range, 100g accuracy	1 No
13	Cutting Pliers	2 Nos
14	Nose Pliers	2 Nos
15	Vacuum cleaner, of industrial type, for control room sweeping / cleaning.	1 No
16	Blowers for cleaning the panels	2 Nos

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

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9.0 General Specification of LT cables

9.0	General specification of LT cables (1) LT power and control cables LT Power & control cables shall be of minimum 1100 volts grade XLPE / PVC insulated conforming to IS 1554 for utilization voltages less than equal to 415 V. 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 the cables shall conform to the requirements of the following standards and codes: <table border="1"> <tbody> <tr> <td>IS :1554 - I</td><td>PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.</td></tr> <tr> <td>IS : 3961</td><td>Recommended current ratings for cables</td></tr> <tr> <td>IS : 3975</td><td>Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.</td></tr> <tr> <td>IS : 5831</td><td>PVC insulation and sheath of electrical cables.</td></tr> <tr> <td>IS:7098 (Part -I)</td><td>Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.</td></tr> <tr> <td>IS : 8130</td><td>Conductors for insulated electrical cables and flexible cords.</td></tr> <tr> <td>IS : 10418</td><td>Specification for drums for electric cables.</td></tr> <tr> <td>IS : 10810</td><td>Methods of tests for cables.</td></tr> <tr> <td>ASTM-D -2843</td><td>Standard test method for density of smoke from the burning or decomposition of plastics.</td></tr> <tr> <td>IEC-754 (Part-I)</td><td>Tests on gases evolved during combustion of electric cables.</td></tr> <tr> <td>IEC-332</td><td>Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).</td></tr> </tbody> </table> (2) LT power cables The cables shall be suitable for laying on racks, in ducts, trenches, conduits and underground buried installation with chances of flooding by water. All cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification. If cables are to be laid underground, laying shall be as per latest relevant IS code.	IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.	IS : 3961	Recommended current ratings for cables	IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.	IS : 5831	PVC insulation and sheath of electrical cables.	IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.	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.	ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.	IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.	IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).
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Copper/aluminium conductor used in power cables shall have tensile as per relevant standards. Conductors shall be stranded.

XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C.

PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

For single core armoured cables, armouring shall be of copper/aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows:

Sl	Calculated nominal dia of cable under armour	Size and Type of armour
i)	Upto 13 mm	1.4mm dia GS wire
ii)	Above 13 upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
iii)	Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0 mm dia GS wire
iv)	Above 40 upto 55mm	1.4 mm thick GS formed wire/ 2.5 mm dia GS wire
v)	Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
vi)	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm² per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.

The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of GS wire / formed wire.

Outer sheath shall be of PVC as per IS: 5831 & black in colour for power cables. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

- (a.) Oxygen index of min. 29 (as per IS 10810 Part-58).
- (b.) Acid gas emission of max. 20% (as per IEC-754-I).

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	(c.) Smoke density rating shall not be more than 60 % (as per ASTM D-2843). Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted: <table> <tr> <td>1 core -</td><td>Red, Black, Yellow or Blue</td></tr> <tr> <td>2 core -</td><td>Red & Black</td></tr> <tr> <td>3 core -</td><td>Red, Yellow & Blue</td></tr> <tr> <td>4 core -</td><td>Red, Yellow, Blue and Black</td></tr> </table> For reduced neutral conductors (in case of power cable), the core shall be black. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a) Cable size and voltage grade - To be embossed (b) Word 'FRLS' at every 5 metre - To be embossed (c) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3. Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum, over the declared value in the technical data sheets. Repaired cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable. Cable selection & sizing Cables shall be sized based on the following considerations: (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time. De rating Factors De rating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:	1 core -	Red, Black, Yellow or Blue	2 core -	Red & Black	3 core -	Red, Yellow & Blue	4 core -	Red, Yellow, Blue and Black
1 core -	Red, Black, Yellow or Blue								
2 core -	Red & Black								
3 core -	Red, Yellow & Blue								
4 core -	Red, Yellow, Blue and Black								

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	a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables. Cable lengths shall be considered in such a way that straight through cable joints are avoided. Cables shall be armoured type if laid in switchyard area or directly buried. All LT power cables of sizes more than 120 sq.mm shall be XLPE insulated. CONSTRUCTIONAL FEATURES for LT Power Cables 1.1 KV grade XLPE power cables shall have compacted aluminium/ copper conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I). Cables which are directly buried shall be armoured. 1.1KV grade PVC power cables shall have aluminium/ copper conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I). CONSTRUCTIONAL FEATURES for LT control cables 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I). 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm. TESTS Indicative list of tests / checks, routine and acceptance tests shall be as per Quality Assurance and Inspection table of LT power cables enclosed at relevant section. All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the cable price. All cables to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for BHEL/BEL/SECI approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid
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opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to BHEL either at third party lab or in presence of BHEL/BEL/SECI representative and submit the reports for approval.

The type test reports once approved for any projects shall be treated as reference. Minor changes if any shall be highlighted on the endorsement sheet.

The reports for following type tests shall be furnished:

Sl	Type Test	Remarks
	Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wires only
6.	Wrapping test	
7.	Resistance test	
8(a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
8(b)	Adhesion test	For GS wires/formed wires only
	For XLPE insulation & PVC Sheath	
9.	Test for thickness	
10.	Tensile strength and elongation test before ageing and after ageing	



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11.	Ageing in air oven	
12.	Loss of mass test	For PVC outer sheath only.
13.	Hot deformation test	For PVC outer sheath only.
14.	Heat shock test	For PVC outer sheath only
15.	Shrinkage test	
16.	Thermal stability test	For PVC outer sheath only
17.	Hot set test	For XLPE insulation only
18.	Water absorption test	For XLPE insulation only
19.	Oxygen index test	For PVC outer sheath only
20.	Smoke density test	For PVC outer sheath only
21.	Acid gas generation test	For PVC outer sheath only
22.	Flammability test as per IEC-332 Part-3 (Category -B)	For completed cable only
23.	Insulation resistance (volume resistivity method)	
24.	High voltage test	

(3) LT control cables

The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

All cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.

Conductor of control cables shall be made of stranded, plain annealed copper.

Outer sheath shall be of PVC as per IS: 5831 & grey in colour for control cables.. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a) Oxygen index of min. 29 (as per IS 10810 Part-58).

(b) Acid gas emission of max. 20% (as per IEC-754-I).



(c) Smoke density rating shall not be more than 60 % (as per ASTM D-2843).

Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:

- | | |
|----------|-----------------------------|
| 1 core - | Red, Black, Yellow or Blue |
| 2 core - | Red & Black |
| 3 core - | Red, Yellow & Blue |
| 4 core - | Red, Yellow, Blue and Black |

For control cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.

In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.

- (a) Cable size and voltage grade - To be embossed
- (b) Word 'FRLS' at every 5 metre - To be embossed
- (c) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed

The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

All cables except module inter-connecting DC cable shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.

Repaired cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

Cable selection & sizing

Control cables shall be sized based on the following considerations:

- (a) The minimum conductor cross-section shall be 1.5 sq.mm.
- (b) The minimum number of spare cores in control cables shall be as follows:

No. of cores in cable	Min. No. of spare cores
2C, 3C	NIL

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5C	1
7C-12C	2
14C & above	3

CONSTRUCTIONAL FEATURES for LT control cables

1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).

(4) Cable Drums

(a) Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. However, for single core cables up to 6 sqmm size, supplier can do alternative packaging of whole drum/spool to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

10.0 Cable installation methodology

10.0	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.								
	<table> <tr> <td>IS:513</td><td>Cold rolled low carbon steel sheets and strips.</td></tr> <tr> <td></td><td>of practice for the use of Structural Steel</td></tr> <tr> <td>IS:802</td><td>Code in</td></tr> <tr> <td></td><td>Overhead Transmission Line Towers.</td></tr> </table>	IS:513	Cold rolled low carbon steel sheets and strips.		of practice for the use of Structural Steel	IS:802	Code in		Overhead Transmission Line Towers.
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IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel flittings
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 galvanising 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 upto and including 33kv performance requirements and type

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	tests. Fire tests on building materials and structures BS:476 IEEE:80 IEEE:142 DIN 46267 (Part-II) DIN 46329 VDE 0278 BS:6121 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 alongwith 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 buried 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 sub-zero level cable vault/trenches shall be provided below control building/switchgear rooms in plant. General
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	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 sqmm for aluminium conductor and 2.5 sqmm 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 galvanized 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
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	cable supporting steel work, hardware fittings 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 galvanised 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, drilling 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) RCC 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.
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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.

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

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Receptacles boxes shall be fabricated out of MS sheet 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 polyimide 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

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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

- b) Cable installation shall be carried out as per IS: 1255 and other applicable standards.
- c) 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.
- d) Cables shall be laid on cable trays strictly in line with cable schedule
- e) 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, H.T. 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.

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	f) Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255. g) Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/HDPE pipe. h) 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. i) 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. j) Wherever few cables are branching out from main trunk route troughs shall be used. k) Wind loading shall be considered for designing support as well Cable trays wherever required. l) Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures. m) 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 - Segregation means physical isolation to prevent fire jumping. - All cables associated with the unit shall be segregated from cables of other units. - 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
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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 enclosed 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's instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carry out satisfactory cable jointing/termination. Contractor shall

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	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.
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11.0 General civil works

11.0	General civil works This section describes the technical requirements of various civil works related to this specification such as design mix for concrete, brick masonry/ plastering/ painting etc for earth chambers, RCC foundation/ coping for lightning arrestors, concrete foundation/ coping for SMB structures, bore well construction with PVC-U casing pipe, underground water tank for module washing system etc. 1) Concrete/ RCC Works All RCC works shall be with design mix as per IS: 456 and the materials used viz. Cement, coarse & fine aggregate, Reinforcement steel etc. shall conform to relevant BIS standards. The contractor shall carry out concrete mix design well in advance prior to construction through NABL accredited laboratory/ Reputed Engineering Institute (IITs/NITs/ Government Engineering Institutes only). The minimum grade of RCC shall be M25 except for underground (UG) water tank where the
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	grade of concrete shall be minimum M30. PCC shall be of min. grade M10 (equivalent nominal Mix – 1:3:6) unless otherwise specified. Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383. Sand shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Sand, when used as fine aggregate in concrete shall conform to IS: 383. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116 Reinforcement steel shall be of high strength TMT bars of grade Fe500 D conforming to IS: 1786. Ductile detailing in accordance with IS: 13920 shall be adopted for superstructure and sub-structure of all RCC buildings and structures. For grouting works anti shrink ready mix grout of approved make or cement mortar (CM) grout with non-shrink additive shall be used. The grout shall be high strength grout having min. characteristic strength of 30 N/ mm² at 28 days. Foundation system shall be made to transfer loads safely to the soil for structures such as lightning arrestors etc, depending on soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability etc. All foundation system and foundation depth shall be decided based on the approved geotechnical investigation report. No foundation allowed on back filled soil and the foundation depth to reach up to NGL. All loads shall be considered in line with IS: 875. Seismic loads for design shall be in accordance with IS: 1893 and relevant Standards. IS: 2502 Code of Practice for Bending and Fixing of Bars for concrete IS: 5525 and SP: 34 shall be followed for reinforcement detailing. A minimum 75 mm thick PCC shall be provided below RCC wherever RCC is laid over the ground. Proper and sufficient formwork/shuttering shall be provided for the required period as per IS: 456. 2) Masonry Works Brick work shall be in cement mortar (CM) 1:6 & 1:4 for 230 mm and 115 mm thick brick wall respectively.
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	Bricks shall be of class designation 7.5 conforming to IS: 1077, IS: 2212 & IS: 3495. All concrete blocks shall be of min. compressive strength of 7.5 N/mm² and shall be of Grade-A conforming to IS: 2185. Bricks/blocks required for masonry work shall be thoroughly soaked in clean water tank for approximately two hours. Brick shall be laid in English bond style. Green masonry work shall be protected from rain. All masonry work shall be kept moist on all the faces for a period of seven days. Suitable damp proof course (DPC) shall be provided. The DPC shall be with PCC (1:2:4) using 6 down coarse aggregate and water proofing admixture. The min. thickness of DPC shall be 40mm 3) Plastering, Pointing & Coping Works All brick masonry work shall be provided with plaster. Wall and ceiling plaster shall be in cement mortar (CM) – 1:6 and 1:3 respectively. Thickness of plaster shall be 18mm and 12mm for rough and smooth surface of the brick wall respectively. The ceiling plaster shall be 6mm thick. All joints in stone masonry shall be raked and pointed in cement mortar (CM) – 1:3 except specified otherwise. Exposed top surface of brick or stone masonry shall be provided with 50 thick plain cement concrete (PCC) coping (1:2:4) with trawl finish. All exposed coping shall be provided with suitable slope and projection for easy drainage of water. 4) Foundation calculations The foundation system shall be made to transfer loads safely to the soil for the various structures, depending on soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability etc. All foundation system and foundation depth shall be decided based on the approved geotechnical investigation report. No foundation allowed on back filled soil and the foundation depth to reach up to NGL. All loads shall be considered in line with IS: 875. Seismic load for design shall be in accordance with IS: 1893 and relevant Standards. IS: 2502 Code of Practice for Bending and Fixing of Bars for concrete IS: 5525 and SP: 34 shall be followed for reinforcement detailing. A minimum 75 mm thick PCC shall be provided below RCC wherever RCC is laid over the
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ground. Proper and sufficient formwork/shuttering shall be provided for the required period as per IS: 456.

5) Design Loads

Unless otherwise specified elsewhere, Dead load, Live load, Wind load and Seismic load for buildings and structures shall be considered as per provisions of relevant IS standards.

The following minimum imposed load as indicated for some of the important areas shall, however be considered for the design. If actual expected load is more than the specified minimum load, then actual load is to be considered.

#	Area	Imposed Load
a	Roof	150 kg/ Sqm
b	Building floors	1000 kg/ Sq
c	RCC Floors (General)	500 kg/ Sqm
d	Outdoor platforms, Stairs, Landing/ Balconies, Walkway, Chequered plate & Grating floor	500 kg/ Sqm
e	Road	As per IRC Standard
f	Road culverts & allied structures over drain & pipe crossings	Design for class -'AA' loading (Wheeled & Tracked both) and check for Class-A loading as per IRC standard
g	Underground structures such as Sumps, Pits, Trench, Drain etc.	In addition to Earth pressure and Ground water table at FGL, a surcharge of 1 T/Sqm shall also be considered
h	Pre-cast cover over cable trench	400 kg/ Sqm

Primary Loads

1. Dead Load (DL)
2. Live Load (LL)
3. Wind Load (WL) – Both along X & Z directions
4. Seismic Load (EL) – Both along X & Z direction
- 5.

Design Load combinations

1. DL+LL
2. DL+LL $\pm$ WLx
3. DL +LL $\pm$ WLz
4. DL+LL $\pm$ ELx
5. DL+LL $\pm$ ELz

All buildings, structures and foundations shall be designed to withstand loads corresponding

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	to worst design load combinations. Unless otherwise specified elsewhere in the specifications, the DL, LL, WL and EL shall be estimated as per provisions of relevant BIS standards. Wind Load Factors K2, K2 and K3 – As per IS 875 (Part-3). However, minimum value for K1, K2 and K3 shall be 1.0. Unless otherwise specified elsewhere in the specifications, the Seismic Load shall be considered corresponding to Earth quake zone at site as per IS: 1893 – (Part- 4) 6) Transformer yard civil works 6.1 Transformer foundations shall be founded on piles/isolated spread footings depending on the geotechnical soil report. 6.2 Transformer foundation shall have its own pit that would cover the area of the transformer and radiators so as to collect any spillage of oil or oil drainage in case of emergency. 6.3 Oil pit shall be filled with granite stone gravel of 40mm size uniformly graded. The retention capacity of the transformer pit shall be minimum 1/3 volume of the transformer oil which is filled with gravel with 300mm free space above gravel fill. 6.4 The individual transformer oil pit shall be connected to an oil collection pit which shall be sized to accommodate full oil volume of the transformer connected to it without backflow. The oil collection pit shall be connected to oily water drainage system. Dimensions of the discharge pipe shall consider rainfall intensity also. Water shall be discharged into the nearest drain by gravity flow or pumping. 6.4 Both the transformer pit and the oil collection pit shall be of RCC. The oil collection pit shall be provided with RCC cover. 6.5 Area around the transformer and earth chambers shall be covered with gravel. 6.6 Transformer yard fencing shall be GI chain link fence mesh fabric. Mesh size shall be 40x40 mm maximum using wire gauge of 3.15mm minimum thickness, both ends twisted conforming to IS: 2721 with suitable internal corner and stay posts of GI angles along with 230 thick brick/ 300 thick RR masonry toe wall, 150mm height above GL. Brick masonry toe wall shall be plastered with 15 thick CM (1:4) plaster on both faces and shall be minimum 50 thick PCC (1:2:4) coping finished smooth and projecting 40mm on either side of the wall and top sloping inwards.
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	Height of the chain link above the foundation level shall be 1.8m minimum. All vertical, stay and corner posts shall be hot dip galvanized conforming to relevant IS code. Galvanization shall be done after completion of fabrication works, cutting of notches, punching holes etc. Galvanization of fence fabric and tie wire shall conform to IS: 4826. Minimum size of GI angle for internal, corner and stay post shall be 50x50x6 mm spaced at 2.5m c/c and conforming to IS: 808-1989. Every corner post shall be provided with two stay posts along either side fence. Fencing gate of 3.5m wide shall be of MS pipe frame with welded wire fabric mesh including all accessories and fittings. Top level of the gate shall be on par top level of fence. MS angle posts shall conform to IS: 2062. Portion of the fence covering towards rail track shall be made of removable type for movement of transformer during erection/ removal. In addition, a small gate, 1.2m wide shall be provide for man entry for maintenance purpose. The transformer yard fencing work shall conform to CEIG requirements. Gates as above shall be painted using silver paints as per CEIG requirements. 6.7 Transformer track rails shall conform to IS: 3443. 7) Structural Steel All structural steel shall design shall carried out as per IS 800. Structural steel shall conform IS 2062, Pipe shall be as per medium/high grade of IS 1161, Chequered plates shall conform to 3502 and Hollow steel sections for structural use shall conform to IS: 4923. 8) Grouting Cement mortar (1:2) grout with non-shrink additives shall be used for grouting below base plate of column. The grout shall be high strength grout having a minimum characteristic compressive strength of min 30 N/mm² at 28 days. The grout shall be chloride - free, cement based, free flowing, non-metallic grout. 9) Bore wells Boring and sinking by rig boring system of min 150 mm x 100 mm dia well to be drill to assess potentiality & quantity / availability of water level for deciding filter position through any type of soil, rock & boulders for. Bore well shall be min of 250 mm dia. Minimum 10 deep tube well and supply, installation of casing pipes, submersible pumping set including all mechanical & electrical accessories, fittings etc. complete at site for Solar Module cleaning systems and
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	water supply to buildings requirement. PVC-U casing pipes shall be as per IS 12818.
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12.0 Pre-commissioning inspections/checks/tests on AC side, MRT tests, coordination/liaison with state / central departments/ CEIG etc for necessary approvals/clearances for commissioning, synchronization with grid/ plant commissioning:

12.1	Pre-commissioning inspections / checks / tests on DC side Vendor shall carry out following minimum pre-commissioning checks: (1) Verification of firmness of SPV module interconnections (MC4) (2) Verification of firmness SMB input terminations (MC4) (3) Verification of firmness of DC cable terminations at SMBs/ PCUs using torque wrench (for the specified torque values) (4) Verification of firmness of RS485 cable terminations (5) Verification of firmness of all earthing connections (6) Cable megger/ continuity check for all DC power cables: 1Cx10, 1Cx300 (to be checked and recorded during installation) (7) Measurement of open circuit voltage of individual strings and combined output of SMBs. (8) Measurement of earth resistance at individual earth pits of solar array: (a) as disconnected from earth mat grid and also, (b) as connected to earth mat grid (9) Submission of test reports for BHEL/BEL approval												
12.2	Pre-commissioning inspections/checks/tests on AC side, MRT tests, coordination/liaison with state / central departments/ CEIG etc for necessary approvals/clearances for commissioning, synchronization with grid/ plant commissioning: <table><tr><th colspan="3">Scope description</th></tr><tr><td colspan="3">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.)</td></tr><tr><td>A</td><td colspan="2">Basic checks</td></tr><tr><td></td><td>A1</td><td>Tightness checks:</td></tr></table>	Scope description			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:
Scope description													
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	A1	Tightness checks:											

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		1) Terminations of AC power cables at PCUs, Inverter transformers, Aux transformer, ACDB panel, UPS/ FCBC/ Battery banks, Aux AC/DC DB boards, ABT metering panels, 33kV VCB panels, SCADA panels. 2) Terminations of Control/ Instrumentation/ Data/ Communication cables wherever applicable. 3) Terminations of earthing at all electrical equipments/ 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 (4 Nos, ~2.9MVA) and Aux transformer (1 No, 150kVA)	
		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. 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	

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	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
		1) IR tests 2) Contact resistance measurement (CRM) 3) Timing test: close/ open/ close-open 4) Functional checks: breaker open/close, spring-charged motor 5) 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 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
		1) MFM meters 2) Trivector meters 3) ABT meters 4) Protection relays
	B8	ACB breaker settings (with the help of PCU service engineer at site)
		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 bank
		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 33kV metering yard at plant side, 33kV transmission lines and 33kV/132kV switchyards at substation 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 above approvals rests with the above said upstream contractor of BHEL. However, wherever technical clarifications are required by the approving agencies with regard to SPV

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		portions (including solar array) up to 33kV side hooking-up to the metering yard at plant side, 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 vendor. 3) Following are the areas of approval, as applicable, for the SPV-side portions including solar array and up to 33kV side connection point to metering yard. (a) Schemes/ layouts/ calculations such as earth mat design, solar array layout, lighting arrestor layout, module cleaning system, cable trench layout, plant lighting system, fire alarm system etc. (b) GTP/ datasheets/ GA drawings/ Bill of materials, MQP etc of supply items. (c) GA drawings of installation such as foundation/ oil pits of inverter transformers / auxiliary transformer etc. (d) Factory test reports of supply items including BHEL-supplied items. (e) Site test reports of transformers, transformer oil, VCB breakers, CTs, PTs, resistance of earth mat grids etc (f) 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. (g) Interaction/ coordination with customer (BEL) in the above process as and when required. (h) 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. (i) Subsequent to site inspection by the concerned agency, vendor shall support the upstream 33kV/132kV transmission line/ switchyard contractor in following-up with them to obtain their clearance for line charging/ grid synchronization. (j) Vendor shall implement all the observations of CEIG related to SPV-side portion including solar array and up to 33kV connection point to metering yard at plant end.	
	E	Commissioning of power plant	
		1) Vendor shall organize presence of an electrical consultant at site at the time of commissioning with no additional charges to BHEL. The consultant shall have adequate expertise in the form of knowledge/ experience in this field. He shall be able to guide the site team on the steps/ procedure/ precautions to be adopted during commissioning. Also, he shall be cable of extempore	

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			trouble-shooting in case of any technical problems encountered on SPV portions up to 33kV connection to metering yard. Vendor shall submit credentials of the proposed consultant for BHEL/BEL approval prior to awarding of work/ availing their service. 2) Vendor shall organize all necessary tools/ measuring instruments required to operate the various electrical equipments 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). 3) It is the responsibility of the vendor to interact technically with upstream contractors for successful charging of 33kV/132kV grid lines at plant side/ substation side respectively followed by grid synchronization of inverters/ plant commissioning. 4) 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 33kV transmission line, 33kV/132kV switchyards at substation.	
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13.0 Spares

13.1	Spares on DC side for O&M purpose Vendor shall supply following spare items along with main consignment of respective supply item. These shall be exclusively reserved for use during 10-year Operations and Maintenance. Spares/ replacements of all the vendor-supplied items until date of plant commissioning shall be separately taken care of by the vendor. (a) MC4 connectors: 200 sets (each set: female + male) (b) Y-connectors for SMB: 20 Nos (c) Bimetallic (Cu/Al) cable lug 300 sqmm (at SMB side): 20 Nos (d) Bimetallic (Cu/Al) cable lug 300 sqmm (at PCU side): 20 Nos (e) Straight-through jointing kit for 1.1kV 1Cx300 cable (Al, XLPE, armoured, PVC): 10 kits (f) Module cleaning system items: 1) Valve at delivery point: 5 Nos 2) All other valves: 2 Nos each type 3) Submersible pump: 1 No 4) Surface pump (booster pump): 1 No 5) Pressure gauge: 2 Nos
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13.2	Spares on AC side: 1) 33kV termination kit for 1Cx300 cable: 15 Nos 2) 33kV straight through jointing kit for 1Cx300 cable: 9 Nos 3) Fuses of all types: 10% of total population of respective items 4) MCCB, MCB of all types: 10% of total population of respective items 5) Indicating lamp set of all types: 10% of total population of respective items 6) Surge protection devices/ MOV: 10% of total population of respective items 7) Plant lighting LED lamps: 5% each type. 8) Spares of aux transformer: a) HV bushings with metal parts and gaskets: 1 set of 3-phases b) LV bushings with metal parts and gaskets: 1 set of 3-phases c) Neutral bushing with metal parts and gaskets: 1 set of 3-phases d) Gaskets : 2 Nos each of all types e) Silica gel breather with charge: 3 Nos f) Diaphragm of explosion vent: 1 No g) Prismatic oil level gauge: 1 No h) Valves: 1 No each of all types Note: In case percentage is a decimal figure, it shall be rounded up to next higher integer.
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14.0 General conditions applicable during supply, installation and commissioning phase

14.1	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.
14.2	Similarly, water required for construction works shall be organized by vendor. Bore wells, which are deliverables of vendor as part of this contract, shall be dug in the beginning stages so that bore well water itself can be used for the construction purposes. In case bore well is not successful, vendor shall make their own alternate arrangements (tankers etc).
14.3	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.
14.4	All necessary tools and tackles such as crimping tool (including heavy duty tools for crimping copper/ aluminium cables up to 300 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.
14.5	All necessary measuring instruments such as measuring tapes, digital multimeters, vernier calipers, electrical testers, digital meggers (1kV, 2.5kV, 5kV), lamp load testers for solar

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	array string measurements, earth resistance meters, weighing machines, water level indicators etc shall be organized by the vendor.
14.6	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.
14.7	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.
14.8	Vendor shall maintain updated labour register, with name, age, qualification, salary, attendance details etc at the site.
14.9	Vendor shall use danger boards, wherever required, to ensure safety of the persons during the work at site.
14.10	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.
14.11	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 earth mat trench, cable trench etc, vendor shall finish the land neatly with necessary leveling, rolling etc.
14.12	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.
14.13	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.
14.14	No child labour shall be employed for execution of the present contract.
14.15	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.
14.16	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 etc as applicable shall be earthed.

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14.17	BHEL/BEL 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/BEL for procurement of the item from dealers.
14.18	Field Quality Plan / Quality control system 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/BEL. 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/BEL 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/BEL.
14.19	Any deviations shall be discussed with BHEL/BEL site engineers and implementation shall be taken up only after approval from BHEL /BEL.
14.20	Vendor shall submit periodic status report, on daily as well as weekly consolidated basis, to BHEL on the progress of the contract.
14.21	Vendor shall, as and when required by BHEL/BEL, participate in the review meetings conducted by BHEL/BEL at project site, BHEL-EDN (Bangalore), BHEL-Corporate office (New Delhi), BEL office (Bangalore) etc.
14.22	General Guidelines - 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. - Vendor shall prepare all designs / drawings based on the specifications given in the tender and in light of relevant BIS/IS/ equivalent standard. - Vendor shall provide type test reports and datasheet/ GTP for all equipments covered under vendor scope of supply. - BHEL reserves right to modify the design at any stage to meet local site conditions / project requirements. - 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.

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15.0 Operations and Maintenance

15.1	Date of commencement of operations and maintenance Zero date for O&M shall be the actual date on which the power plant is commissioned with synchronization of PCUs to grid / export of power for full 10MW (AC). O&M shall be for 10 years with scope of solar plant up to the point of hooking up to the 33kV metering yard on the plant side.
15.2	O&M personnel 1. Vendor shall deploy following minimum personnel: (a) Technical / administrative / office personnel • One technical-cum-administrative in-charge having graduation in electrical/ electronics engineering and experience with overall responsibility for complete plant operations. The in-charge shall have competence to deftly handle technical and operational / crisis problems. • Five working level staff with ITI / diploma level qualifications in engineering with competence for operating electrical/ electronics/ mechanical equipment, taking measurements, data logging / maintaining registers, preparation of reports in computer. • Six unskilled persons for regular house-keeping (cleaning / mopping etc) • Number of persons required for water cleaning of SPV modules on daily basis shall be decided considering maximum 7 days per cleaning cycle. However, during PG test for 30 days, number of persons shall be decided accordingly as to ensure cleaning at the rate of maximum 3 days per cycle. • Number of skilled/unskilled persons (as applicable) required for changing the tilt angle of all the module mounting structures two times every year (6 deg, 36 deg) shall be decided considering maximum 7 days per tilting cycle. • Note: At least one among the technical personnel shall essentially have certification/ license for HT operations (33kV minimum) issued by reputed government agency. Evidence documents shall be submitted for BHEL/BEL approval during detailed engineering. This is a mandatory requirement. (b) Security personnel • Nine security guards with competence to handle tough situations and safeguard the plant from miscreants. • Among these, number of persons per shift shall be as per BHEL/BEL approval during detailed engineering. 2. Vendor shall provide uniforms for the O&M staff. 3. Similarly, O&M personnel shall be provided with raincoats, toolsets, earthing rods, safety gloves, safety goggles, gumboots, helmets and all other personal protective equipment

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	(PPE) that will be relevant to ensure human safety. 4. Names, qualification, work responsibility of personnel shall be listed on a display board within control room. 5. Attendance registers shall be maintained for all the staff, workmen and security guards. 6. Vendor shall ensure statutory requirements such as ESI, PF and labour license for their O&M personnel posted at site. 7. BHEL/BEL shall have right to disallow any O&M employee, if found unfit to perform. BHEL instructions issued in writing shall be binding on vendor who shall replace the person. 8. O&M personnel at site shall conform to general regulations in force at site and to any special instructions from BHEL/BEL administration. 9. O&M personnel at site shall be deemed to be aware of damages and risks incidental to conditions of ordnance factory land & works from time to time and BHEL/BEL shall not be responsible for any injury to personnel arising there from. 10. Training to O&M personnel It is the absolute responsibility of vendor to ensure imparting of necessary training to their O&M personnel to get them acquainted with the operations of various electrical and mechanical equipment of the power plant. For this purpose, vendor shall identify the O&M personnel well in advance and involve them during installation and commissioning stages so that they become well versed with various functional aspects of the power plant. 11. Availability of O&M personnel at power plant (a) Vendor shall ensure that operating staff are present in the power plant during 7:30 AM – 6:30 PM every day. (b) Vendor shall ensure that certain minimum operating staff are present at the power plant even on festivals, public holidays and any other unique occasions so that the plant is run under competent supervision on all days. 12. O&M personnel shall, strictly, not use any part of the power plant for their personal / residential purposes. Their presence at the plant shall, strictly, be meant only for the purpose of operation and maintenance of plant.
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15.3	Responsibility of vendor during PG test Vendor shall, in addition to the O&M activities (as per this specification), carry out the initial acceptance test and Performance Guarantee test (PG test). PG test shall commence on a date (as mutually decided by BHEL/BEL) after successful completion of initial acceptance test that is carried out for 7 continuous days and evaluated with reference to performance ratio (PR) as per IEC 61724. PG test is the final acceptance test conducted for a period of 30 days to prove the performance of the power plant with reference to PR. Vendor shall carry out the following activities during this period: 1. O&M activities as per this specification 2. Monitoring of power plant parameters including SCADA 3. Reporting the power plant parameters to BHEL/BEL on daily basis
15.4	O&M operations – daily basis (1) Water cleaning of SPV modules with one cycle of cleaning of all the modules of the power plant not exceeding 7 days. In order to fulfil this requirement, vendor shall organize all necessary resources such as (a) manpower (number of persons for the cleaning work), (b) number of simultaneously-operating teams, (c) machinery/ materials/ accessories such as pressurised water pumps, hose pipes, nozzles etc. Whenever the integral module washing system of the plant is not operational due to reasons of any kind, vendor shall make alternate arrangements such as water tankers, water delivery mechanisms (pumps, hoses, nozzles and other fittings), operating personnel etc required to fulfil the above specified cleaning of max 7 days/cycle. Note: For water cleaning activity, separate manpower shall be deployed. Accordingly, the technical/ administrative/ office personnel or security guards shall not be used for this purpose. (2) Inverter room / main control room cleaning – dry sweeping, wet mopping. Vendor shall provide suitable vacuum cleaners. (3) Water wash cleaning of toilets, urinals (4) Gardening of landscaping areas: watering of plants, trimming of plants as applicable and necessary. (5) Logging of DC, AC, grid parameters (current, voltage, power, energy) at PCUs & VCB panels, transformer temperatures, equipment tripping/ breakdown, grid outage etc as per BHEL formats. (6) SCADA data station / PC operations for daily monitoring of weather parameters, trend graphs and urgent reporting to BHEL/BEL in case of any problems/ anomalies observed with any of the parameters. (7) Drinking water to be arranged for O&M personnel at site.

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15.5	O&M activities – weekly basis (1) Removal of garbage from solar array field, switchyard, roads, drains, pathways, sand buckets; logging in registers with signatures of operating persons and in-charge. (2) Monitoring and logging of fire extinguisher levels / pressures as per BHEL formats
15.6	O&M activities – monthly basis (1) Inspection of fire extinguishers (weight, pressure indication, physical status etc) followed by refilling actions, if necessary, based on indications. Report to be submitted as per BHEL approved recording formats. (2) Earthing resistance measurements for solar array structures, control room equipment, switchyard equipment and lightning arrestors: measured values shall be recorded in registers and reported to BHEL as per BHEL approved recording formats. (3) Submission of values / status of plant parameters and events for the corresponding month, as below, as per BHEL approved formats: a. Daily values of solar array strings (SMB parameters) b. Daily values of weather parameters (solar energy, wind speed, ambient temperature) c. Daily energy generation d. Events (with date, time) of faults / tripping / breakdown of equipment e. Events (with date, time) of grid outage f. Events (with date, time) of equipment damages, accidents and thefts g. Activities of module cleaning (4) Monthly reports shall be submitted to BHEL for all the above data. (5) Energy generation / meter reading report to be prepared and submitted to the concerned department. Signatures from BHEL/BEL representatives shall be obtained wherever required.
15.7	O&M activities - quarterly basis (1) Cleaning of PCUs, LT panels, VCB panels, UPS panels etc to remove accumulated dust. (2) Monitoring and status review, followed by rectification/ calibration/ replenishment/ replacement actions as necessary and applicable for following: (a) Spare items of all electrical equipment (b) First aid box items - medicines and accessories (c) Safety gadgets (d) Tool kits and measuring instruments (e) Yard lights (f) Pumps, starters (g) Control room appliances: air conditioners, lights, fans, exhaust fans, switch boards etc (3) Pest control for control room (rats, snakes etc) – sprays, chemicals, medicines etc to be applied wherever required. (4) Submission of quarterly report on above activities to BHEL.

	Technical specification for Design, supply, installation and commissioning of 10MW (AC) solar PV plant at Ordnance Factory Bolangir Odisha	PS-439-1109
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15.8	O&M activities – half yearly basis (1) Cleaning of overhead water storage tanks
15.9	O&M activities – yearly basis (1) BDV measurements for oil samples from all transformers and submission of report to BHEL/ BEL. (2) Filtration of oil to be arranged, if required based on BDV measurement report. (3) Lubrication of moving contacts (VCBs, isolators etc) with appropriate grease etc (4) Cleaning of sewerage lines, septic tanks (if found necessary) (5) Painting of main gate, switchyard gate / fencing, earthing chambers, other steel structures within control room and switchyard if required based on conditions of rusting etc. (6) Checking tightness of hardware in solar array structures and tightening wherever required. (7) Checking tightness of power cable terminations in SPV modules (MC4), SMBs, electrical panels of control room and switchyard.
15.10	O&M activities - as and when required (contextual basis) (1) Monitoring and operation of plant electrical equipment as and when required: (a) VCB on/off: local operations from VCB panels and remote operations from SCADA system. (b) Settings of numerical relays in VCB panels: review and revision in consultation with BHEL. (c) ACB and MCCB on/off operations on LT side (d) PCU operations: emergency close, displays (selection of settings, monitoring the DC/ AC/ event/fault status parameters), operation of duct fans, cleaning of filters (e) UPS panels and Battery bank operations (f) Bore well pump operations to fill the water storage tanks (2) Seasonal tilting of MMS structures from one angle to the other (two angles; 6, 36 degrees) based on tilting angle chart that will be finalized by BHEL/BEL during detailed engineering phase. This is a critical activity as energy generation is strongly affected by the angle. Vendor shall deploy all the necessary tools/ tackles/ machinery etc for this purpose. Number of skilled/unskilled persons (as applicable), to be deployed, shall be decided considering tilting of all the MMS structures within maximum 7 days per cycle. (3) Coordinating, on behalf of BHEL, and obtaining renewal of statutory licenses, clearances and approvals from state departments such as electricity boards, CEA/CEIG etc. (4) Repair and replacement of vendor supplied items, by vendor, with urgent action plans and implementation, when the items are found non-working / damaged. The same shall be reported to BHEL within 12 hours from time of observation. (5) Reporting, on an immediate basis (within max 2 hours) of functional problems / damages in BHEL supplied items to facilitate repair / replacement by BHEL. Further, vendor shall correspond / coordinate with respective equipment vendors / service centers, on behalf

	Technical specification for Design, supply, installation and commissioning of 10MW (AC) solar PV plant at Ordnance Factory Bolangir Odisha	PS-439-1109
		Rev No: 00
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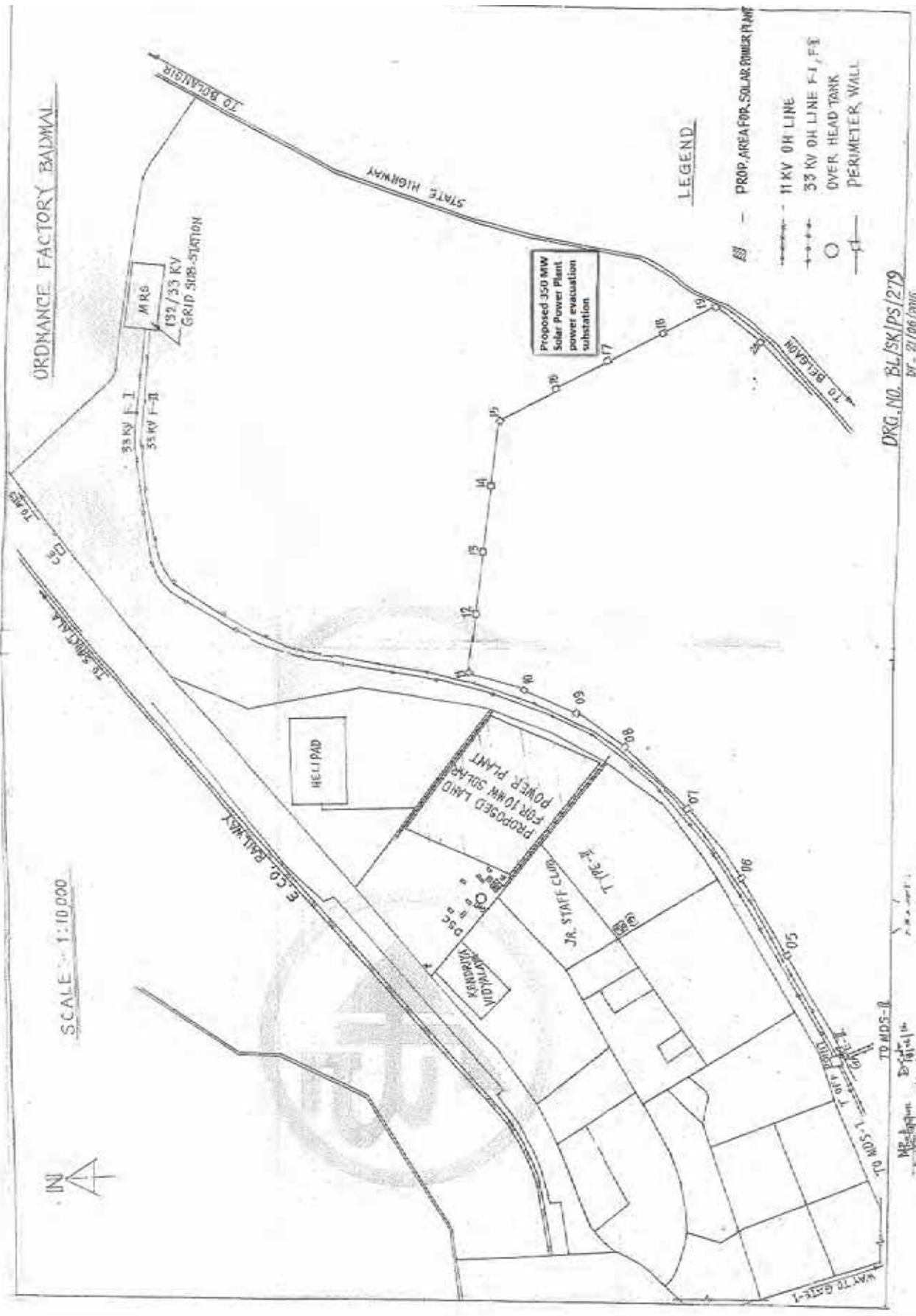
	of BHEL, for getting the service engineers to the site. Later, coordinating with the service engineers during their visit to site, and assisting them in the trouble shooting process until the problem is resolved. Vendor shall report to BHEL (within max 2 hours) immediately after the problem is resolved. (6) Vendor shall keep updating the spares inventory at the site every time there is consumption of spare items towards replacement. In case of shortage of spares, the same shall be reported on an urgent basis (with max 2 hours) to BHEL. (7) Coordinating with sub-station upon grid failures, line problems etc and implementing the needful steps to restore the plant to normal operation. (8) Theft incidents: immediate reporting to BHEL, filing FIRs with police stations on behalf of BHEL, coordination for site inspection by insurance companies and clearance of insurance claims, logging of events (date, time) and maintaining records. (9) Accidents: immediate reporting to BHEL, coordinating with hospitals, logging of events (data, time) and maintaining records.
--	---

16.0 Documents to be submitted for BHEL/BEL approval during detailed engineering

16.1	BHEL/BEL 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).
16.2	Name of vendor / make, model number / part number, specification / sizes / dimensions / drawings / datasheets shall be submitted for all the vendor supplied items.
16.3	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) MC4 connectors, cable ties for module interconnections/ dressing of 1Cx10 cables in solar array/ dressing of cables on cable trays in inverter/ main control rooms etc, HDPE DWC conduit for 1Cx10 array cable, HDPE DWC conduits for control/ communication cables from transformer marshalling box to SCADA/HT panels etc, HDPE pipe for RS485 cables, PLB HDPE pipe for OFC cables, RCC Hume pipes at cable entry points of inverter/ main control rooms and for water drain outlets in 33kV transformer yards. (2) All cables that are in vendor scope of supply (3) Cable glands, cable lugs of all types (4) Routing layout for 1Cx10 cable with locations of string monitoring boxes (5) Underground trench for 1Cx10 between rows: routing layout/ trench cross sections etc (6) Underground trench for 1Cx300/ RS485: routing layout/ trench cross sections etc (7) Underground trench for 1Cx300 33kV cables, Aux AC cables, OFC cable: routing layout/ cross sections etc (8) RCC cable trench in 33kV transformer yard (9) Lightning arrestors (ESE) system: design calculations, layouts, GA, BoM etc.

	Technical specification for Design, supply, installation and commissioning of 10MW (AC) solar PV plant at Ordnance Factory Bolangir Odisha	PS-439-1109
		Rev No: 00
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	(10) Bore well / booster pump head calculations (11) Module cleaning system: design calculations, layouts, BoM, electrical circuit diagram, water circuit diagram etc (12) Underground sump tanks: design calculations, GA/BoM, cross sections etc (13) GI cable trays for internal cable trenches and outdoor RCC trenches (14) LT straight through jointing kits, 33kV termination kits, 33kV straight through jointing kits (15) Earth mat grid for solar array: design calculations, layout, BoM, cross sections etc (16) Earth chambers for solar array, lightning arrestors (ESE) etc: GA/BoM, layout, cross section etc (17) Earth mat grid for inverter rooms: design calculations, layout, BoM etc (18) Earth mat grid for main control room: design calculations, layout, BoM etc. (19) Earth chambers of inverter/ main control rooms: GA, cross section, BoM with GTP/ datasheets etc (20) Aux transformer sizing calculations (21) UPS/ FCBC/ Battery bank sizing calculations for main control room and inverter rooms. (22) Plant 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. (23) Fire detection/ alarm system: layouts in inverter rooms, layout in main control room, overall layout with zones/ sensor/ hooter/ control panel locations, BoM with GTP/ datasheets etc. (24) Security cabin, watch cabins: foundation design calculations, GA drawings (25) Any other designs/ schemes/ layouts etc as applicable as per BHEL/BEL requirements that will be discussed during detailed engineering.
16.4	Manufacturing Quality Plans for all the vendor supplied items
16.5	Field quality plan for the field work: civil works, electrical works
16.6	Detailed activity-time chart for project implementation
16.7	Detailed manpower deployment schedule
16.8	Installation manuals for MC4 connectors, chemical earthing electrodes, lightning arrestors (ESE), fire alarm systems, submersible pumps, surface pumps etc.
16.9	Operation and maintenance manuals of MC4 tool kits, lightning arrestors (ESE), fire alarm systems, submersible pumps, surface pumps etc.



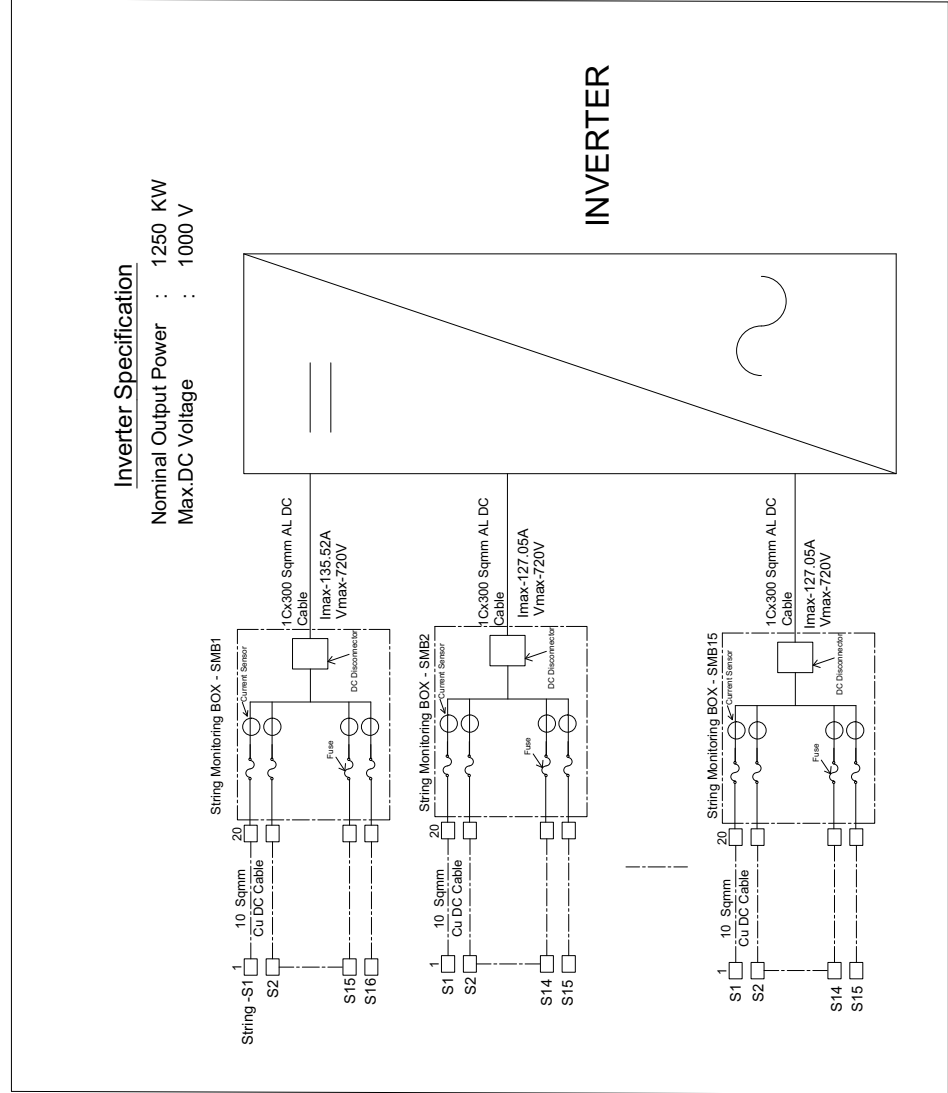
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DT - 21/06/2016

MR. [Name] [Signature]
[Title]
[Date]

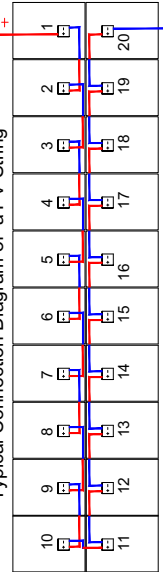
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Note:

- All SMBs shall have provision for 16 strings. However, 14 SMBs shall be connected with 15 strings and 1 SMB shall be connected with 16 strings (Total 226 strings per inverter).

Typical Connection Diagram of a PV String



MODULE PARAMETER

Power - 305 Wp
Imp - 8.47 A
Vmp - 36 V
Isc - 8.8 A
Voc - 45 V

DC Switch Disconnector
315A, 1000V

DETAILS

Module Type	Poly Crystalline
BHEL Model	L24270P
No. of modules in one string	20
Total no. of modules/inverter	4520
No. of String per Inverter	226
No. of Module mounting structures / Inverter	226
String Monitoring Box (SMB)	16 IN 1 OUT
No. of SMBs per Inverter	15
Rating of Inverter	1250 KVA
Cable Size-String to SMB	1Cx10 mm Copper Cable
Cable Size-SMB to Inverter	1Cx300 sq mm Al armored cable

PRODUCT : 10MW SPV Power Plant, O.F. Badmal, Bolangir
CUSTOMER: BEL

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

TITLE:

DC SINGLE LINE DIAGRAM

REV.	DATE	ALTERED CHECKED	REV.	DATE	ALTERED CHECKED	NAME	SIGN	DATE	DEPT.	CODE	No. OF SHEETS
						LNK		26.12.16	SC&PV	439	3
						VKY		26.12.16			2
						VKG		26.12.16			REV
											01

DRG. No.

BEL-OFBOL-SL-E002

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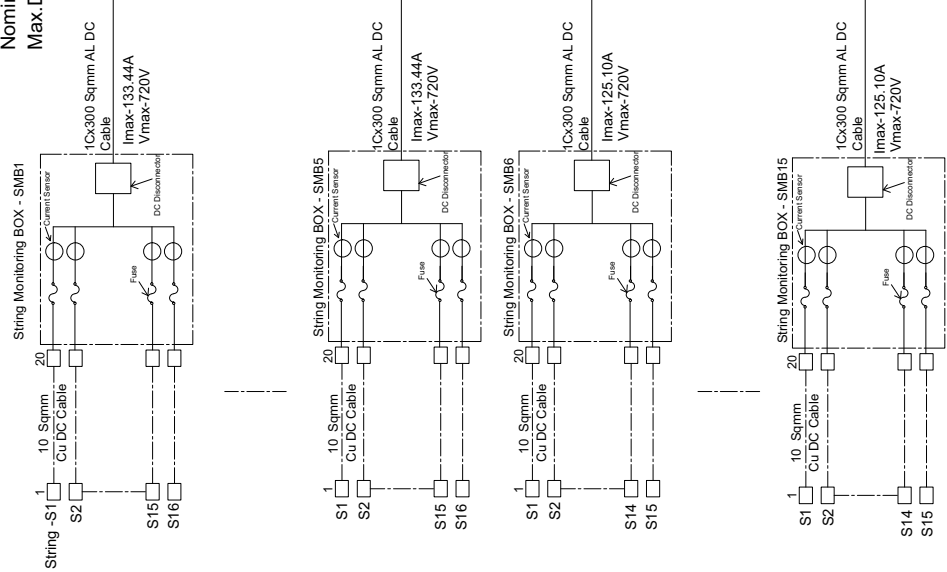
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SIGN. & DATE

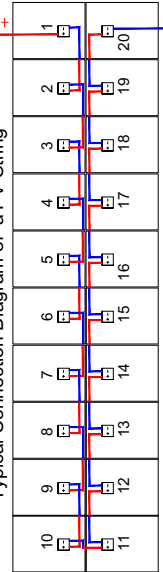
INVENTORY No.

Inverter Specification

Nominal Output Power : 1250 KW
Max.DC Voltage : 1000 V



Typical Connection Diagram of a PV String



MODULE PARAMETER

Power - 300 Wp
Imp - 8.34 A
Vmp - 36 V
Isc - 8.7 A
Voc - 45 V

DC Switch Disconnector
315A, 1000V

DETAILS

Module Type	Poly Crystalline
BHEL Model	L24270P
No. of modules in one string	20
Total no. of modules/inverter	4600
No. of String per Inverter	230
No. of Module mounting structures / Inverter	230
String Monitoring Box (SMB)	16 IN 1 OUT
No. of SMBs per Inverter	15
Rating of Inverter	1250 kVA
Cable Size-String to SMB	1Cx10 mm Copper Cable
Cable Size-SMB to Inverter	1Cx300 sq mm Al armored cable

Note:

- All SMBs shall have provision for 16 strings. However, 10 SMBs shall be connected with 15 strings and 5 SMBs shall be connected with 16 strings (Total 230 strings per inverter).

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		APPROVED			CHECKED	VKY		26.12.16
		APPROVED			APPROVED	VKG		26.12.16



DEPT.	CODE
SC&PV	439



INVENTORY No.

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

TITLE:

DC SINGLE LINE DIAGRAM

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

PRODUCT : 10MW SPV Power Plant, O.F. Badmal, Bolangir
CUSTOMER: BEL

WBS. No.

DRG. No.

BEL-OFBOL-SL-E002

REV

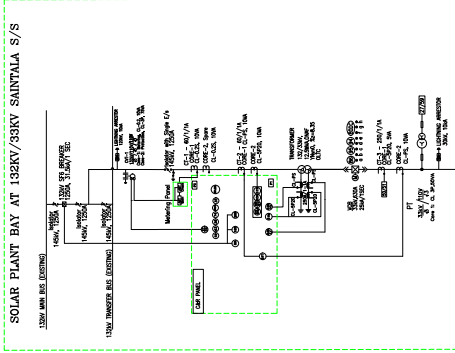
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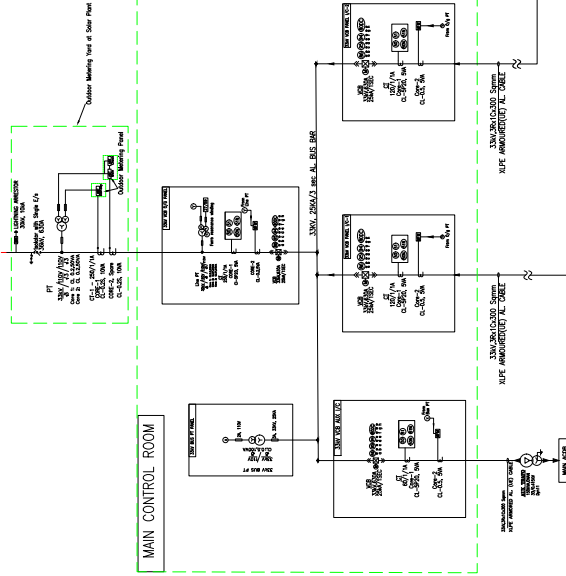
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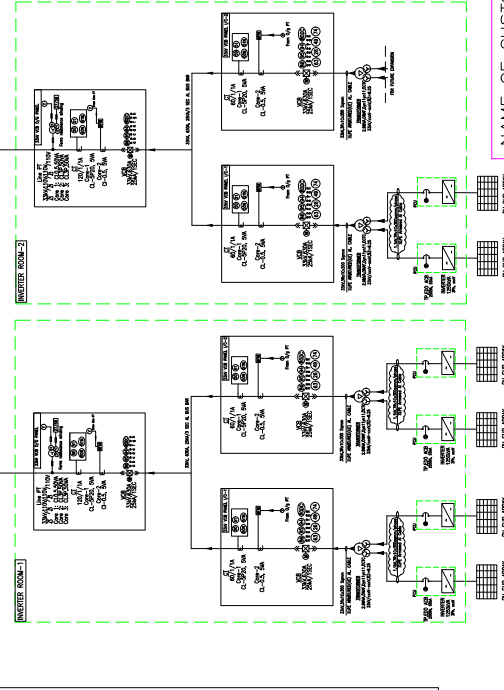
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33KV Overhead Transmission line



33KV/11KV Transformer

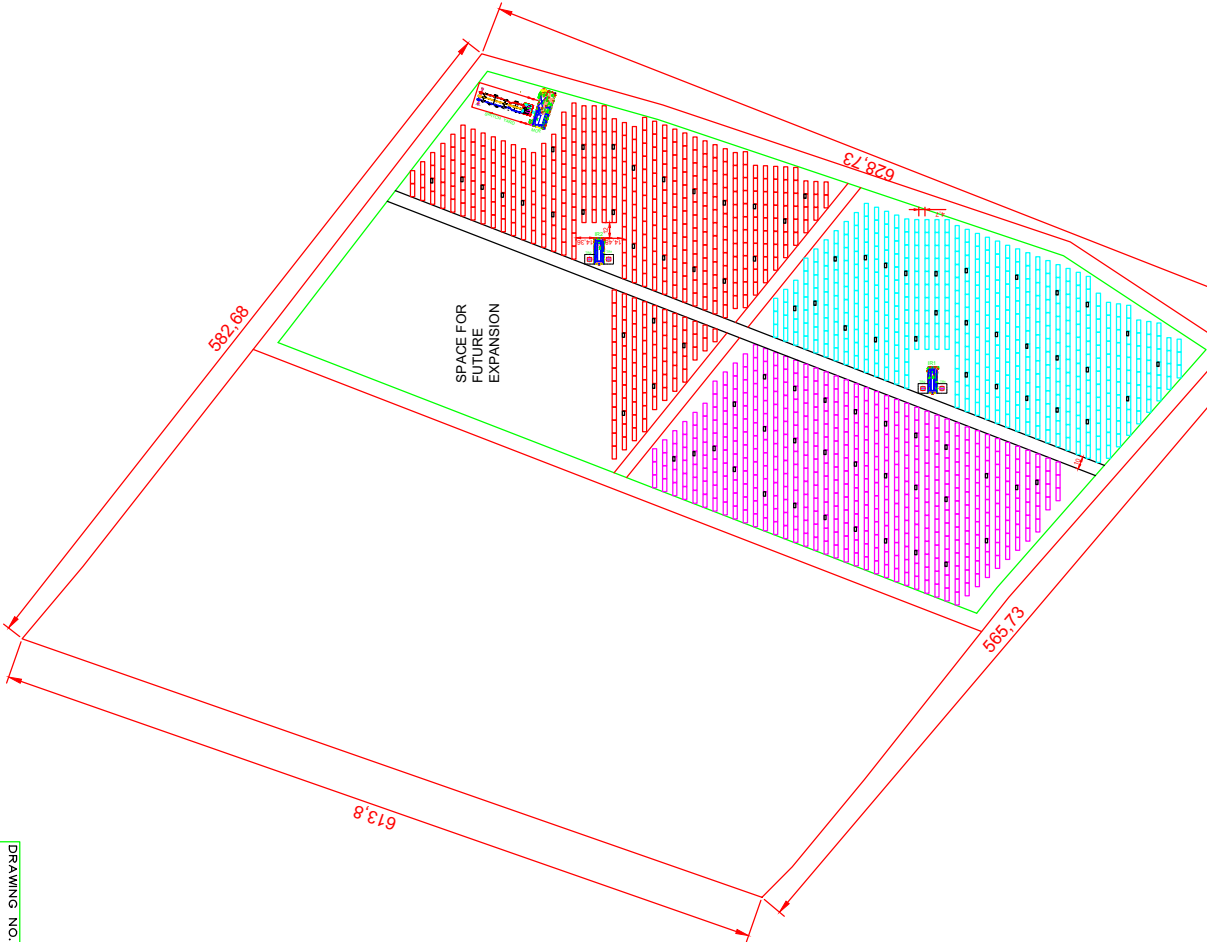


NOTE:
OUTPUT FROM SOLAR POWER PLANT IS EVACUATED THROUGH 33KV OVERHEAD TRANSMISSION LINE (ACSR CONDUCTOR LAID ON RSJ POLES).

LEGEND DETAILS

SL. NO.	SYMBOL	DESCRIPTION
1		INVERTER TRANSFORMER
2		132 KV SF6 BREAKER
3		MASTER TRIP RELAY
4		TRIP CIRCUIT SUPERVISION RELAY
5		ANTI PUMPING RELAY
6		BUCHHOLZ RELAY
7		MAGNETIC OIL LEVEL GAUGE
8		WINDING TEMP INDICATOR AND OIL TEMP INDICATOR
9		PRESSURE RELIEF DEVICE
10		RST OVER CURRENT RELAY
11		RMT OVER CURRENT RELAY
12		NEUTRAL INRUSH/OVER CURRENT RELAY
13		SMT EARTH FAULT RELAY
14		MULTI FUNCTION METER
15		CURRENT TRANSFORMER
16		UNDER VOLTAGE RELAY
17		OVER VOLTAGE RELAY
18		POTENTIAL TRANSFORMER
19		FUSE
20		AFT SHIFT ENERGY METER
21		DC FAILURE INDICATOR
22		INVERTER, 1500VA
23		ELECTRICALLY DRAW OUT AIS
24		LIGHTNING ARRESTER
25		RESTRICTED EARTH FAULT RELAY (N SIDE)
26		TRANSFORMER DIFFERENTIAL RELAY
27		ANNUNCIATOR RELAY
28		LOCAL BREAKER BACKUP PROTECTION
29		TRIP CIRCUIT SUPERVISION RELAY
30		RESTRICTED EARTH FAULT RELAY (M SIDE)
31		DIRECTIONAL OVER CURRENT RELAY
32		SOLATOR WITH SINGLE EARTH SWITCH
33		SOLATOR

NAME OF CUSTOMER		BEL		NAME OF PROJECT		10 MW (AC) SOLAR PV POWER PLANT AT BEL ORDNANCE FACTORY BOLANGIR	
BHARAT HEAVY ELECTRICALS LIMITED		ELECTRONICS DIVISION, BANGALORE		SCALE		NTS	
DEPT. SCPV		FOR UNSPECIFIED TOLERANCES		REFER ED 0230499		REV. DATE	
439		APPROVED		APPROVED		APPROVED	
REV. DATE		REV. DATE		REV. DATE		REV. DATE	
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DRAWING NO.		BEL-OFBOL-SL-E001		SHEET NO.		01	
NO. OF SHEETS		01		NO. OF SHEETS		01	



ARRAY DETAILS

PV ARRAY CAPACITY

Total no.of PV Modules (>=300Wp) 26880 nos

PV Modules in series string

Total No. of strings 1344nos

Inverter 1250KVA
6 nos

String per Inverter 222 (4 inv), 226 (1 inv)

calling for invoice
zzz (+ inv)
&230(i inv)

LEGEND:

STRING or TABLE (10 X 3.952m)

STRING MONITORING UNIT (SMB)

IR	INVERTER ROOM (20.5X7.5m) (FOR 4 INVERTERS)
----	---

CMCS	CONTROL ROOM (21.5X11.5m)
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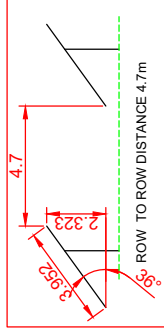
SWITCH	SWITCH YARD (50x20m)
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NOTE: DISTANCE BETWEEN TWO ROWS 4.7m

DISTANCE BETWEEN EACH STRUCTURE 0.2m

PATHWAY DISTANCE IS 10m

ALL AROUND BOUNDARY DISTANCE IS 12m

TYPE OF PRODUCT OR
NAME OF CUSTOMER/PROJECT

BEL

	BHARAT HEAVY ELECTRICALS LIMITED					SCALE NTS	WEIGHT (Kg) 1 : 1	REF. TO ASSY. DRG.	SIGN.	DATE	NEW ITEM
	ELECTRONICS DIVISION, BANGALORE										
	DIN	ASN	GRD	WY							
	APPD	VKG									
DEPT. SCOPV. CODE	FOR UNSPECIFIED- QUANTITY AND SIZE REFER ED 02504998										
439											

OVERALL PLANT LAYOUT-7.5MW

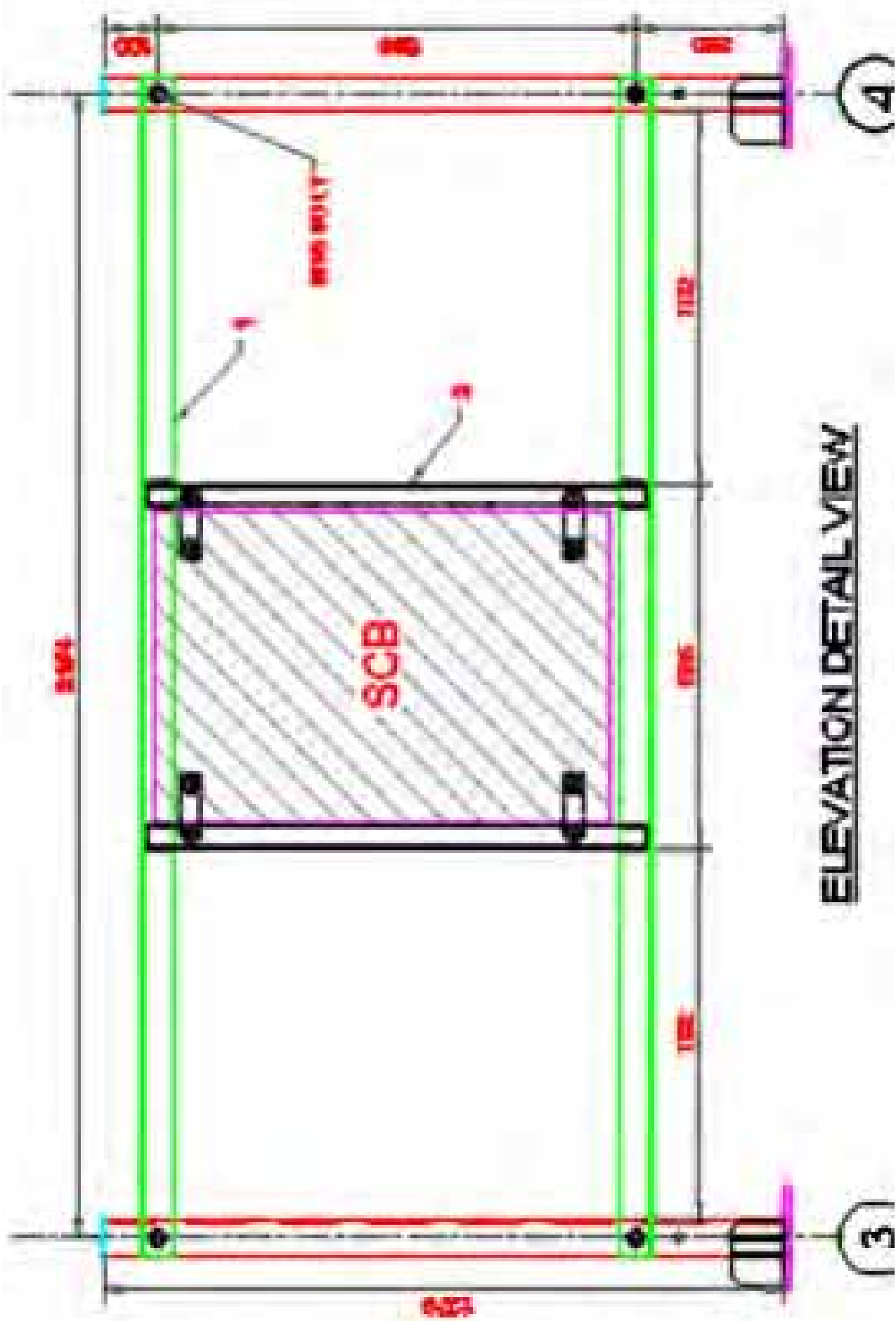
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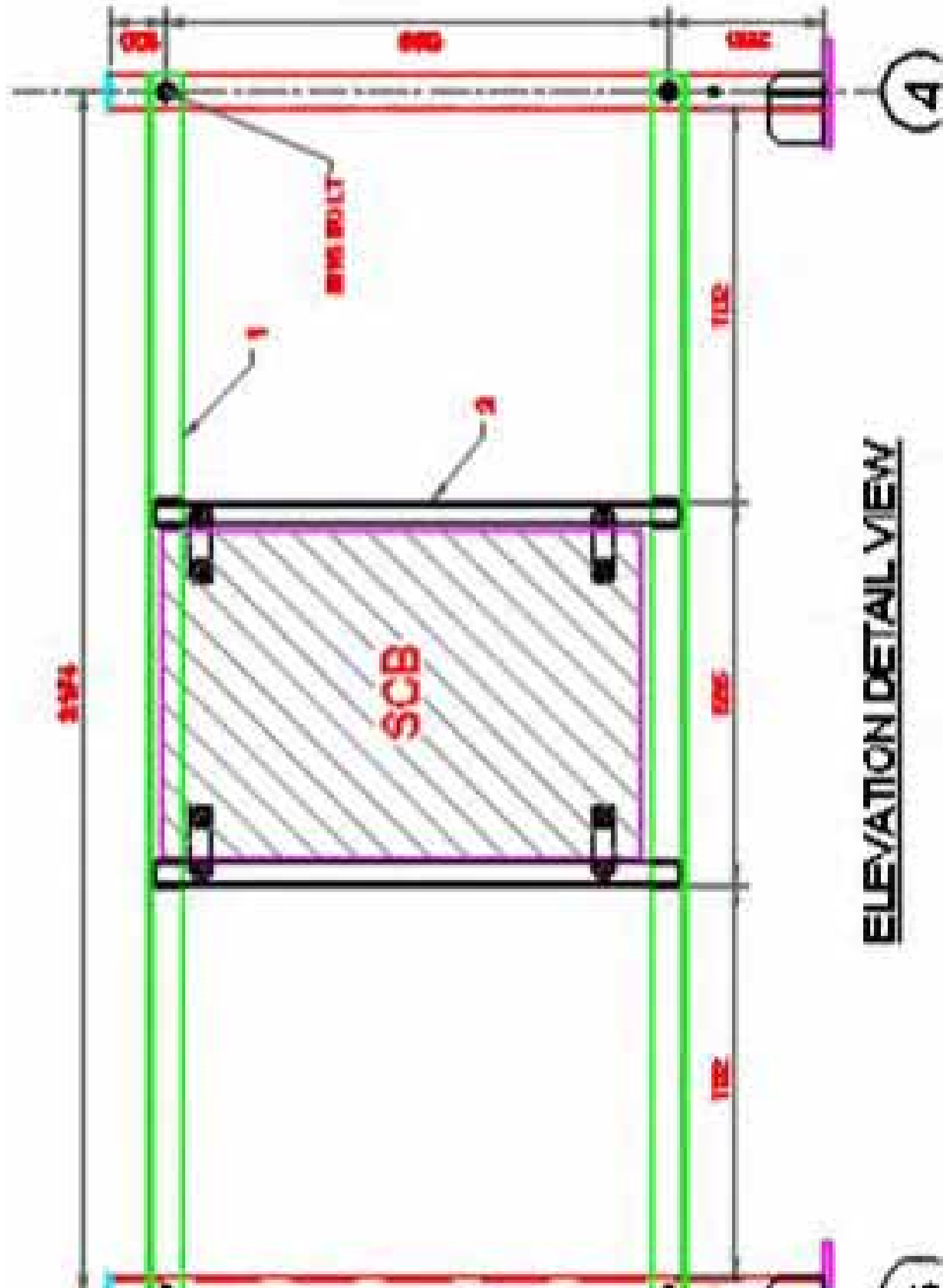
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EL-OFBOL-LY-E001

SHEET NO.	NO. OF SHEETS
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ELEVATION DETAIL VIEW

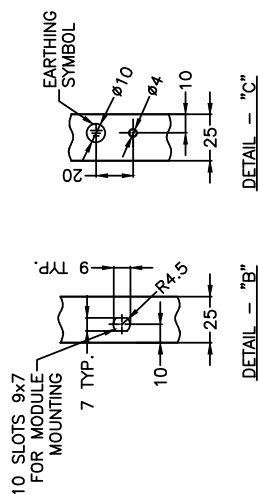
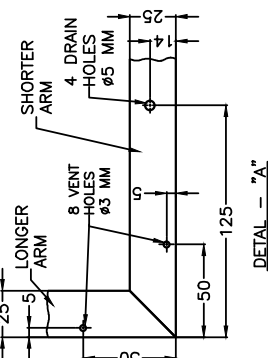


ELEVATION DETAIL VIEW

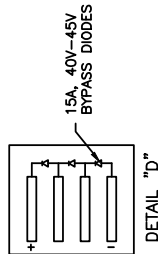
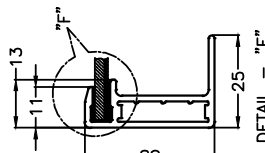
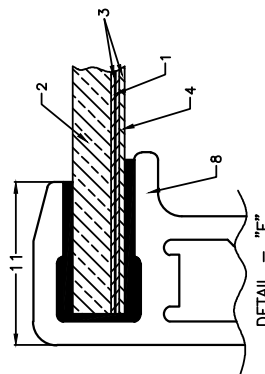
DRAWING NO.

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11	RFID TAG
10	MODULE RATING STICKER
9	PV MODULE SL. NO. STICKER
8	ANODISED ALUMINIUM EDGE FRAME
7	JUNCTION BOX WITH CABLES & CONNECTORS
6	BUS BAR
5	INTER CONNECTS
4	BACK SHEET
3	EVA SHEET
2	HIGH TRANSMISSION TEMPERED GLASS – 3.2mm Thk
1	72 Nos. OF 156 mm MULTI CRYSTALLINE SILICON SOLAR CELLS CONNECTED IN SERIES
ITEM NO	ITEM DESCRIPTION

TYPE OF PRODUCT OR
NAME OF CUSTOMER/PROJECT

F	 DETAIL "D"		 DETAIL — "E"		 DETAIL — "F"		 BHARAT HEAVY ELECTRICALS LIMITED. ELECTRO-PROCESS DIVISION, BANGALORE		NAME		SIGN.	DATE	No. Of VAR					
	REV. DATE ALTERED CHECKED APPROVED		REV. DATE ALTERED CHECKED APPROVED		REV. DATE ALTERED CHECKED APPROVED		DEPT. SPV CODE 901		FOR UNSPECIFIED - TOLERANCES REFER ED 0230499		SCALE 1 : 10		WEIGHT(KGS) REF. TO ASSY. DRG.		ITEM NO.		No. Of ITEM	
G					FIRST ISSUE				TITLE PHOTOVOLTAIC MODULE-L24300P 156mm Multi Solar Cell (Corner Block Type)		DRAWING NO. 3 988 00 001 10		REV. 00					
									SHEET NO. 01		NO. OF SHEETS 01		7		8		A3 SIZE	
1 2 3 4 5 6 7 8																		FORM No. A3-02
SIGN & DATE																		INVENTORY NO.

**GEOTECHNICAL INVESTIGATION FOR 10 MWP PV
SOLAR PROJECT AT ORDINANCE FACTORY
BOLANGIR, ODISHA.**

CLIENT

**BHARAT HEAVY ELECTRICALS LIMITED,
ELECTRONICS DIVISION,
BANGALORE.**

TITLE

REPORT

REPORT NO: SI/CHN/16/1352 /01

JANUARY 2017



GEO FOUNDATIONS & STRUCTURES PVT LTD

**3/2, RAMS, No.89, I Main Road, Gandhi Nagar, Adyar,
Chennai – 600 020. Ph: 044 – 24431462, 24430399**

Website: www.geofoundations.net

Email: geogfs@gmail.com

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SOIL INVESTIGATION REPORT

1.0 INTRODUCTION

- 1.1 The work of sub- soil Investigation for 10 MWp PV Solar Project at ordinance factory Bolangir, Odisha was entrusted to M/s. Geo Foundations and Structures (P) Ltd., Adyar, Chennai – 600 020, by M/s. BHEL EDN, Bangalore.
- 1.2 The soil Investigation and laboratory studies were carried out during **December 2016** and **January 2017**. This report summarizes the results of the soil investigation, and presents recommendation for suitable type of foundations.

2.0 OBJECTIVE OF INVESTIGATION

- 2.1 The objective of soil investigation is to determine the nature and characteristics of sub-soil below the ground level for the proposed structures. The study includes identification of suitable type of foundations for the proposed structures and assessment of safe bearing capacity.

3.0 SCOPE OF WORK

The scope of work at this site comprises of the following:

- 3.1 Mobilization of boring rig with all necessary equipments and personnel.
- 3.2 Boring of **Six** bore holes of 150 mm diameter with Calyx drilling equipments through sand, silt, clay & rock etc up to hard strata.
- 3.3 Conducting Standard Penetration Tests in the bore holes and collecting the representative soil samples including packing and transportation to laboratory.
- 3.4 To conduct the following laboratory tests on soil samples:
- (a) Sieve analysis
 - (b) Index properties:
 - (i) Liquid limit
 - (ii) Plastic limit

- (c) Dry & wet density
- (d) Water content
- (e) Specific gravity
- (f) Direct shear test
- (g) UCS

3.5 Recording ground water level.

3.6 Conducting Fifteen CBR Tests.

3.7 Conducting Twelve Electrical Resistivity tests.

3.8 Preparation and sub submitting detailed report with field and laboratory results and recommendations for foundations.

4.0 FIELD INVESTIGATIONS-GEO-TECHNICAL STUDIES

4.1 Boring rig with all requisite equipments and accessories were mobilized at the worksite. A team of technical personnel with skilled labours was also deputed.

4.2 **Six** bore holes of 150 mm diameter were bored to a maximum depth up to **10 m** below the existing ground level. The bore holes were made as per relevant Indian Standard IS: 1892.

4.3 Representative soil samples were collected at every change of strata of about 1 m depth interval up to the termination depth. The samples so collected were sealed and numbered with full particulars for identification and sent to the laboratory for conducting the required tests.

4.4 Standard Penetration tests were conducted in the bore holes, as per the relevant Indian Standard, IS: 2131. In this test, a standard split spoon sampler is driven into the ground at the required depth by means of standard hammer of 63.5 kgs weight, falling from a height of 75 cm. Number of blows for the first 15 cm is not taken into consideration because of possible disturbances or presence of settled,

suspended matters at the bottom of the bore- holes. The total number of blows for the next 30 cm depth of penetration is considered as SPT 'N' value as shown in Figure nos. 1 to 6.

5.0 LABORATORY INVESTIGATION

The following laboratory tests were conducted on the selected soil samples collected from the test bore holes:

- (a) Sieve analysis
- (b) Index properties:
 - (i) Liquid limit
 - (ii) Plastic limit
- (c) Dry & wet density
- (d) Water content
- (e) Specific gravity

The above laboratory tests were carried out as per relevant Indian Standards.

All the soil samples were identified and classified as per relevant Indian Standard, IS: 1498.

The results are shown in Tables Nos. 1 to 6.

6.0 SOIL PROFILE

Soil profile of the bore holes are as given below:

In bore hole BH 1, Medium dense clayey sand occurs from ground level up to 3 m, followed by dense silty sand up to 4 m, weathered rock up to 7.45 m, there after rock pieces occurs up to **10 m**, at which depth the borehole was terminated.

In bore hole BH 2, medium dense clayey sand/ clayey sand with gravel occurs from ground level up to 3 m dense silty gravelly sand up to 4 m, there after weathered rock up to **5 m**, at which depth the borehole was terminated.

In bore hole BH 3, medium dense silty sand occurs from ground level up to 2 m, followed by very dense silty sand up to 4 m, there after rock pieces occurs up to **10 m**, at which depth the borehole was terminated.

In bore hole BH 4, very dense clayey sand occurs from ground level up to 2 m, followed by up very dense silty sand up to 3 m, weathered rock up to 5 m, there after rock pieces up to **6.5 m**, at which depth the borehole was terminated..

In bore hole BH 5, very dense silty gravelly sand occurs from ground level up to 2 m, followed by very dense silty sand up to 3 m, there after rock pieces occurs up to **10 m**, at which depth the borehole was terminated.

In bore hole BH 6, dense silty sand occurs from ground level up to 2m, followed by very dense silty sand up to 4 m, there after rock pieces occurs up to **10 m**, at which depth the borehole was terminated.

7.0 GROUND WATER LEVEL

Ground water level was met at a depth ranging from **1 m** to **2.8 m**, with in the bore holes during the continuous boring from **24.12.2016 to 27.12.2016**.

8.0 DISCUSSION AND RECCOMENDATIONS ON RESULTS AND TYPE OF FOUNDATIONS:

Based on the subsoil conditions discussed in Sl. No. 6, the following recommendations are made for suitable type of foundation for the proposed structure.

Two alternative types of foundations, namely,

1. Open Foundations
2. Pile foundations

Alternative 1: OPEN FOUNDATIONS:

- Open foundations (Individual column footings or combined footings or strip raft combining each row of columns or raft foundation) are recommended.
- Excavation shall be made up to a depth of at least **1.5 m** below the existing ground level, for all foundations, irrespective of the importance of the column or the loading on the column.
- After thorough compaction of the bottom of excavation, PCC for the foundations can be laid on the compacted surface.
- If clayey stratum occurs at the bottom, further excavation of 100 mm is required and after thorough compaction of the bottom of excavation, a layer of clean river sand, 100 mm thickness, shall then be laid. The sand cushion layers shall be at least 200 mm wider on all four sides of the Individual column footings or combined footing or strip raft combining each row of columns. The sand cushion layer shall be watered and well compacted.
- A safe bearing capacity of **15 t/m²** is recommended under the RCC foundations.
- At the time of excavation for foundations, in case ground water table occurs within the recommended depth of excavation, sumps may be made to an additional depth of 0.3 m at one or more corners of the foundation pits for column footings/combined footings or at desired locations along the periphery of excavation for strip raft and the water collected in the sumps may be bailed out. Dewatering shall be maintained until that part of the concrete in the foundations, which comes below the ground water table level, sets.
- The excavated sandy soil can be used for back filling of foundations. Back filling shall be done in layers of not more than 150 mm thickness. Each 150 mm thick layer shall be watered and well compacted (mere spreading the back fill material for back filling is not adequate. Layered compaction shall be done for back filling).

Alternative 2: PILE FOUNDATION :

- Bored cast in situ concrete pile foundations of **1.5 m** length from existing ground level are recommended.
- The recommended safe load carrying capacities of bored cast in situ concrete piles as per IS 2911 (Part 1/Sec2) for 30 cm pile diameter are presented in Table 7.

TABLE 7

Approximate Length of Pile from G.L (m)	Dia (cm)	Recommended Safe Vertical Capacity (T)	Lateral Capacity (T)	Up lift capacity (T)
1.5	30	4	1	1.8

9.0 CHEMICAL ANALYSIS OF SOIL AND WATER:

The results of chemical analysis of soil and water samples are presented in Appendix V.

- 10.0** The results and recommendations given in this report are based on the results of the soil investigation carried out. In actual execution, if any variation is found, the consultants may also be referred to.

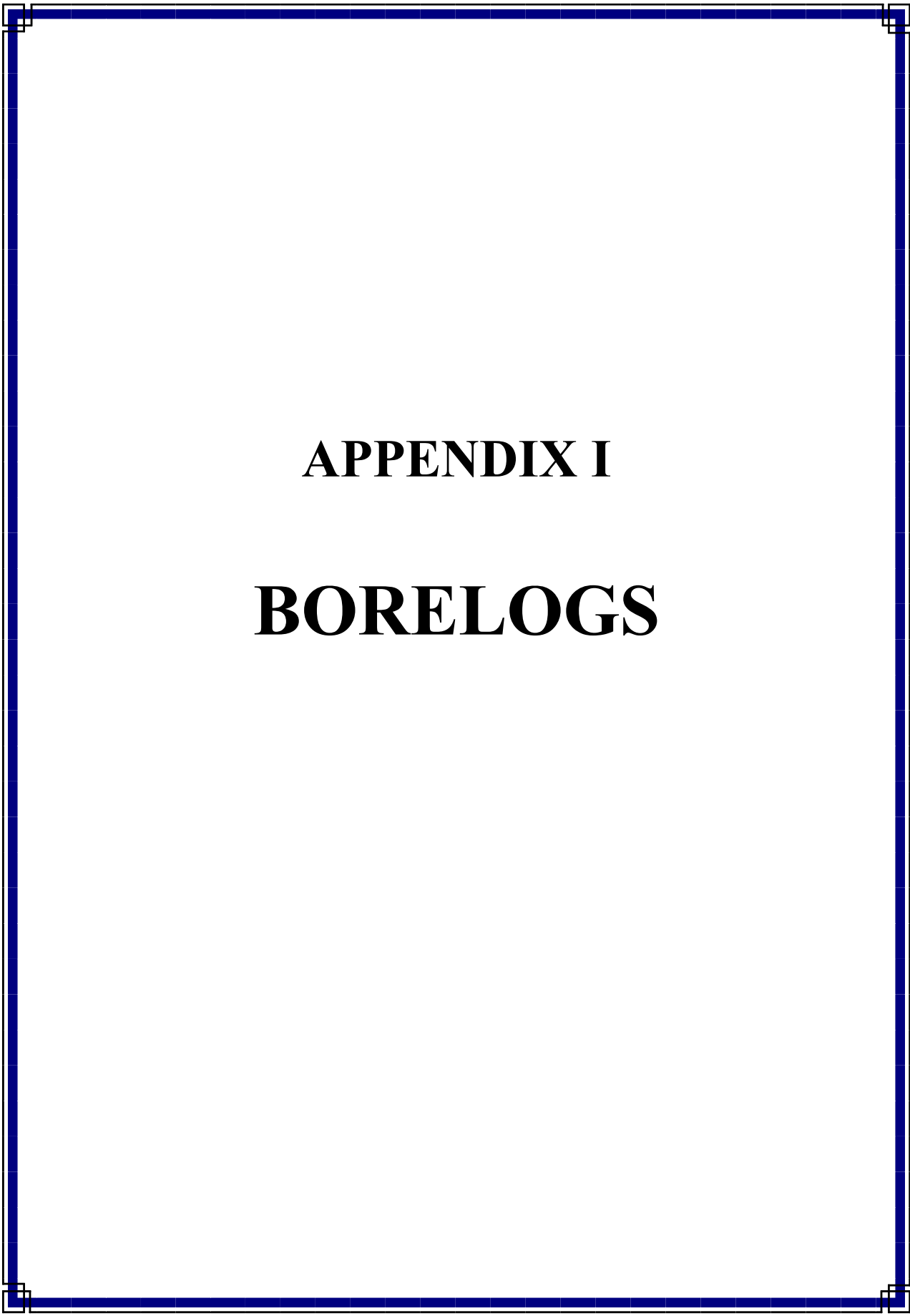
For GEO FOUNDATIONS & STRUCTURES PVT. LTD.

A. Suresh Kumar, M.Tech (Geo technical), **M.B.A** (T.M)

D.G.M. (Geo Technical)

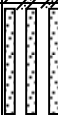
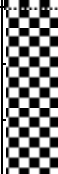
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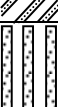
Dr. K. Muthukrishnaiah BE (Hons), M.Tech., Ph.D.,
(Professor & Head, Ocean Engineering Dept. IIT Madras)(Rtd),
(Chief Consultant)



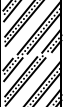
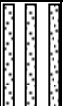
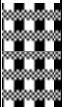
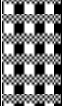
APPENDIX I

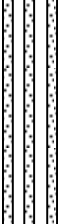
BORELOGS

Project : Soil investigation for the proposed 10 MWp PV Solar Project at Ordnance Factory Bolangir, Odisha.																				
 GEO FOUNDATIONS & STRUCTURES PVT. LTD					Bore Hole No : 1 Location : Bolangir Co-ordinates : 739536 E, 2256354 N Type of Boring : Calyx Ground Water Level : 2.10 m from GL on 25.12.2016 Termination Depth : 10.00 m							Drillhole Record -01								
												Fig No. 1								
Start Date : 24.12.2016 End Date : 24.12.2016																				
SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES			SPT 'N' Blows/300mm	SPT 'N' PROFILE					C.R. (%)	R.Q.D(%)	REMARKS
									15cm	30cm	45cm		20	40	60	80	100			
Clayey SAND (SC-CL)	Brown	Medium Dense, Granular	3.00		UDS-1	OT	0.50	0.50-0.95	-	-	-	-								
					SPT-1	SS	1.00	1.00-1.45	7	9	13	22								
					SPT-2	SS	2.00	2.00-2.45	7	16	19	35								
Silty SAND (SM)	Brown	Dense, Granular	4.00		SPT-3	SS	3.00	3.00-3.45	15	19	22	41								
					SPT-4	SS	4.00	4.00-4.13	>50	-	-	>100								
Weathered Rock			7.45		SPT-5	SS	5.00	5.00-5.10	>50	-	-	>100								
					SPT-6	SS	6.50	6.50-6.58	>50	-	-	>100								
					SPT-7	SS	7.45	7.45-7.45	-	-	-	>100								
Rock Pieces			10.00		CR-1	CS	7.45	7.45-8.50	-	-	-	-								
					CR-2	CS	8.50	8.50-10.00	-	-	-	-								
G.W.L: 2.10 m from G.L on 25.12.2016					No of SPT: 07 Nos			No of UDS: 01 Nos			No of CR: 02 Nos			Remarks						

Project : Soil investigation for the proposed 10 MWp PV Solar Project at Ordnance Factory Bolangir, Odisha.																				
 GEO FOUNDATIONS & STRUCTURES PVT. LTD					Bore Hole No : 2 Location : Bolangir Co-ordinates : 739674 E , 2256176 N Type of Boring : Calyx Ground Water Level : 1.00 m from GL on 26.12.2016 Termination Depth : 5.00 m								Drillhole Record -02							
													Fig No. 2							
Start Date : 25.12.2016 End Date : 25.12.2016																				
SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES			SPT'N" Blows/300mm	SPT 'N' PROFILE					C.R (%)	R.Q.D(%)	REMARKS
									15cm	30cm	45cm		20	40	60	80	100			
Clayey SAND (SC-CL)	Brown	Medium Dense, Granular	2.00		UDS-1	OT	0.50	0.50-0.95	-	-	-	-								G.W.L
					SPT-1	SS	1.00	1.00-1.45	4	5	7	12								
					UDS-2	OT	1.50	1.50-1.95	-	-	-	-								
Brownish, Medium dense, Clayey SAND with Gravel (SC-CL-G)			3.00		SPT-2	SS	2.00	2.00-2.45	8	8	10	18								
Silty Gravelly SAND (SM-G)	Brown	Dense Granular	4.00		SPT-3	SS	3.00	3.00-3.45	19	22	26	48								
Weathered Rock					SPT-4	SS	4.00	4.00-4.42	21	27	>50	>100								50/12 cm Penetration
			5.00		SPT-5	SS	5.00	5.00-5.23	29	>50	-	>100								50/8 cm Penetration
G.W.L: 2.50 m from G.L on 27.12.2016			No of SPT: 05 Nos			No of UDS: 02 Nos			Remarks											

Project : Soil investigation for the proposed 10 MWp PV Solar Project at Ordnance Factory Bolangir, Odisha.																				
 GEO FOUNDATIONS & STRUCTURES PVT. LTD				Bore Hole No : 3				Drillhole Record -03												
				Location : Bolangir				Fig No. 3												
				Co-ordinates : 739853 E , 2256157 N																
				Type of Boring : Calyx																
				Ground Water Level : 2.50 m from G.L on 27.12.2016				Start Date : 25.12.2016												
				Termination Depth : 10.00 m				End Date : 26.12.2016												
SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES			SPT 'N' Blows/300mm	SPT 'N' PROFILE					C.R (%)	R.Q.D(%)	REMARKS
Silty SAND (SM)	Brown	Medium Dense, Granular	2.00		UDS-1	OT	0.50	0.50-0.95	-	-	-	-								
					SPT-1	SS	1.00	1.00-1.45	8	8	10	18								
	Brown	Very Dense, Granular	4.00		SPT-2	SS	2.00	2.00-2.27	32	>50	-	>100								
					SPT-3	SS	3.00	3.00-3.25	31	>50	-	>100								
Rock Pieces				SPT-4	SS	4.00	4.00-4.02	>50	-	-	>100									
				CR-1	CS	4.02	4.02-5.00	-	-	-	-									
				CR-2	CS	5.00	5.00-6.00	-	-	-	-									
				CR-3	CS	6.00	6.00-7.00	-	-	-	-									
				CR-4	CS	7.00	7.00-8.00	-	-	-	-									
				CR-5	CS	8.00	8.00-9.00	-	-	-	-									
				CR-6	CS	9.00	9.00-10.00	-	-	-	-									
G.W.L: 2.50 m from G.L on 27.12.2016			No of SPT: 04 Nos			No of UDS: 01 Nos			No of CR: 06 Nos			Remarks								

Project : Soil investigation for the proposed 10 MWp PV Solar Project at Ordnance Factory Bolangir, Odisha.																				
 GEO FOUNDATIONS & STRUCTURES PVT. LTD				Bore Hole No : 4 Location : Bolangir Co-ordinates : 739670 E, 2255707 N Type of Boring : Calyx Ground Water Level : 1.30 m from G.L on 27.12.2016 Termination Depth : 6.50 m						Drillhole Record -04 Fig No. 4 Start Date : 26.12.2016 End Date : 26.12.2016										
SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES			SPT 'N' Blows/300mm	SPT 'N' PROFILE					C.R (%)	R.Q.D(%)	REMARKS
Clayey SAND	Brown	Very Dense, Granular	2.00		UDS-1	OT	0.50	0.50-0.95	15cm	30cm	45cm	SPT 'N'	20	40	60	80	100			G.W.L 50/11 cm Penetration
					SPT-1	SS	1.00	1.00-1.41	19	25	>50	>100								
Silty SAND (SM)	Brown	Very Dense, Granular	3.00		SPT-2	SS	2.00	2.00-2.15	>50	-	-	>100								50/15 cm Penetration
					SPT-3	SS	3.00	3.00-3.03	>50	-	-	>100								
Weathered Rock			5.00		SPT-4	SS	4.00	4.00-4.04	>50	-	-	>100								50/04 cm Penetration
					SPT-5	SS	5.00	5.00-5.00	-	-	-	>100								
Rock Pieces			6.50		CR-1	CS	5.00	5.00-6.50	-	-	-	-							Nil	Nil
G.W.L: 1.30 m from G.L on 27.12.2016			No of SPT: 05 Nos			No of UDS: 01 Nos			No of CR: 01 Nos			Remarks								

Project : Soil investigation for the proposed 10 MWp PV Solar Project at Ordnance Factory Bolangir, Odisha.																							
 GEO FOUNDATIONS & STRUCTURES PVT. LTD				Bore Hole No : 5 Location : Bolangir Co-ordinates : 739526 E , 2255858 N Type of Boring : Calyx Ground Water Level : 2.80 m from GL on 28.12.2016 Termination Depth : 10.00 m						Drillhole Record -05 Fig No. 5 Start Date : 26.12.2016 End Date : 27.12.2016													
SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES			SPT 'N' Blows/300mm	SPT 'N' PROFILE					C.R (%)	R.Q.D(%)	REMARKS			
									15cm	30cm	45cm		20	40	60	80	100						
Silty Gravely SAND (SM-G)	Brown	Very Dense Granular	2.00		UDS-1	OT	0.50	0.50-0.95	-	-	-	-											
					SPT-1	SS	1.00	1.00-1.45	15	22	29	51											
					SPT-2	SS	2.00	2.00-2.25	40	>50	-	>100											
Brownish, Very dense, Silty SAND (SM)			3.00		SPT-3	SS	2.90	2.90-2.90	-	-	-	>100											
					CR-1	CS	2.90	2.90-4.00	-	-	-	-											
Rock Pieces			10.00		CR-2	CS	4.00	4.00-5.00	-	-	-	-											
					CR-3	CS	5.00	5.00-6.00	-	-	-	-											
					CR-4	CS	6.00	6.00-7.00	-	-	-	-											
					CR-5	CS	7.00	7.00-8.00	-	-	-	-											
					CR-6	CS	8.00	8.00-9.00	-	-	-	-											
					CR-7	CS	9.00	9.00-10.00	-	-	-	-											
G.W.L: 2.80 m from G.L on 28.12.2016			No of SPT: 03 Nos			No of UDS: 01 No			No of CR: 07 Nos			Remarks											

APPENDIX II

**LABORATORY TEST
RESULTS**

TEST RESULTS			Project : Soil Investigation work for the Proposed 10 MWp PV Solar Project at Ordnance factory Bolangir, Odisha.										Termination Depth(m)				Table No.	
N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS				G.W.T (m)				Bore-Hole No.		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX	DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	TEST METHOD	C in Kg/cm²	Φ in degrees
-	0.50	UDS-1	Clayey SAND	SC-CL	1	52	47	28	10	18			20	2.66		SD		30
22	1.00	SPT-1	Clayey SAND	SC-CL	1	55	44	31	10	21			21					
35	2.00	SPT-2	Clayey SAND	SC-CL	0	52	48	33	11	22			20					
41	3.00	SPT-3	Silty SAND	SM	4	68	28						13					
>100	4.00	SPT-4	Weathered Rock															
>100	5.00	SPT-5	Weathered Rock															
>100	6.50	SPT-6	Weathered Rock															
>100	7.45	SPT-7	Rock pieces															
-	7.45-8.50	CR-1	Rock pieces															
-	8.50-10.00	CR-2	Rock pieces															

TEST RESULTS			Project : Soil Investigation work for the Proposed MWp PV Solar Project at Ordnance factory Bolangir, Odisha.										Termination Depth(m)				Table No.	
N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	TEST METHOD	C in Kg/cm²	Φ in degrees
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX								
-	0.50	UDS-1	Clayey SAND	SC-CL	9	52	39	31	11	20			18	2.65		DS		31
12	1.00	SPT-1	Clayey SAND	SC-CL	8	52	40	30	9	21			17					
-	1.50	UDS-2	Clayey SAND	SC-CL	8	53	39	31	10	21			15	2.67		DS		32
18	2.00	SPT-2	Clayey SAND with Gravel	SC-CL-G	10	56	34	28	18	10			12					
48	3.00	SPT-3	Silty Gravely SAND	SM-G	36	47	17											
>100	4.00	SPT-4	Weathered Rock															
>100	5.00	SPT-5	Weathered Rock															

TEST RESULTS			Project : Soil Investigation work for the Proposed 10 MWp PV Solar Project at Ordnance factory Bolangir, Odisha.										Termination Depth(m)				Table No.	
N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	G.W.T (m)	Bore-Hole No.	
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX								
-	0.50	UDS-1	Clayey SAND	SC-CL	3	62	35	31	15	16			15			6.50	4	
>100	1.00	SPT-1	Clayey SAND	SC-CI	5	62	33	38	18	20			15					
>100	2.00	SPT-2	Silty SAND	SM	1	73	26						13					
>100	3.00	SPT-3	Weathered Rock															
>100	4.00	SPT-4	Weathered Rock															
>100	5.00	SPT-5	Rock pieces															
-	5.00-6.50	CR-1	Rock pieces															

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TEST RESULTS		Project : Soil Investigation work for the Proposed 10 MWp PV Solar Project at Ordnance factory Bolanglr, Odisha.										Termination Depth(m)		Table No.	
N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			G.W.T (m)			Bore-Hole No.	
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX	DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %		SPECIFIC GRAVITY
-	0.50	UDS-1	Silty Gravely SAND	SM-G	22	51	27						DS	C in Kg/cm²	Φ in degrees
51	1.00	SPT-1	Silty Gravely SAND	SM-G	41	43	16					10			
>100	2.00	SPT-2	Silty SAND	SM	9	75	16					11			
>100	2.90	SPT-3	Rock pieces												
-	2.90-4.00	CR-1	Rock pieces												
-	4.00-5.00	CR-2	Rock pieces												
-	5.00-6.00	CR-3	Rock pieces												
-	6.00-7.00	CR-4	Rock pieces												
-	7.00-8.00	CR-5	Rock pieces												
-	8.00-9.00	CR-6	Rock pieces												
-	9.00-10.00	CR-7	Rock pieces												

TEST RESULTS		Project : Soil Investigation work for the Proposed 10 MWp PV Solar Project at Ordnance factory Bolangir, Odisha.										Boring Start: 27.12.2016 Boring End : 27.12.2016		Termination Depth(m)			Table No.	
N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR PARAMETERS		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX						TEST METHOD	C in Kg/cm²	Φ in degrees
-	0.50	UDS-1	Silty SAND	SM	4	71	25											
41	1.00	SPT-1	Silty SAND	SM	2	65	33	Non plastic										
50	2.00	SPT-2	Silty SAND	SM	1	78	21											
53	3.00	SPT-3	Silty SAND	SM	0	75	25											
>100	4.00	SPT-4	Rock pieces															
-	4.20-5.00	CR-1	Rock pieces															
-	5.00-6.00	CR-2	Rock pieces															
-	6.00-7.00	CR-3	Rock pieces															
-	7.00-8.00	CR-4	Rock pieces															
-	8.00-9.00	CR-5	Rock pieces															
-	9.00-10.00	CR-6	Rock pieces															

APPENDIX III

CBR TEST RESULT

2.0 CALIFORNIA BEARING RATIO TEST RESULTS

2.1.0 INTRODUCTION

- The soil samples were collected from the site and the laboratory testing on the soil samples were carried out during **December 2016 and January 2017**. This report summarizes the results of the investigation and furnishes result of California Bearing ratio Tests on soil samples.

2.2.0 OBJECTIVE OF THE SOIL INVESTIGATION

- The objectives of the soil investigation are to evaluate the California Bearing ratio values of soil sample collected from fifteen locations at a depth of 0.5 m from the existing ground level.

2.3.0 SCOPE OF WORK

The scope of work at this site comprised the following:

- Mobilization of all necessary equipments and personnel.
- Collecting soil samples from the specified locations, packing and transporting to laboratory.
- Conducting California Bearing Ratio Tests.
- Preparation and submission of the laboratory results.

2. 4.0 LABORATORY INVESTIGATION

- California bearing ratio tests were conducted on the soil samples at maximum dry density, as per the relevant Indian Standard, IS 2720: Part 16 : 1987, The results of CBR tests are presented in **Table 2.1**.

2.5.0 CONCLUSIONS

The field and laboratory tests were carried out as per the relevant Indian Standard and the results show that the CBR value varies from 4.5 to 13.6 at the maximum dry density and optimum moisture content.

Table 2.1			
SL.NO	SAMPLE TYPE	SAMPLE NAME	CBR %
1	Sandy CLAY	CBR-1	5.0
2	Sandy CLAY	CBR-2	4.5
3	Sandy CLAY	CBR-3	4.6
4	Clayey SAND	CBR-4	13.6
5	Clayey SAND	CBR-5	12.2
6	Silty SAND	CBR- 6	12.4
7	Clayey SAND	CBR- 7	12.8
8	Silty SAND	CBR- 8	13.2
9	Silty SAND	CBR- 9	12.6
10	Silty SAND	CBR- 10	13.5
11	Silty SAND	CBR- 11	12.5
12	Silty SAND	CBR- 12	11.8
13	Silty SAND	CBR- 13	13.2
14	Silty SAND	CBR- 14	13.5
15	Silty SAND	CBR- 15	12.8

APPENDIX IV

ELECTRICAL RESISTIVITY **TEST**

3.0 ELECTRICAL RESISTIVITY TEST

3.1.0 INTRODUCTION

3.1.1 The field studies were carried out in **December 2016**. This report summarizes Earth Resistivity values for 12 different locations.

3.2.0 OBJECT OF INVESTIGATION

3.2.1 The object of investigation is to ascertain the variation in apparent resistivity of sub-soil below the ground level and to obtain an idea about the variation in soil profile at the proposed site. Electrical Resistivity values are required for designing safety grounding system in the area.

3.3.0 FIELD INVESTIGATIONS

- 3.3.1 The method depends on the difference in the electrical resistance of different soil strata. These are several methods by which the field resistivity measurements are made. The most popular method is by Wenner's four-electrode configuration. The test is carried out as per IS 3043-1987.
- 3.3.2 The particular location required for conducting the tests were cleared and made free from disturbances.
- 3.3.3 Four electrodes were driven into the ground at equal spacing and designed depth. The four electrodes are connected to the terminals of the earth resistivity meter. The resistivity meter is pressed "ON" to allow the current to flow through the electrodes. On pressing the "TEST" switch available in the meter for 10 ohms and 1000 ohms, the resistance value is displayed in the meter, which is noted down.
- 3.3.3 Readings of resistance for different electrode spacing in different directions are noted as per the said procedure.

3.4.0 METHOD OF COMPUTING OF RESISTIVITY VALUE

Earth resistivity is calculated by according to the formula.

$$= 2 \pi d R$$

Where

R = resistance in Ohms (megger reading for 10 ohm)

d = is the distance between spikes if spikes are placed at equal distances (m).



3.5.0 RESULTS

The values of resistivity, calculated as per formula given in section 4.0 above are as enclosed. After finding out the resistivity, average resistivity value at very test locations were also calculated and given in Table No: 3.1. The polar resistivity curves were drawn as per IS: 3043-1987 under Clause: 36.6. and corresponding other graphs are also drawn as show in **Annexure - I.**



Table No.3.1

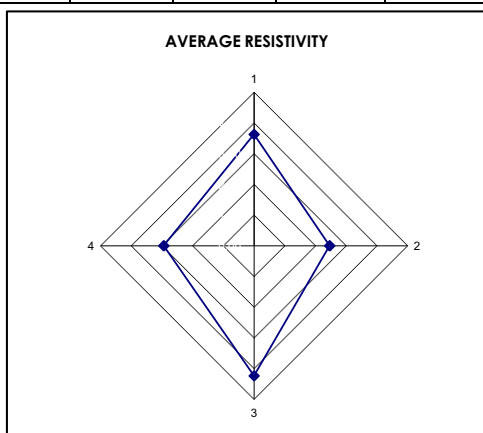
MARKINGS	Average Resistivity in each direction (Ω m)				
	1 m	2 m	5 m	10 m	15 m
ERT 1	1.23	2.17	3.30	4.71	4.71
ERT 2	17.70	7.38	5.10	6.60	5.42
ERT 3	18.47	15.20	17.99	26.70	28.27
ERT 4	38.36	23.34	18.77	11.62	8.65
ERT 5	18.50	18.47	17.51	16.34	11.55
ERT 6	6.66	6.00	6.20	16.65	5.89
ERT 7	6.42	6.09	4.71	2.83	
ERT 8	18.16	7.32	6.13	7.23	8.01
ERT 9	3.03	2.98	4.95	6.60	5.42
ERT 10	17.01	19.01	25.21	27.33	7.78
ERT 11	7.68	8.61	6.13	4.40	3.77
ERT 12	11.58	13.85	19.79	14.92	5.65



GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 1

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	1.19	1.88	3.46	5.03	6.59	3.63
E	0.88	1.38	2.51	3.77	3.77	2.46
S	1.76	3.39	3.77	5.65	6.60	4.23
W	1.07	2.01	3.46	4.40	3.77	2.94



Average Resistivity at 15 m (ohm-meter) : 3.32

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.

Each axis unit indicates 1 Ohm - m

ERT 1

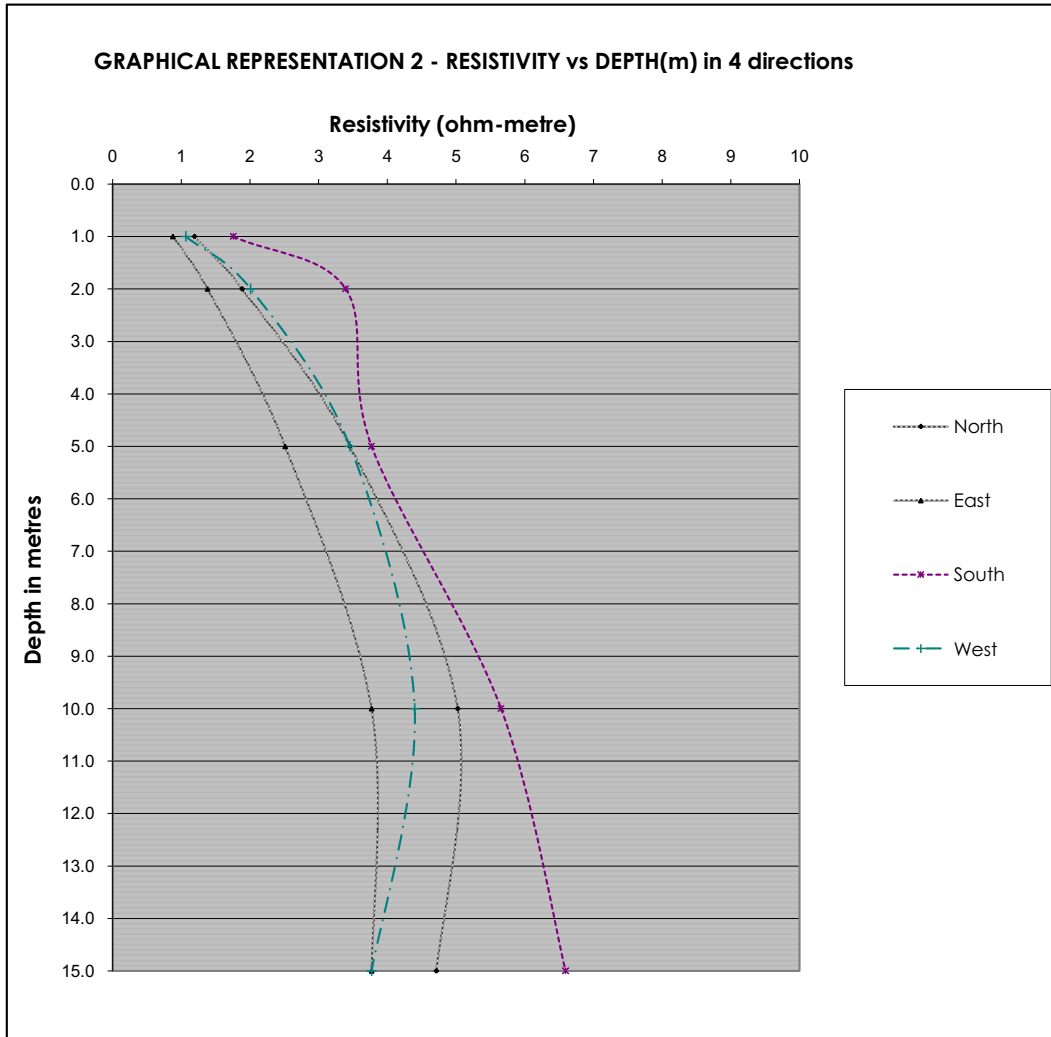


Fig No : 2.1.2

ERT 1

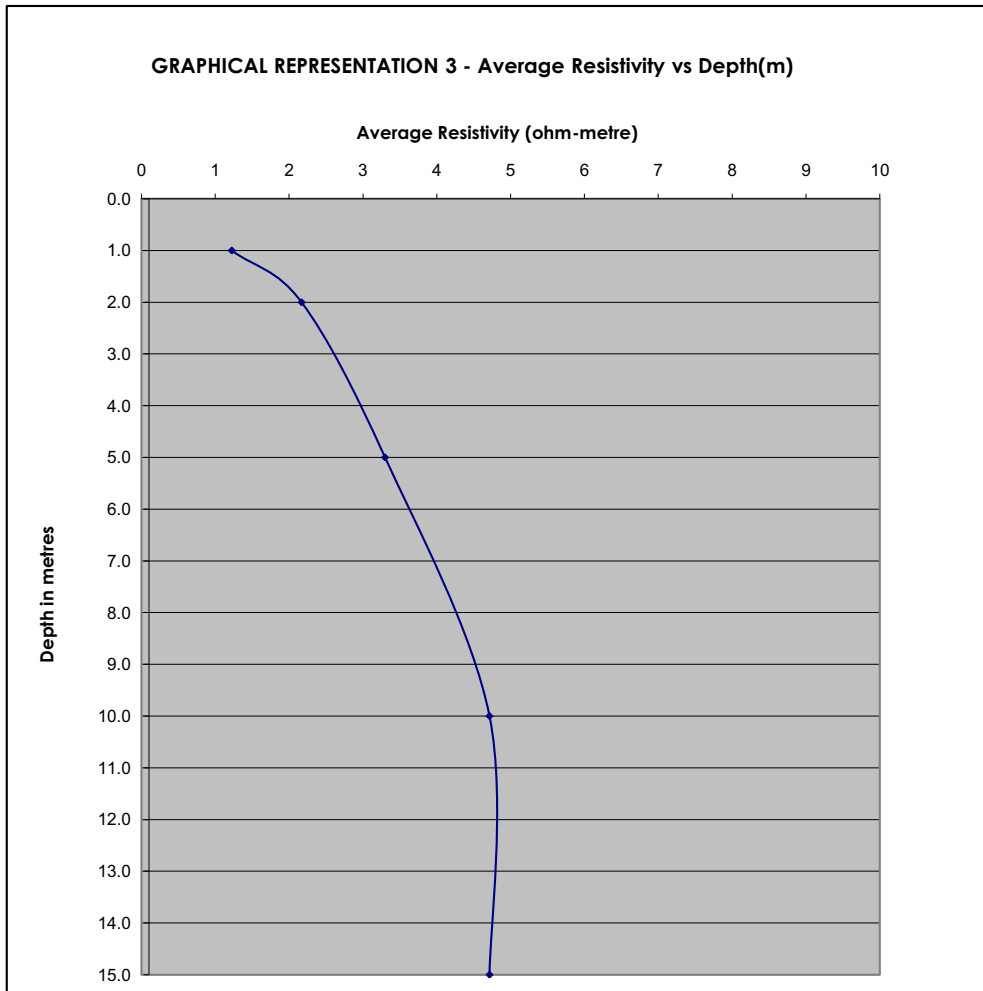
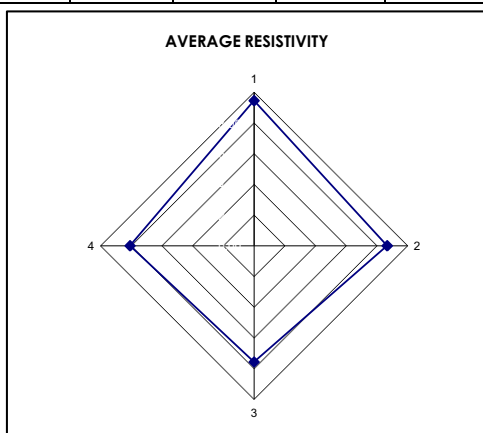


Fig No : 2.1.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 2

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	20.36	7.41	5.34	7.54	6.60	9.45
E	20.42	6.91	4.71	5.65	5.65	8.67
S	16.59	7.41	4.40	5.65	3.77	7.56
W	13.45	7.79	5.97	7.54	5.65	8.08



Average Resistivity at 15 m (ohm-meter) : 8.44

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.
 Each axis unit indicates 2 Ohm - m

ERT 2

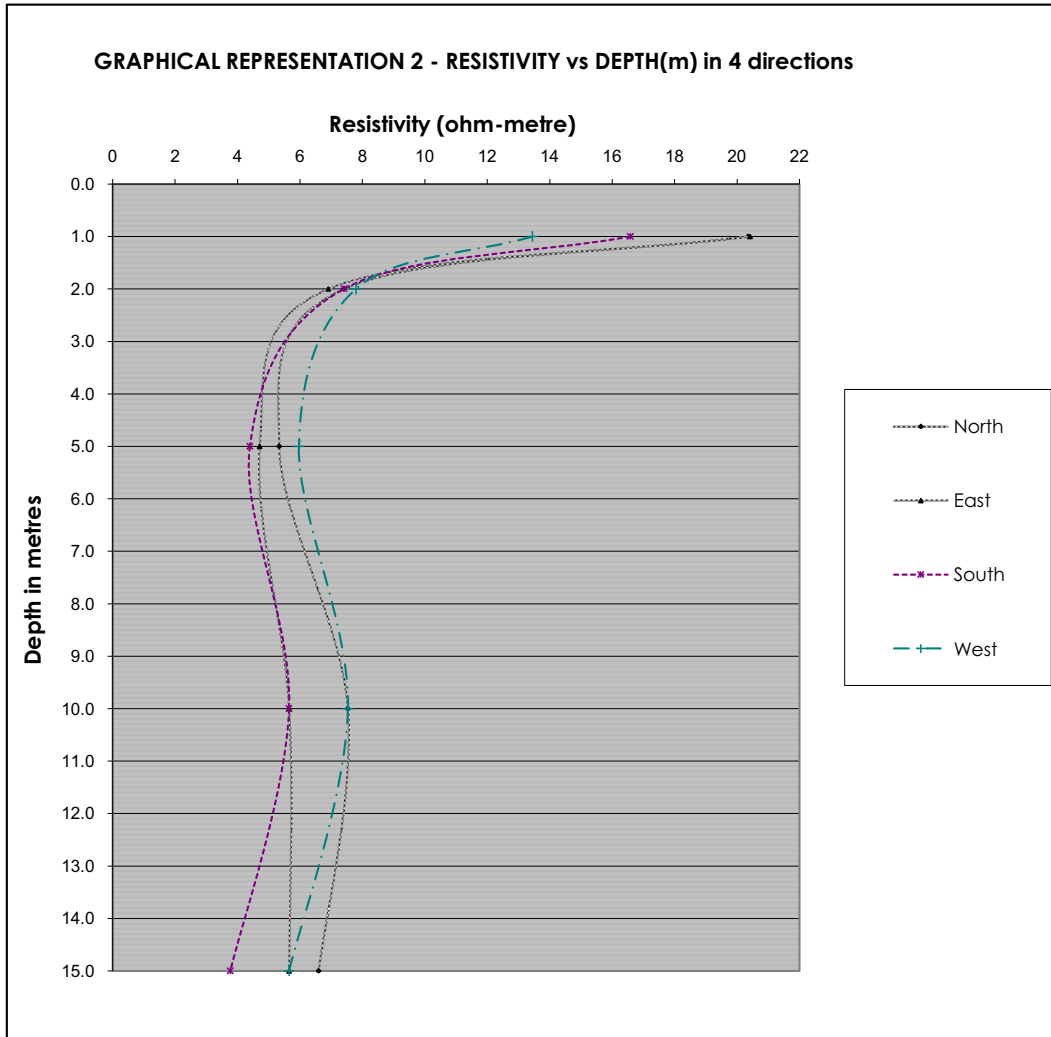


Fig No : 2.2.2

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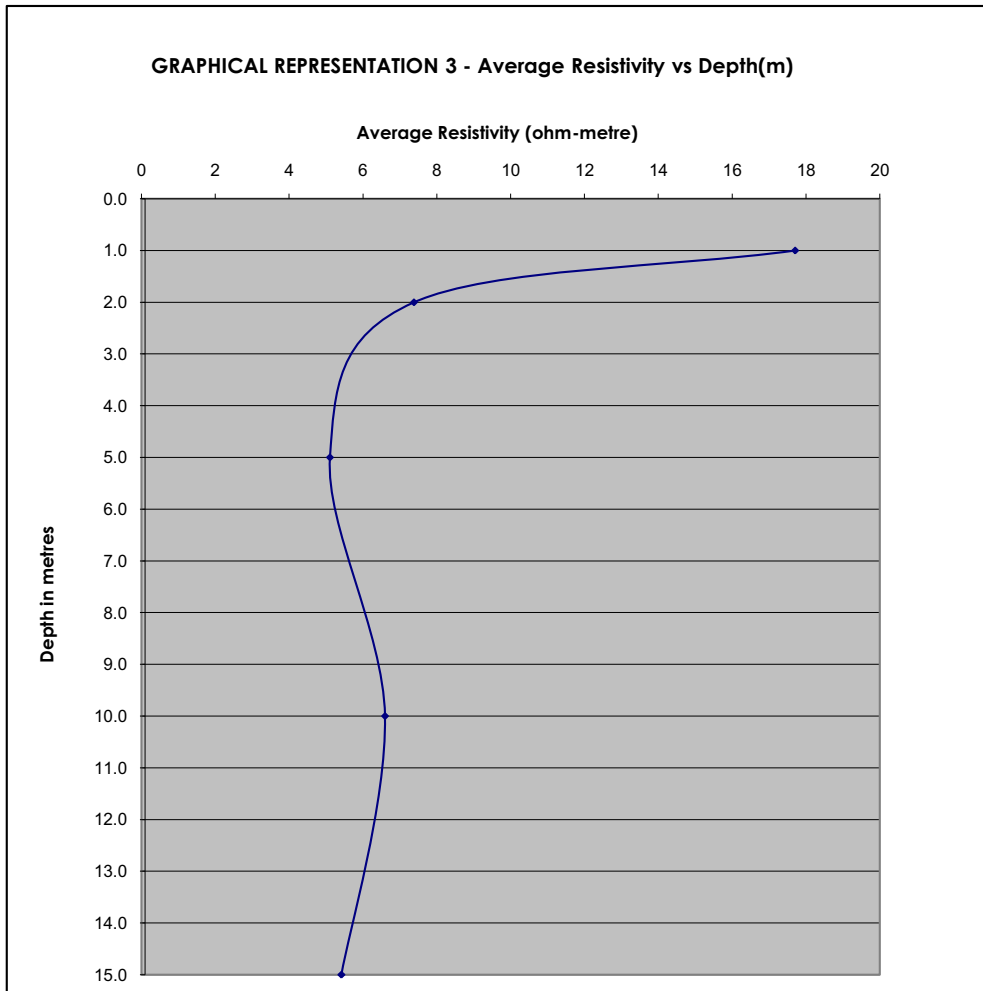
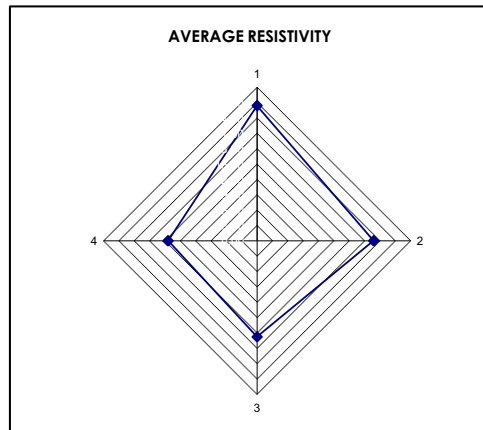


Fig No : 2.2.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 3

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	24.13	21.74	20.11	33.93	32.04	26.39
E	17.28	20.23	19.48	25.76	31.10	22.77
S	18.35	12.31	19.16	25.13	18.85	18.76
W	14.14	6.53	13.19	21.99	31.10	17.39



Average Resistivity at 15 m (ohm-meter) : 21.33

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.

Each axis unit indicates 3 Ohm - m

ERT 3

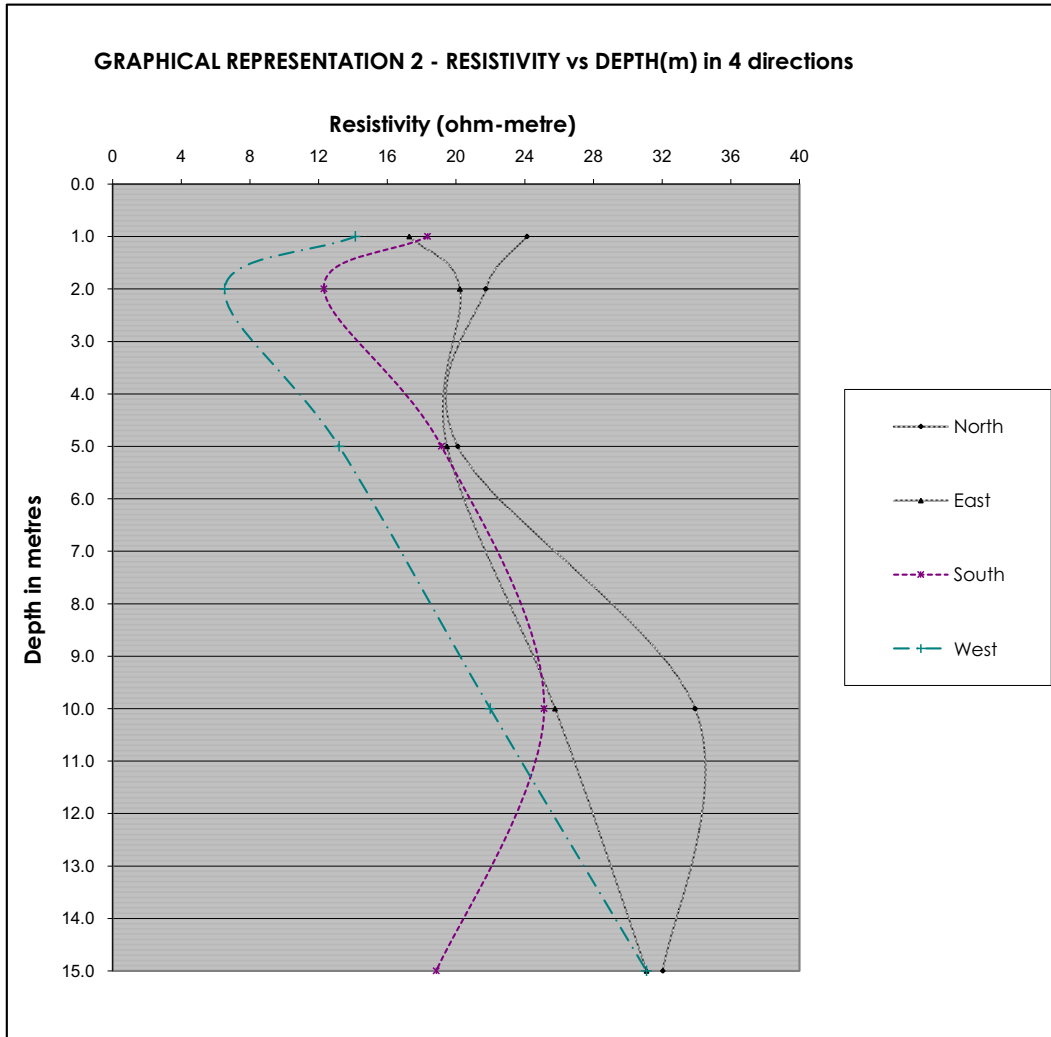


Fig No : 2.3.2

ERT 3

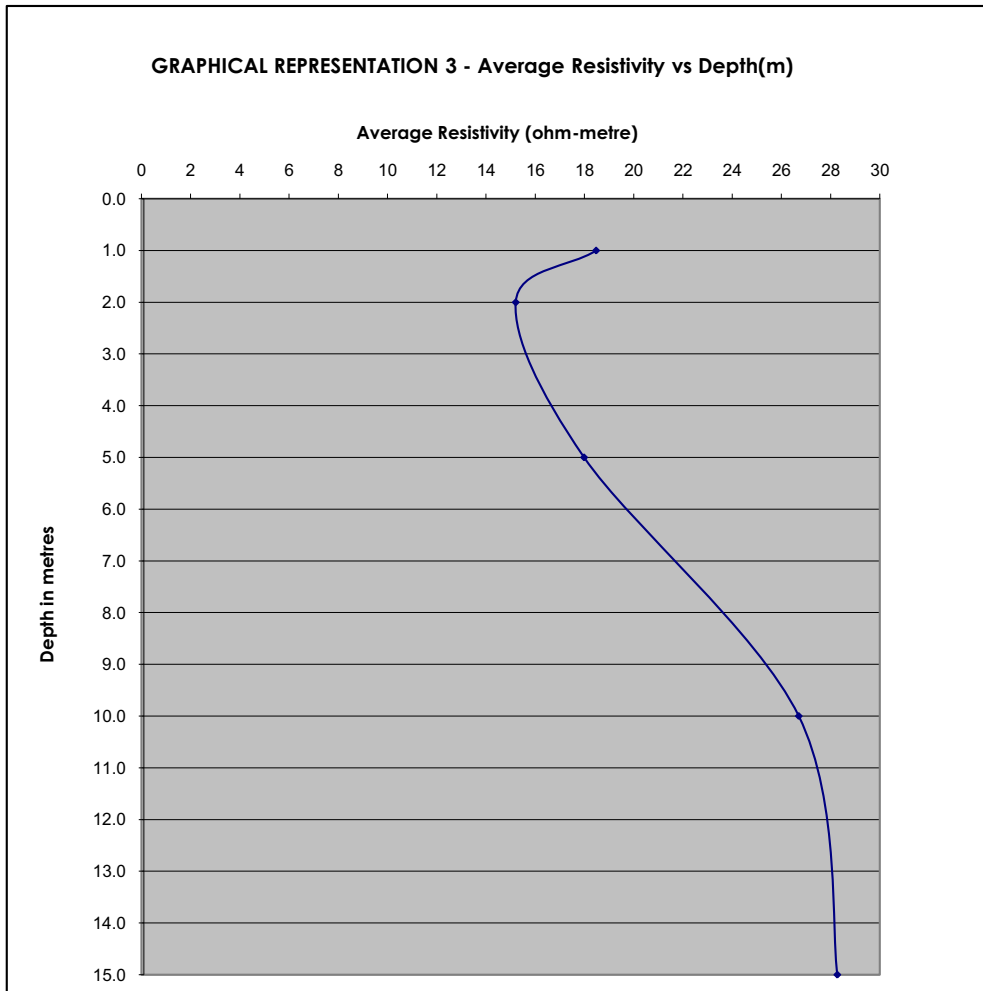
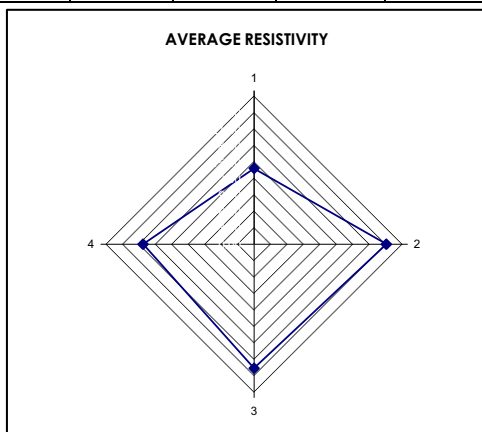


Fig No : 2.3.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 4

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	32.73	15.96	6.60	10.05	3.77	13.82
E	44.30	26.14	29.22	12.57	8.48	24.14
S	38.14	24.13	25.76	11.94	13.19	22.63
W	38.26	27.14	13.51	11.94	10.37	20.24



Average Resistivity at 15 m (ohm-meter) : 20.21

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.
 Each axis unit indicates 3 Ohm - m

ERT 4

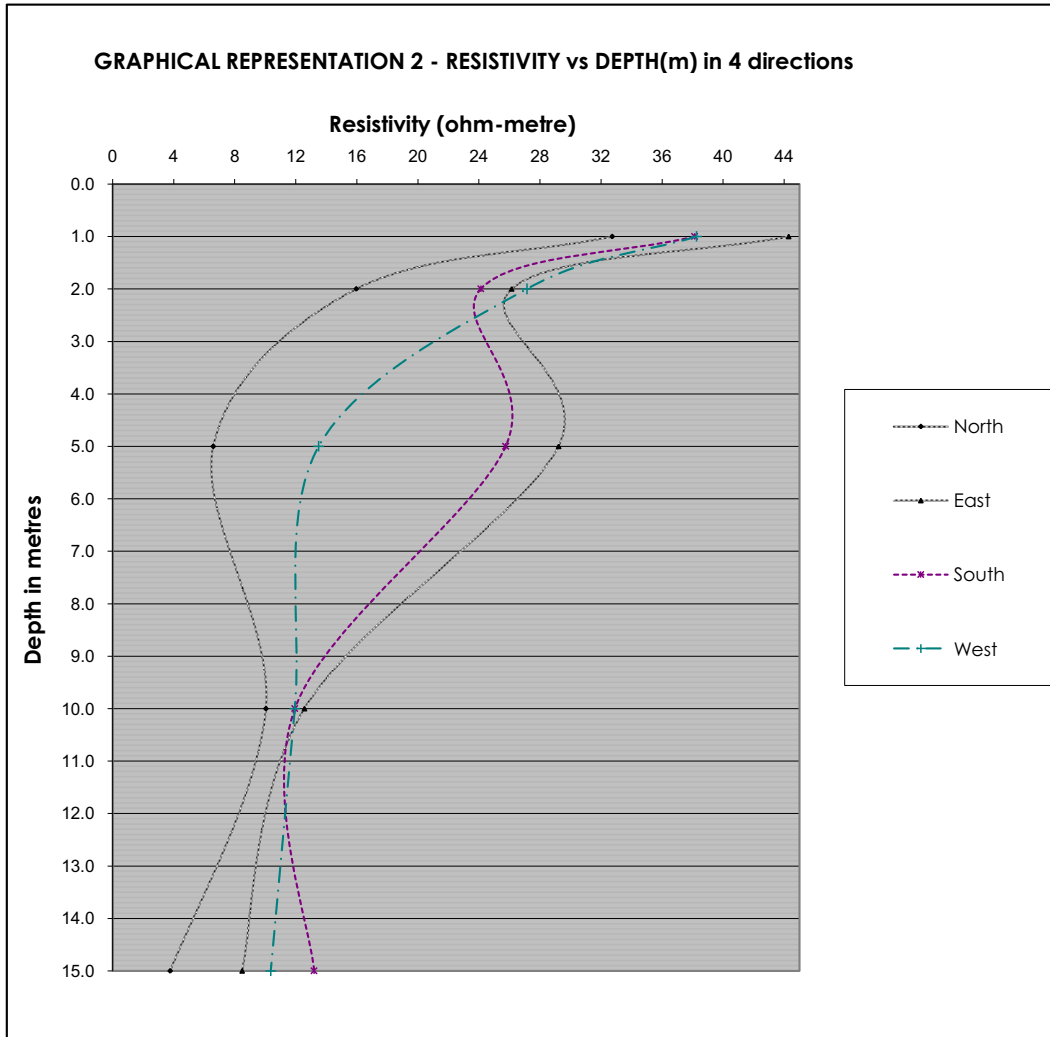


Fig No : 2.4.2

ERT 4

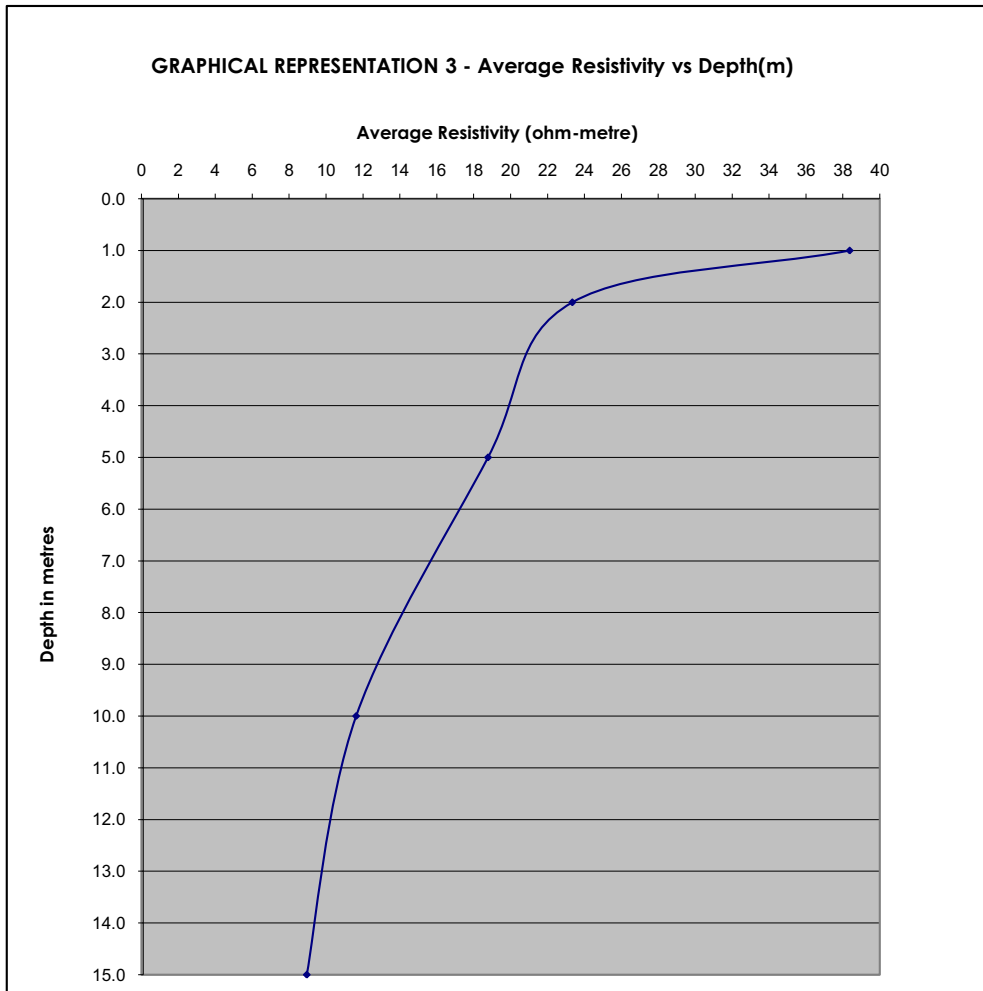
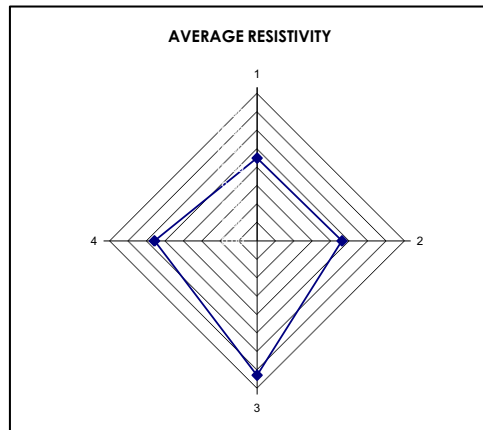


Fig No : 2.4.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 5

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	17.66	15.20	16.02	10.05	8.48	13.48
E	18.53	16.34	12.57	11.31	10.37	13.82
S	18.28	24.63	22.30	32.04	12.25	21.90
W	19.54	17.72	19.16	11.94	15.08	16.69



Average Resistivity at 15 m (ohm-meter) : 16.47

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.
 Each axis unit indicates 3 Ohm - m

ERT 5

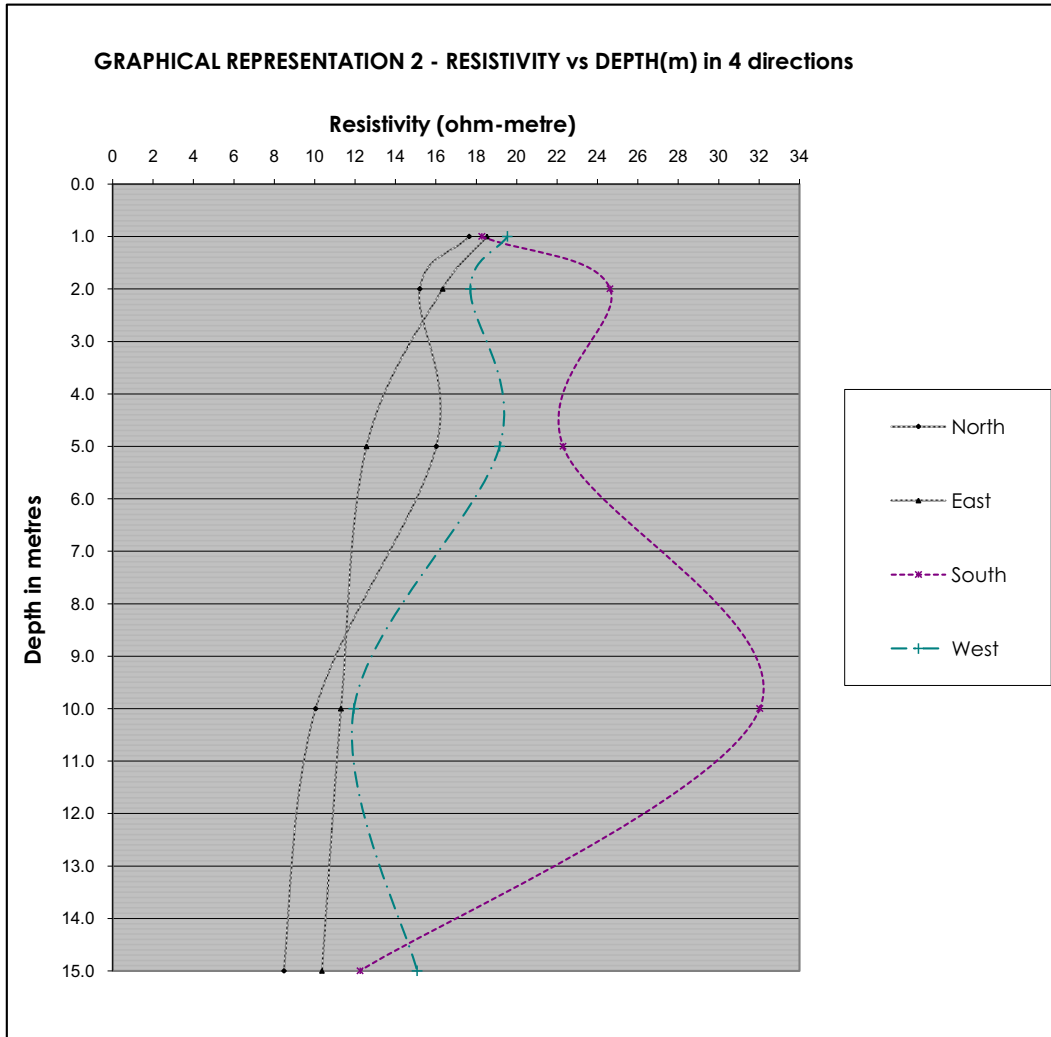


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ERT 5

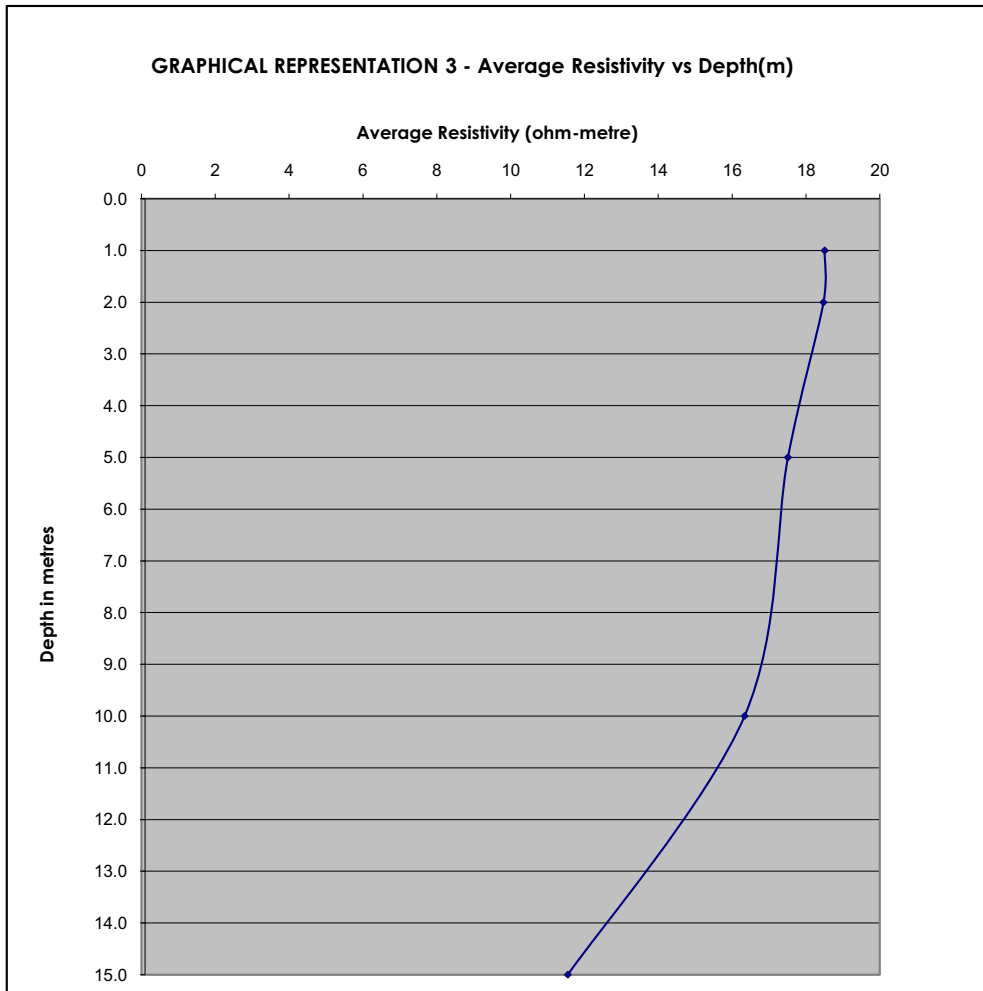
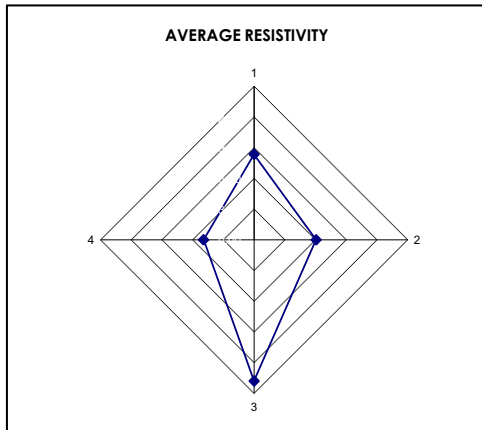


Fig No : 2.5.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 6

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	7.04	6.41	8.80	11.94	7.54	8.34
E	9.11	8.29	4.71	4.40	3.77	6.06
S	5.97	6.16	6.60	44.61	5.65	13.80
W	4.52	3.14	4.71	5.65	6.60	4.93



Average Resistivity at 15 m (ohm-meter) : 8.28

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.

Each axis unit indicates 3 Ohm - m

ERT 6

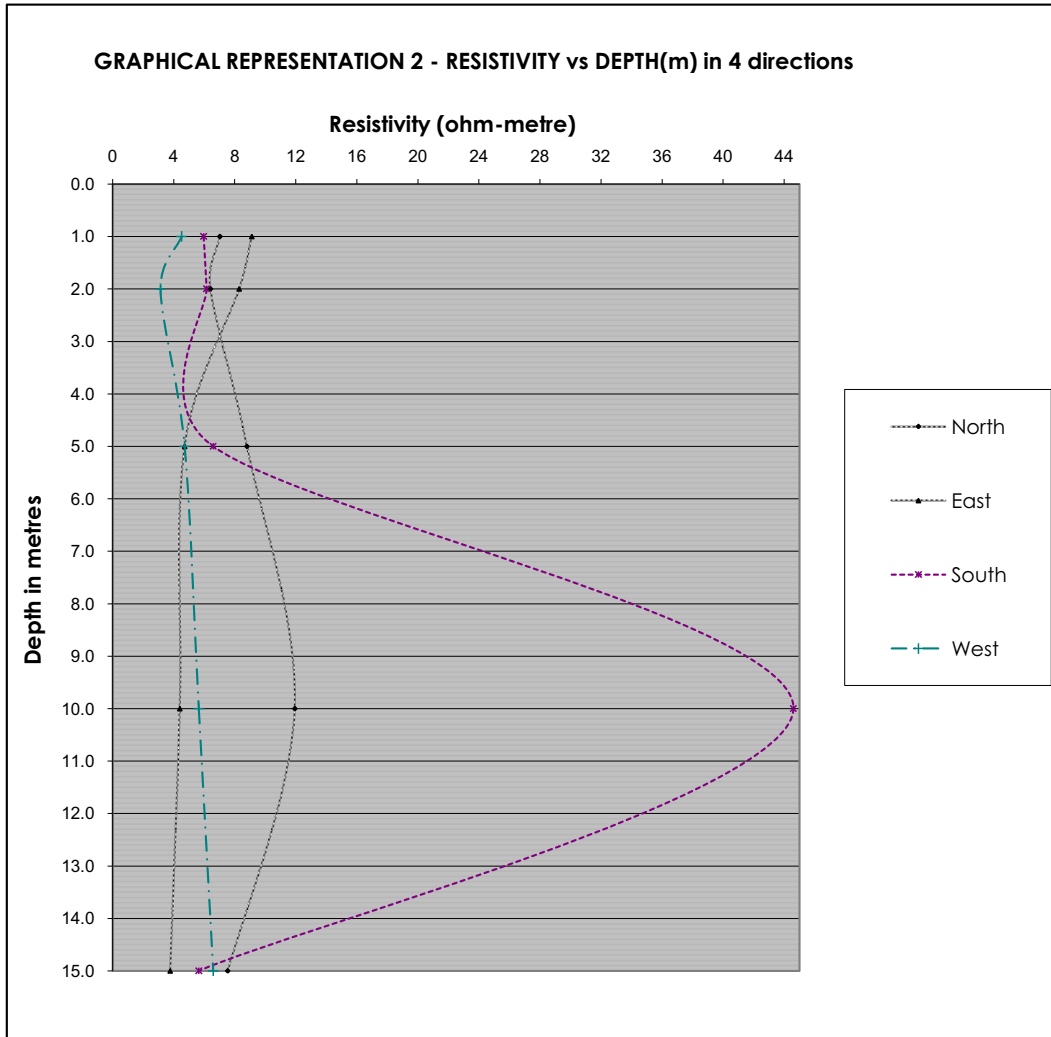


Fig No : 2.6.2

ERT 6

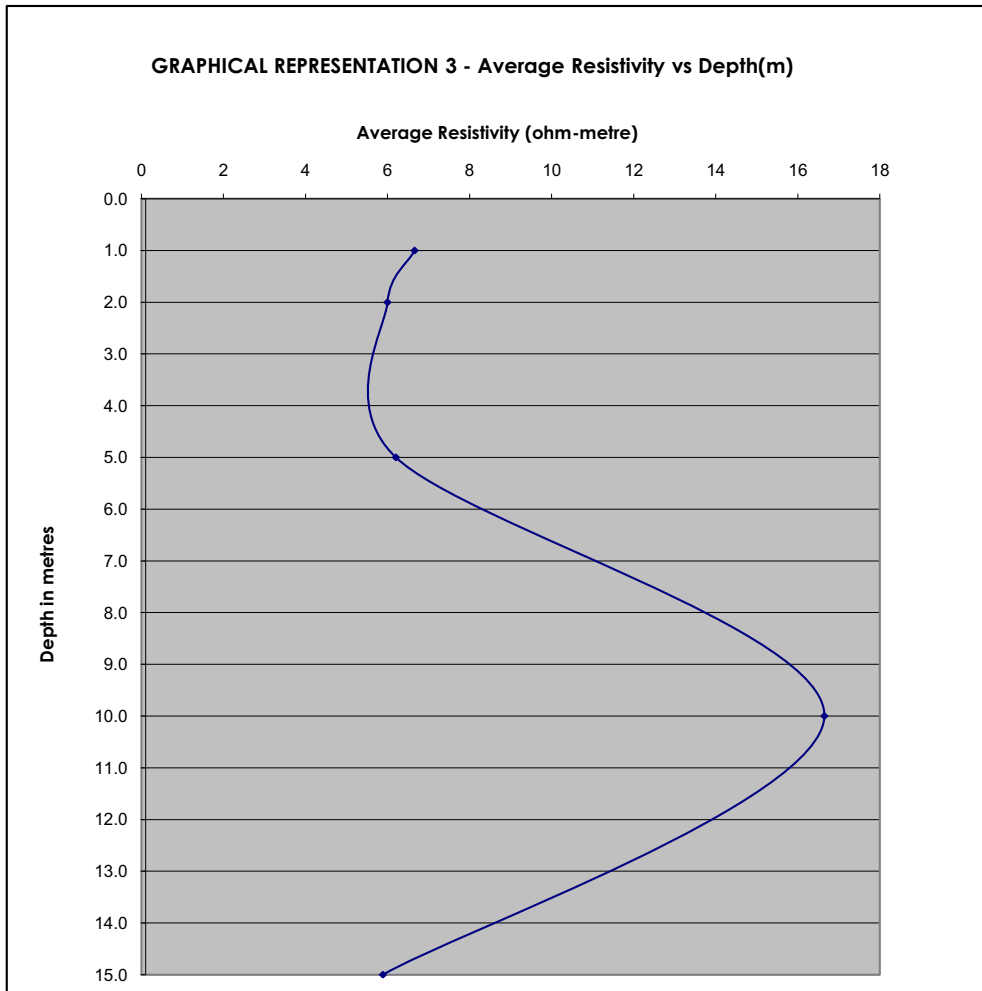
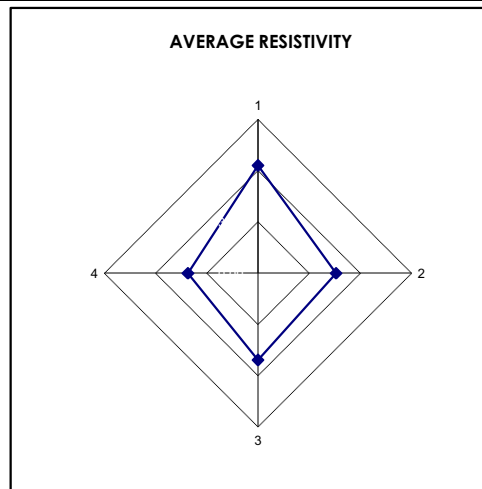


Fig No : 2.6.3

GRAPHICAL REPRESENTATION 1 - POLAR GRAPH AS PER IS 3043 - 1987

ERT 7

Direction	Average Resistivity in each direction				
	1 m	2 m	5 m	10 m	Avg.
N	8.42	7.67	5.97	3.14	6.30
E	6.41	4.65	4.71	2.51	4.57
S	5.78	6.41	4.40	3.77	5.09
W	5.09	5.65	3.77	1.88	4.10



Average Resistivity at 15 m (ohm-meter) : 5.01

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.
 Each axis unit indicates 3 Ohm - m

ERT 7

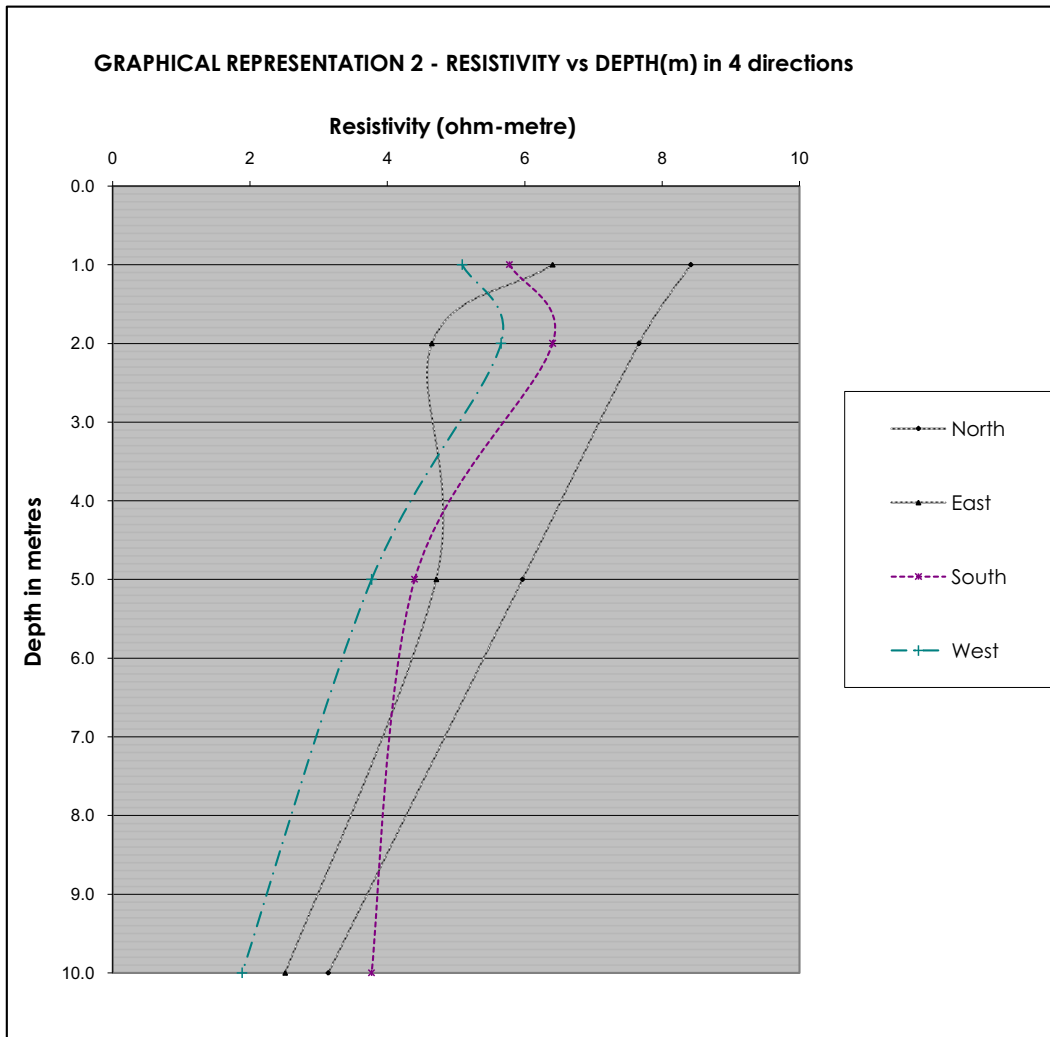


Fig No : 2.7.2

ERT 7

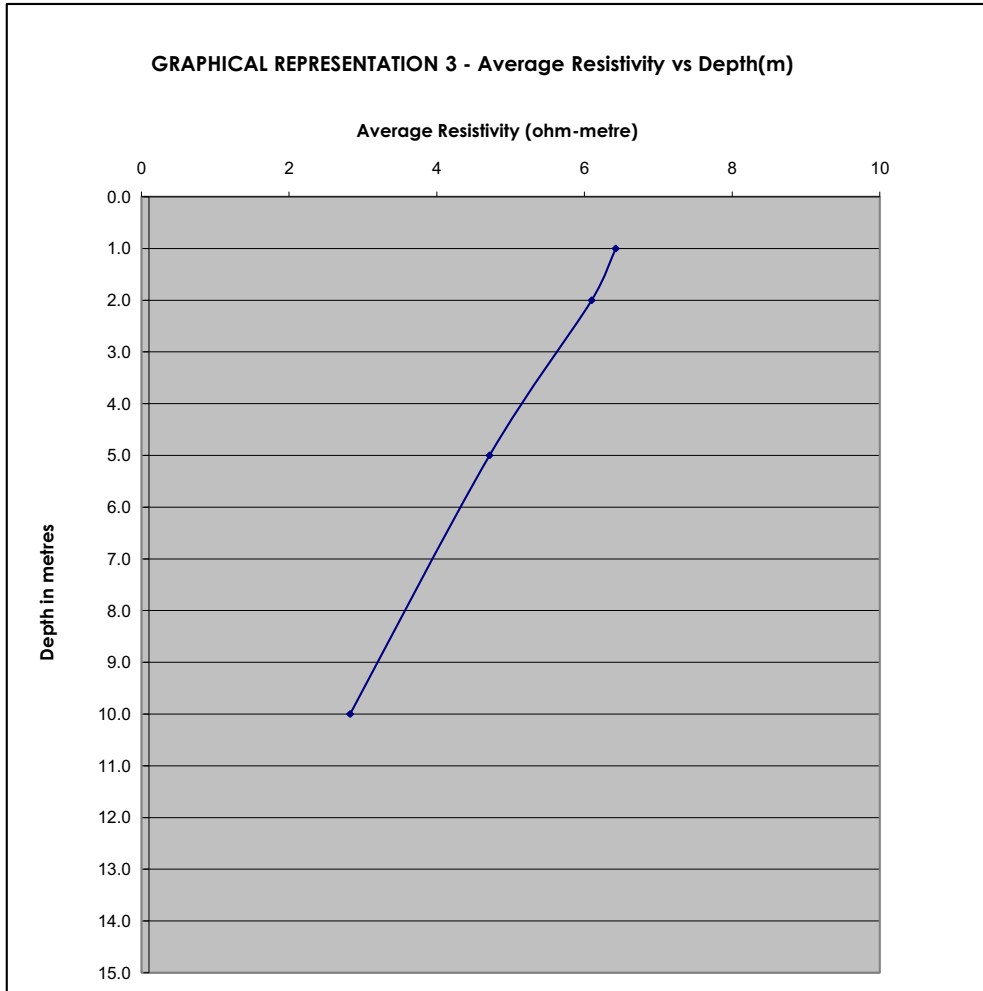
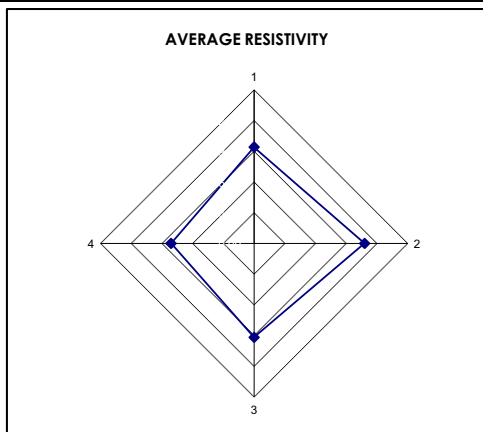


Fig No : 2.7.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 8

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	21.68	7.41	4.71	5.65	7.54	9.40
E	19.60	7.67	7.23	8.17	11.31	10.79
S	17.28	7.54	6.60	6.91	7.54	9.17
W	14.07	6.66	5.97	8.17	5.65	8.11



Average Resistivity at 15 m (ohm-meter) : 9.37

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.

Each axis unit indicates 3 Ohm - m

ERT 8

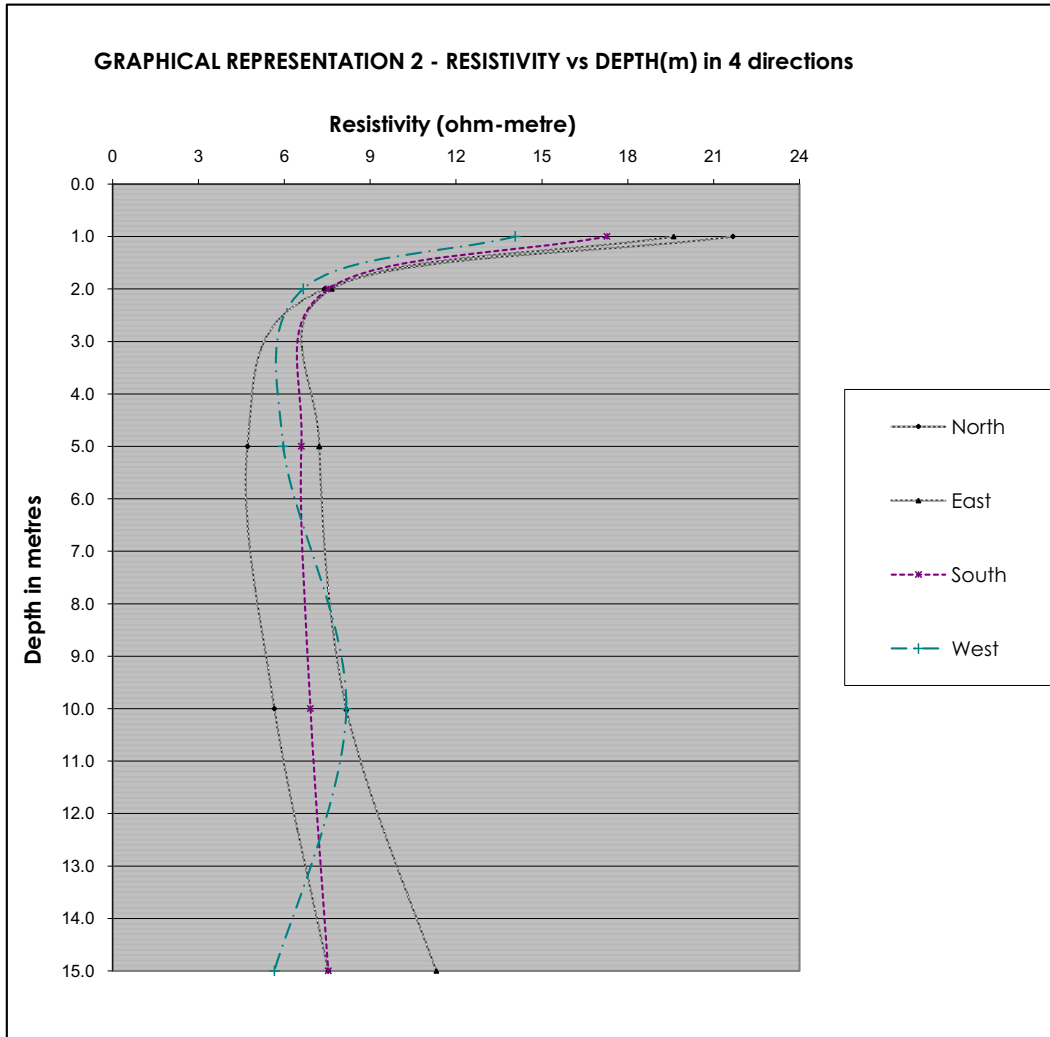


Fig No : 2.8.2

ERT 8

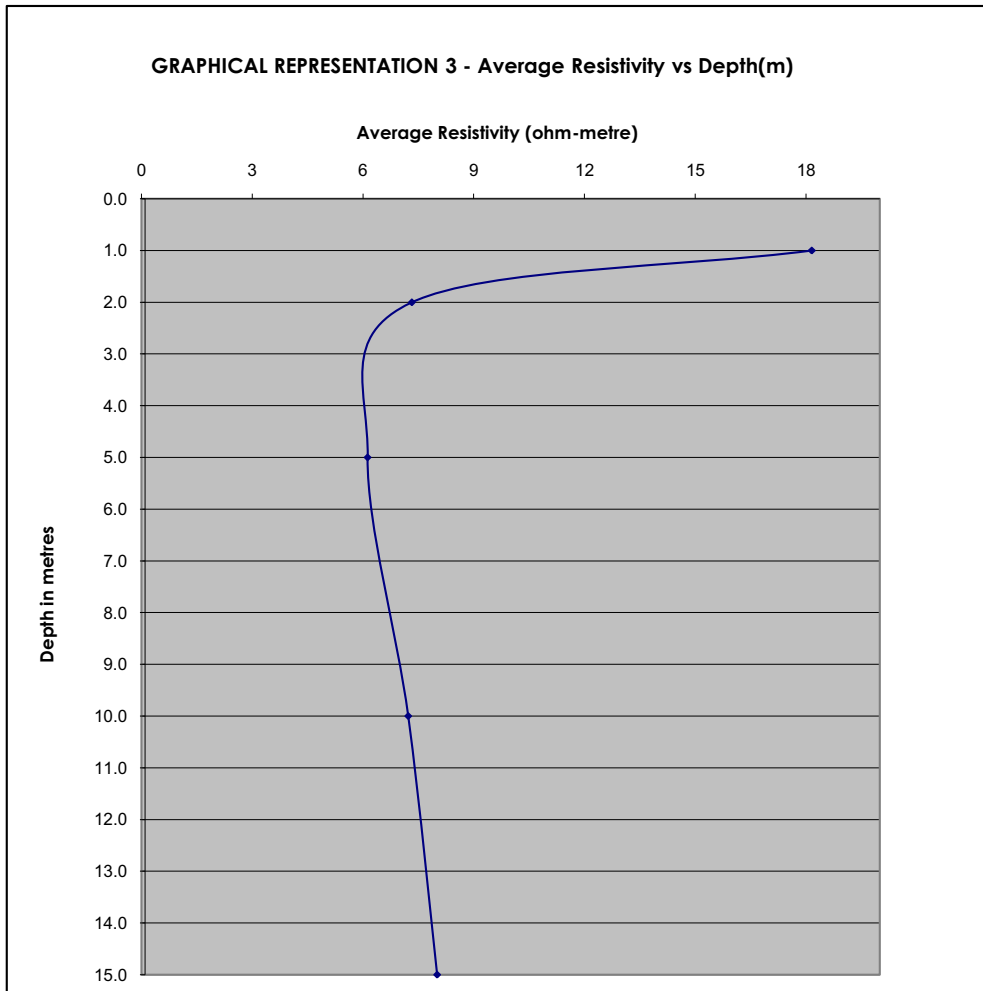
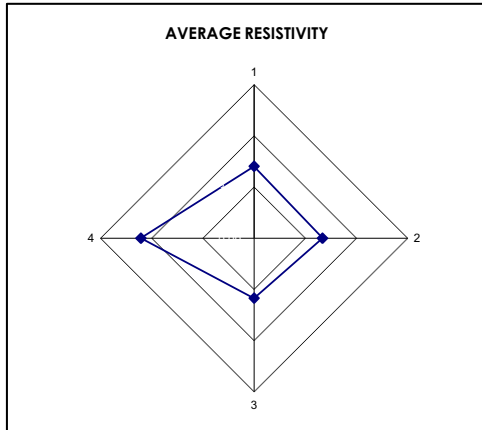


Fig No : 2.8.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 9

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	3.27	3.64	4.71	5.65	3.77	4.21
E	3.77	1.88	2.83	5.03	6.60	4.02
S	1.88	2.51	3.46	5.03	4.71	3.52
W	3.20	3.90	8.80	10.68	6.60	6.63



Average Resistivity at 15 m (ohm-meter) : 4.60

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.
 Each axis unit indicates 3 Ohm - m

ERT 9

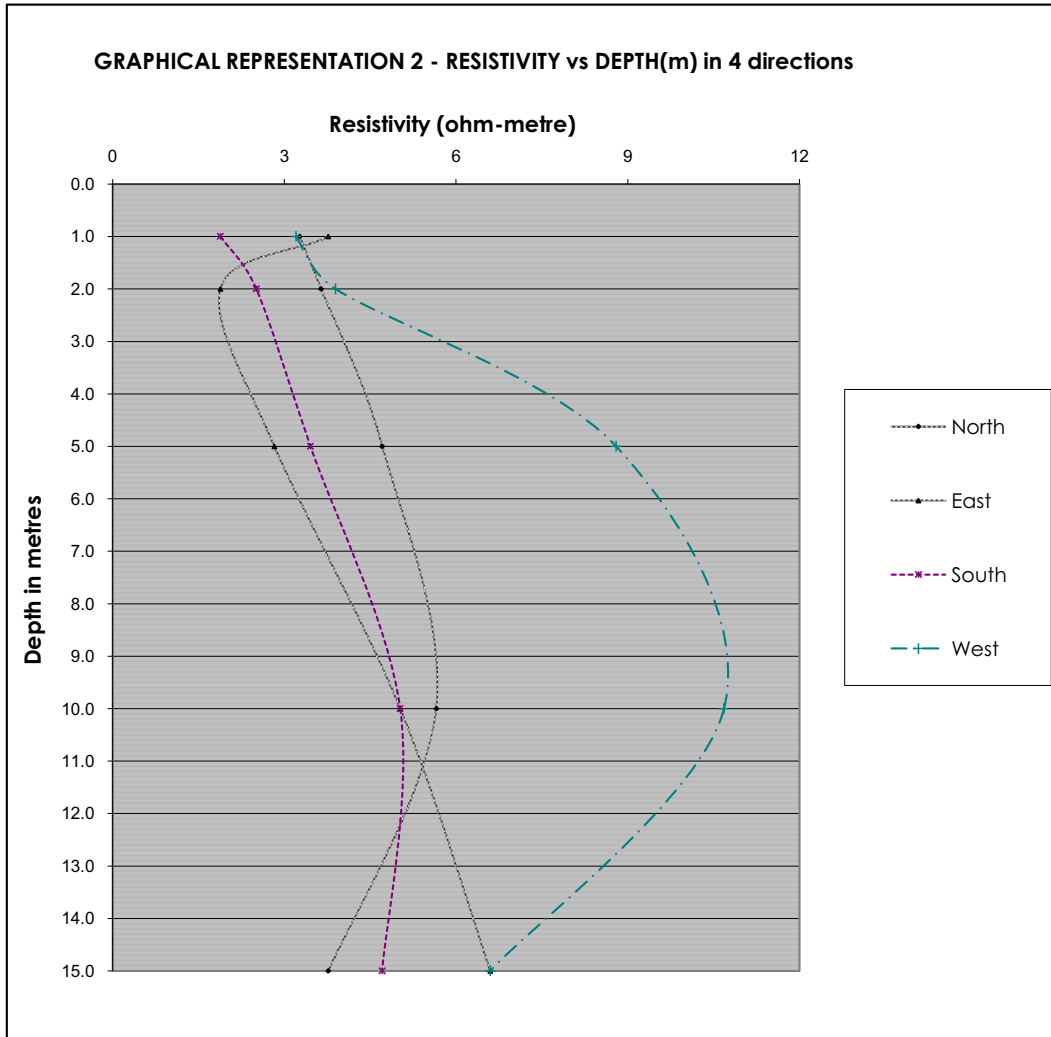


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ERT 9

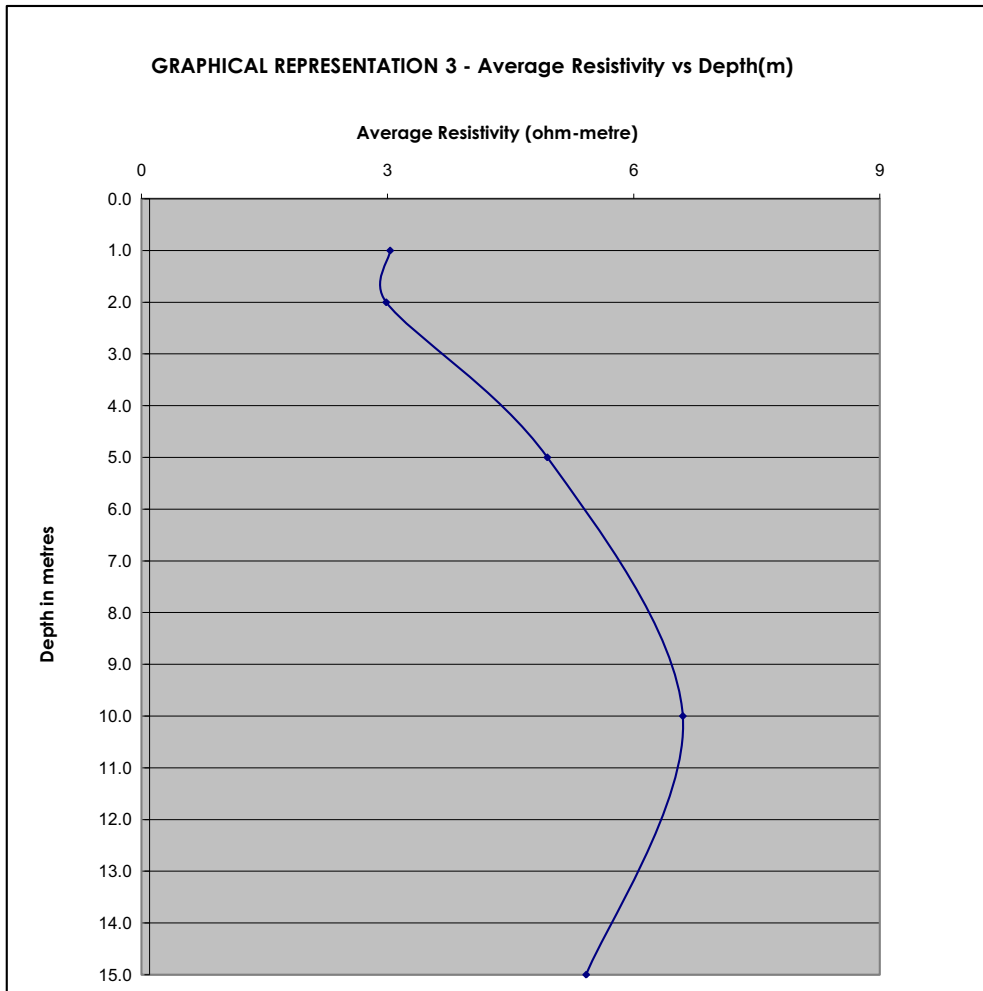
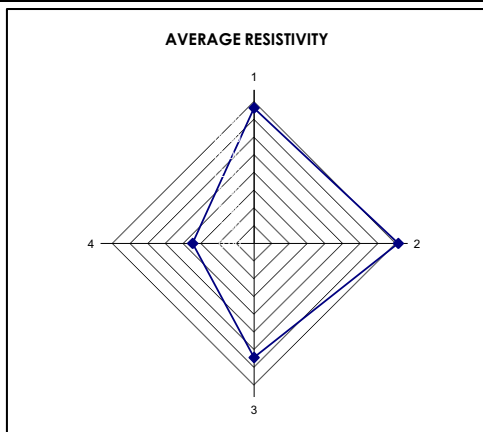


Fig No : 2.9.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 10

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	19.41	21.99	29.84	32.04	11.31	22.92
E	23.25	22.87	28.59	38.95	8.48	24.43
S	18.22	19.98	25.45	26.39	6.60	19.33
W	7.16	11.18	16.96	11.94	4.71	10.39



Average Resistivity at 15 m (ohm-meter) : 19.27

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.

Each axis unit indicates 3 Ohm - m

ERT 10

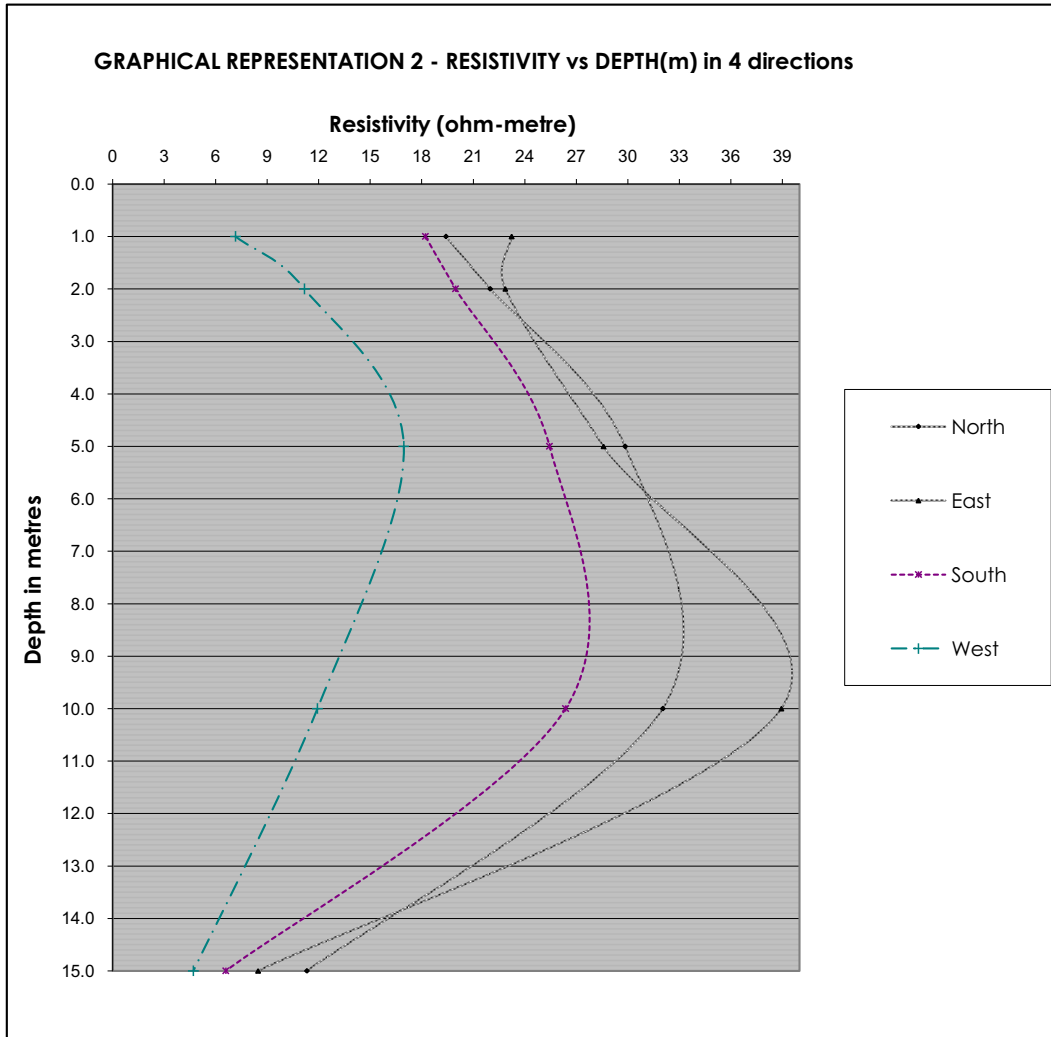


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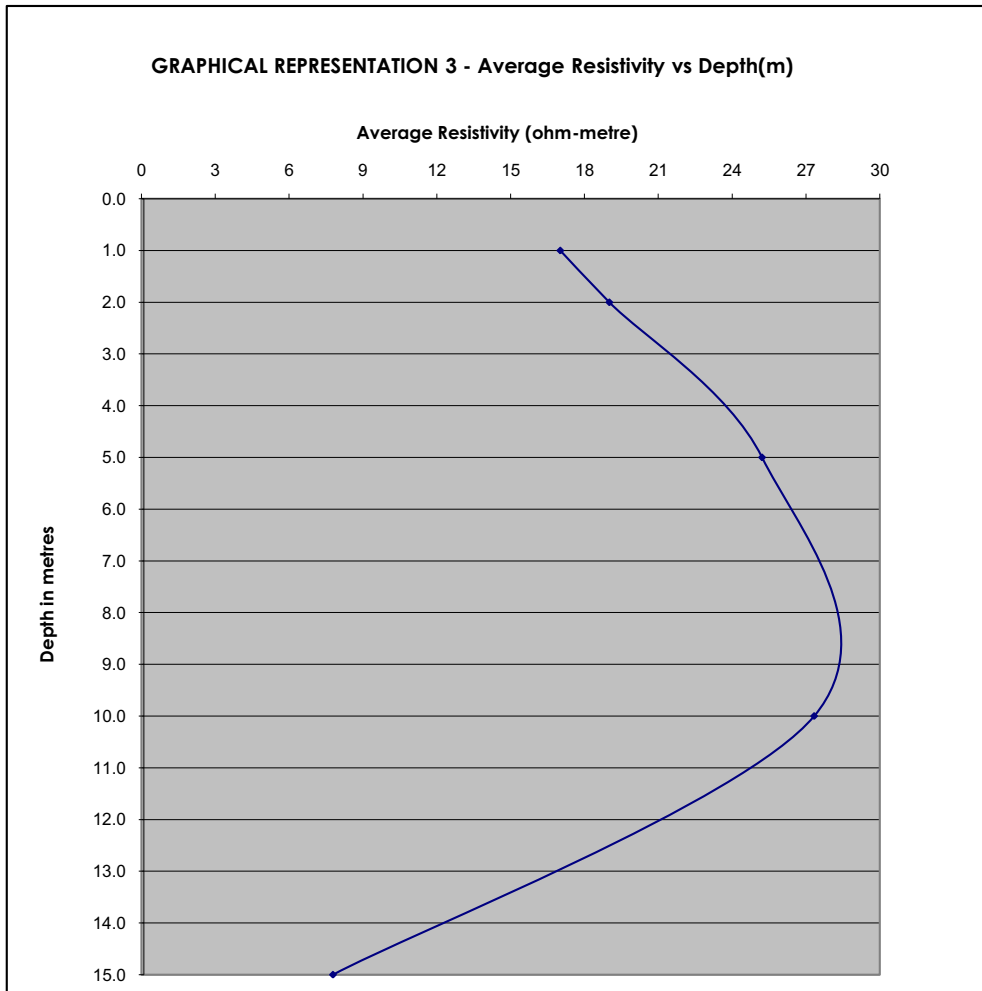
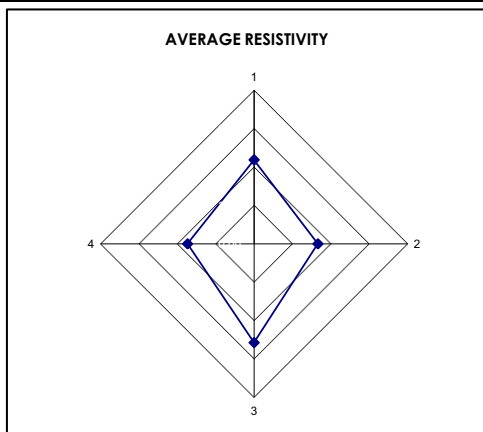


Fig No : 2.10.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 11

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	8.98	9.05	7.23	3.77	3.77	6.56
E	5.97	7.67	5.34	3.14	2.83	4.99
S	8.80	10.30	8.17	5.65	5.65	7.72
W	6.97	7.41	3.77	5.03	2.83	5.20



Average Resistivity at 15 m (ohm-meter) : 6.12

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.
 Each axis unit indicates 3 Ohm - m

ERT 11

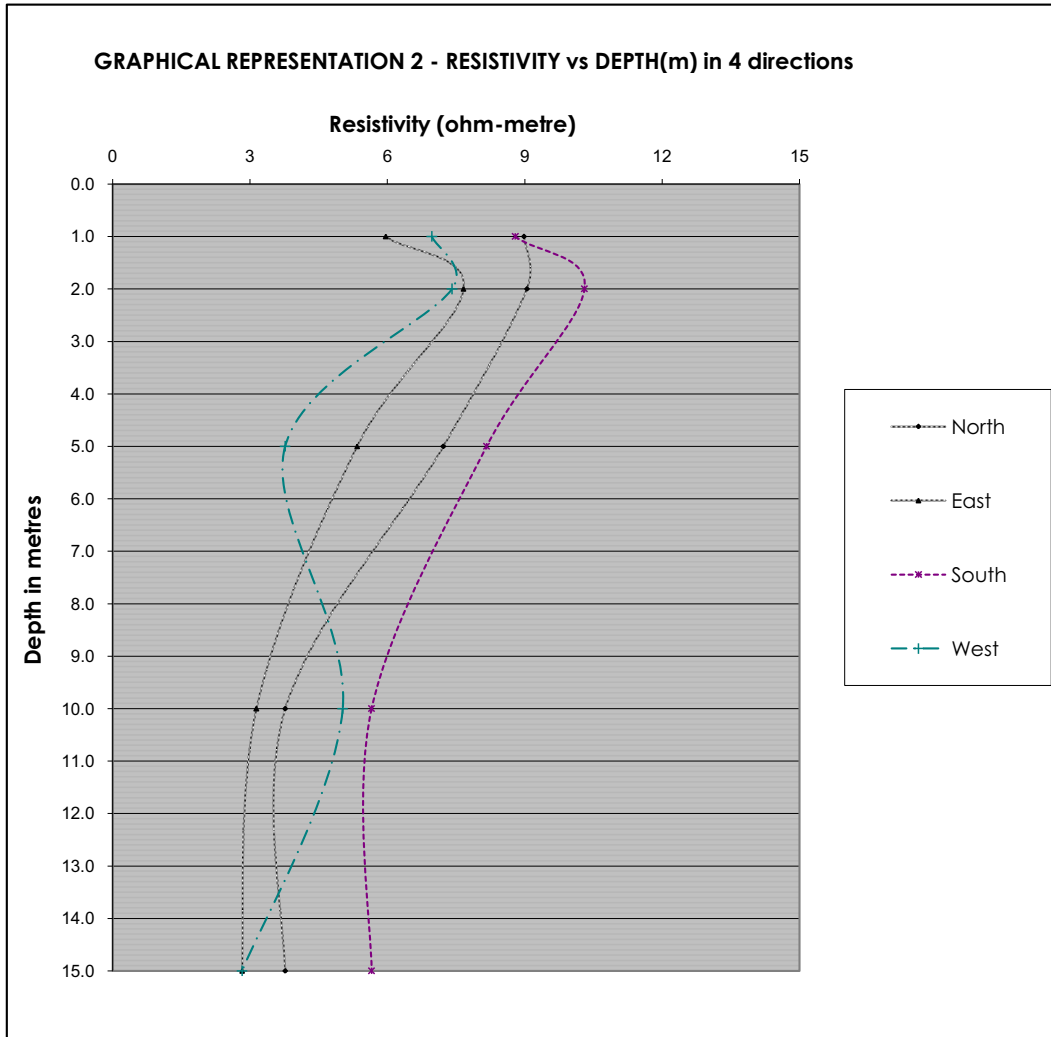


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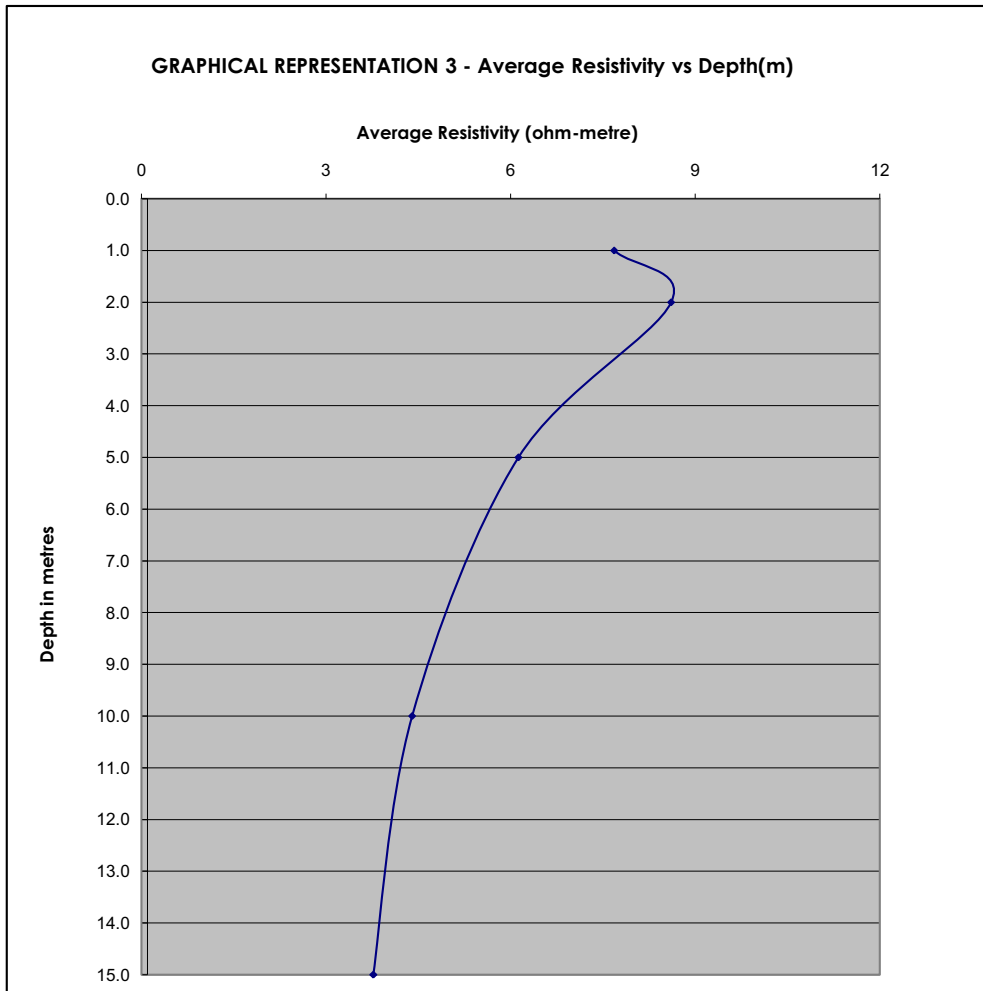
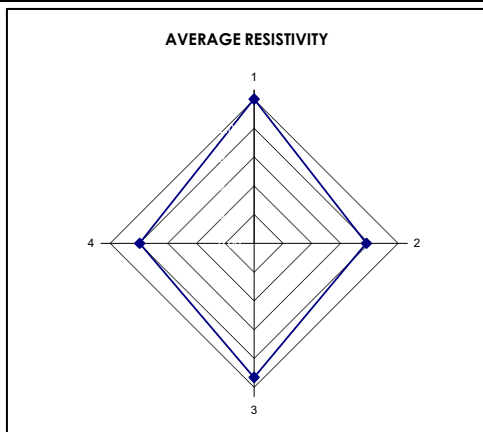


Fig No : 2.11.3

GRAPHICAL REPRESENTATION 1- POLAR GRAPH AS PER IS 3043 - 1987

ERT 12

Direction	Average Resistivity in each direction					
	1 m	2 m	5 m	10 m	15 m	Avg.
N	12.06	17.84	18.53	18.22	8.48	15.03
E	9.86	11.56	19.16	13.19	4.71	11.70
S	11.87	12.82	22.30	16.34	6.60	13.99
W	12.50	13.19	19.16	11.94	2.83	11.93



Average Resistivity at 15 m (ohm-meter) : 13.16

The term 1,2,3,4 in Polar graph indicates direction N, E, S, W respectively.
 Each axis unit indicates 3 Ohm - m

ERT 12

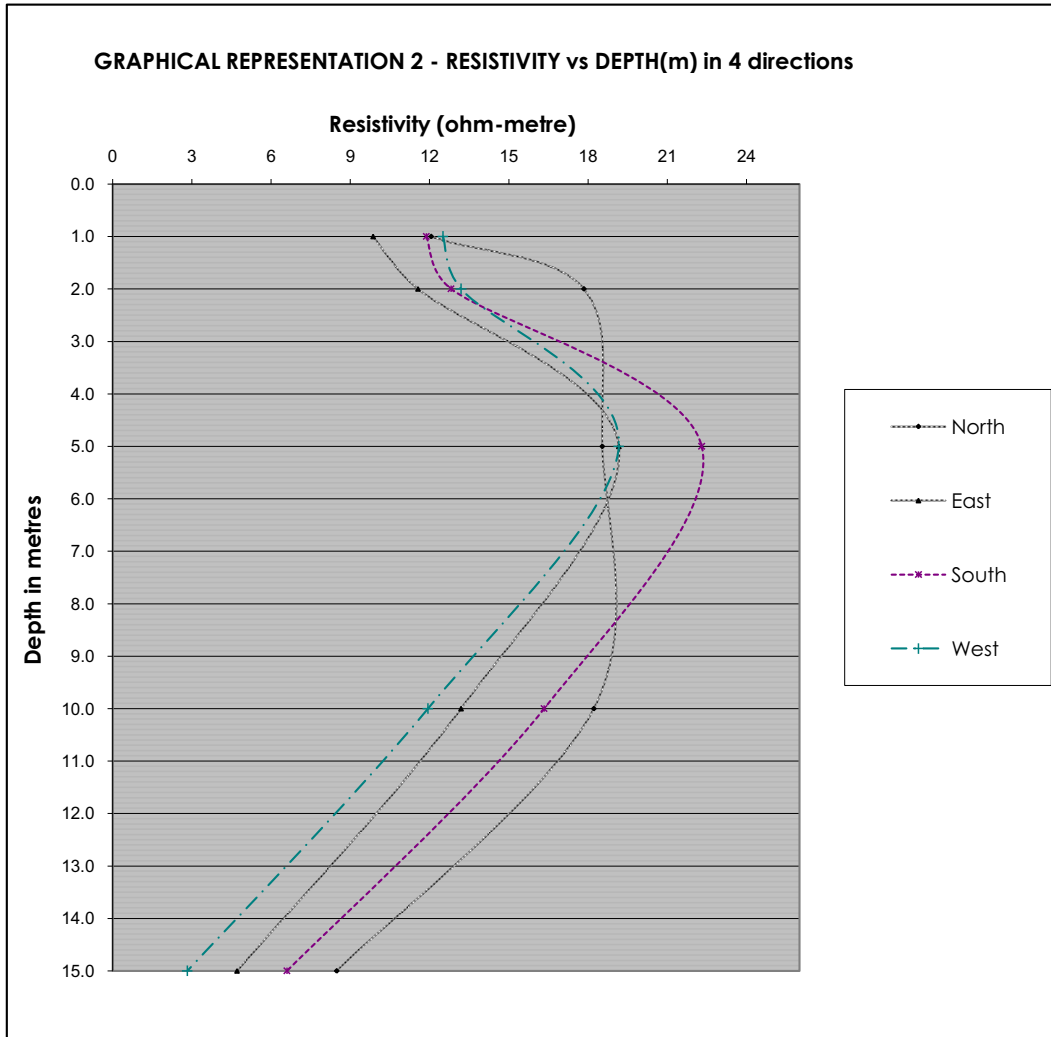


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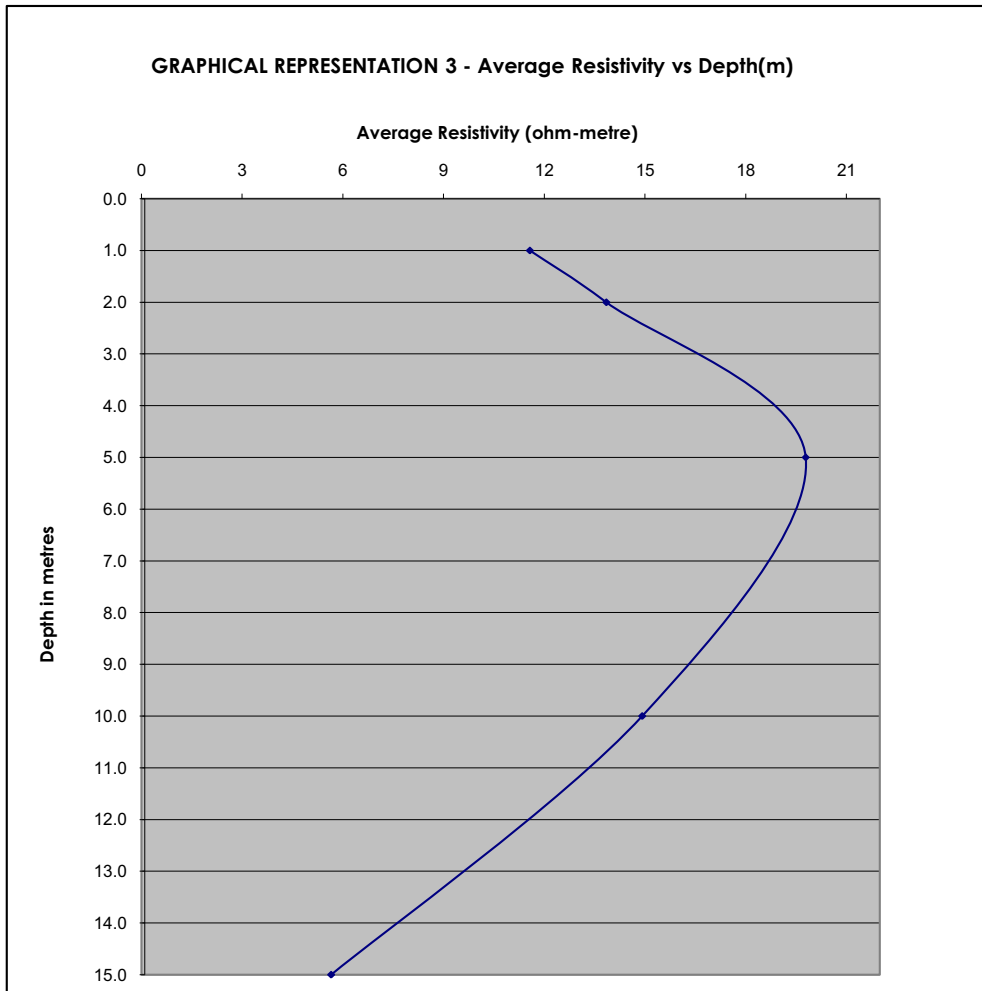


Fig No : 2.12.3

APPENDIX V

CHEMICAL ANALYSIS OF **SOIL AND WATER**

		GEO FOUNDATIONS & STRUCTURES PVT. LTD	
Client : Bharat Heavy Electricals Limited			
Project : soil Investigation for the 10 MWp PV Solar Project at ordinance factory Bolangir, Odisha			
Report No. : SI/CHN/16/1352/			
Chemical Analysis of Soil Sample			
TESTS		Result Obtained	
		BH -2	BH-1
Depth		3 m	3 m
p ^H		6.21	6.31
Chloride asCl		100 ppm	113 ppm
Sulphate as SO ₃		0.050%	0.046%



ISO 9001 : 2008 Certified

GEO FOUNDATIONS & STRUCTURES PVT LTD

No.89, Ist Main Road, Gandhi Nagar, Adyar, Chennai – 600 020. Ph: 044 - 24430399

Website: www.geofoundations.net Email: geogfs@gmail.com

**PROJECT NAME: Soil Investigation for 10 MWp PV Solar Project at ordinance factory
Bolangir, Odisha.**

A) NATURE OF SAMPLE : WATER
B) REFERENCE NO. : SI/CHN/16/1352/01

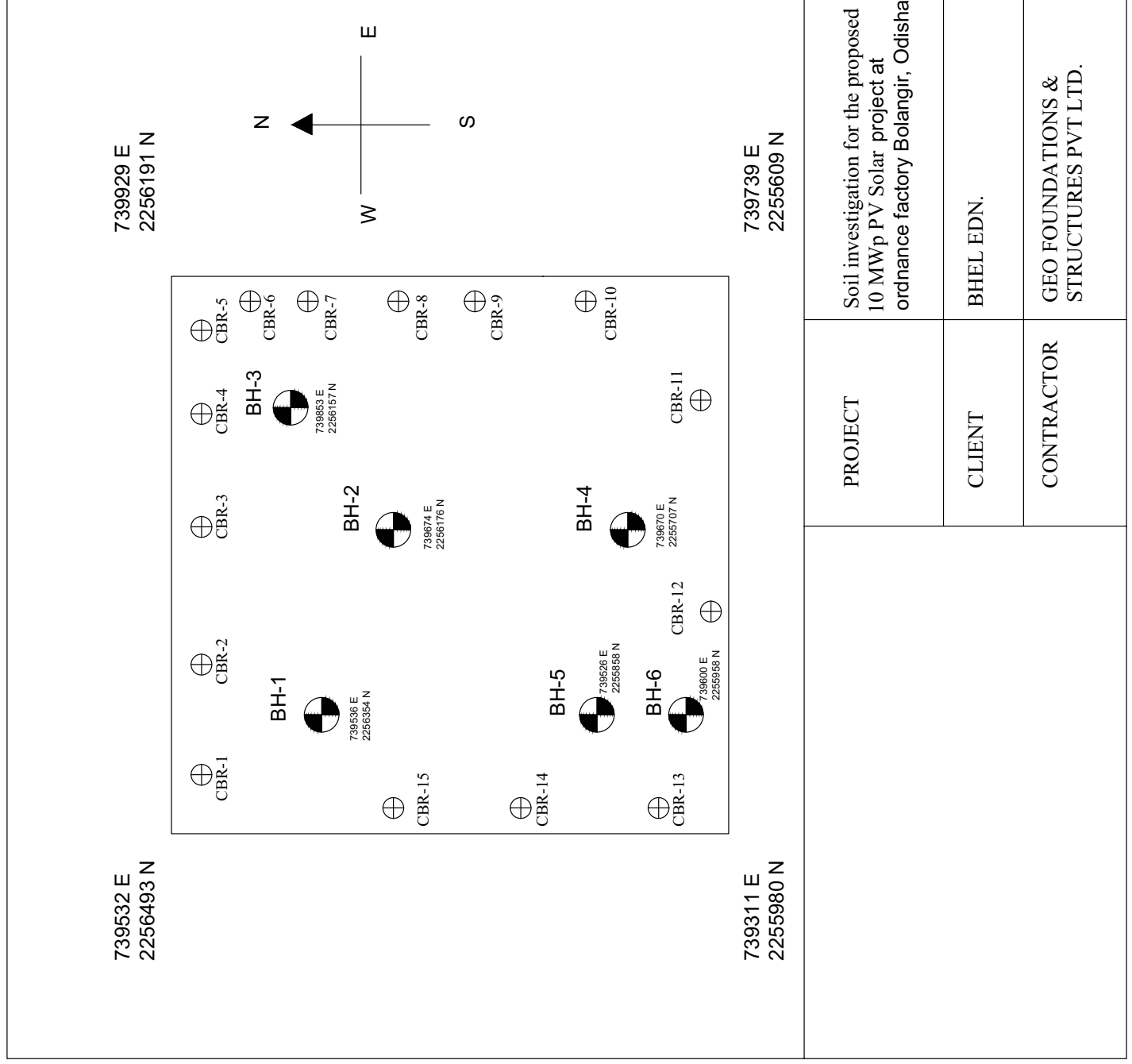
RESULTS OF ANALYSIS

<u>TESTS</u>	<u>Limits as per IS 456-2000</u>	
	BH-1	
a) To neutralize 100 ml. of water using Phenolphthalein as indicator	2.60 ml	Not more than 5.0ml. of 0.02N NaOH
b) i) Organic solids mg/l	96	200 max
ii) Inorganic solids mg/l	262	3000 Max
iii) Sulphate as SO ₃ mg/l	Nil	400 Max.
iv) Chloride as Cl mg/g	14	I.2000 Max for Plain concrete II. 500 Max for reinforced concrete
v) Suspended matter mg/l	3	2000 Max
vi) pH @ 25°C	7.44	6.0 Min

Remarks: The sample submitted conforms to I.S. 456-2000. Hence, it can be used for construction purposes.

APPENDIX VI

BORE HOLES LOCATION **DRAWING**



SPECIAL COMMERCIAL CONDITIONS OF CONTRACT (for foreign vendors)				
RFQ No. UPK0000978 Dtd. 24-01-2017 Due on 06-02-2017				
Sl. No.	Terms	Particulars	Confirmation	Deviation/Remarks
1	Pre Qualification Requirement (PQR)	1. Vendor should have executed at least one contract of indoor / outdoor electrical installation of 33kV minimum in power plants or sub-stations in India with scope including both supply and erection for total value, not less than Rs. 2 Crores. As evidence for this, the vendor should submit (a) Certification from clients for completion of supply and erection (b) Copies of Purchase orders from the clients.	Complied	
		2. Vendor should furnish the solvency certificate issued by Nationalised / Scheduled works for minimum worth Rs. 1 Crore with date of issue not before three months from the tender opening date.	Complied	
		3. Vendor should be registered company for a period not less than one year from the date of tender opening. As evidence to this, vendor should submit certificate of registration.	Complied	
2	Bidding	(a) Bid has to be submitted as Two Part – Techno Commercial Bid (Part-1) & Price Bid (Part-II). Bids shall be submitted through e-Procurement portal https://bheleps.buyjunction.in of M/s. Mjunction Services Limited.	Complied	
		(b) Annexures B & B1 to be submitted along with technical bid (Part-I) & Annexure B2 to be submitted along with Price bid (Part-II).	Complied	
		(c) Clause-wise compliance to BHEL Purchase specification along with all documents as called in Technical specification to be submitted along with technical bid (Part-1).	Complied	
3	Price basis:	Firm i.e., from the date of PO to completion of supply if I&C is not applicable. If I&C is in supplier's scope, then the prices shall remain Firm till commissioning & handing-over of the complete system. (PVC clause not acceptable).	Complied	
4	Evaluation of L1 vendor	Over all L1 of Supply on "FOR" basis to site will only be considered.	Complied	
5	Octroi / Entry Tax	Any Entry Tax / Octroi if applicable for supplies to these project location, the same has to borne by the vendor.	Complied	
6	Terms of Delivery:	CIF Seaport/CIF Airport/FCA Airport (Indicate name of Seaport/Airport)	Acceptable / Not acceptable	
7	Delivery Period	(a) Supply: 4 Wks from drawing approval Date (b) Drawing Submission: 1 Wk from PO Date (c) I&C: 4 Weeks from supply	Acceptable / Not acceptable	

8	Payment Term	For Supply: 1) 80% of the basic value (excluding I&C charges) will be paid with 45 days credit, against Sight draft, from the date of AWB/BOL on submission of complete set of documents as in PO. 2) 10% of basic supply value will be paid on completion of I&C against submission of supplementary invoice along with proof of completion of I&C along with I&C charges (if any). 3) Balance 10% (retention money) against submission of supplementary invoice along with PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank. For I&C: 100% on completion of I&C/Supervision and certification line item wise on pro-rata basis. For O&M: Quarterly payment of 100% O&M charges shall be done against report certified by BHEL. NOTE: In exceptional cases, if vendor fails to submit PBG after supplies, vendors can also accept for the final 10% payment, payable after the warranty period + 3 months of claim period against supplementary invoice subject to the completion of commissioning (if applicable) as PBG is linked to Warranty period.	Acceptable / Not acceptable	
		(b) For any deviation in payment term, the offer will be liable for loading as per Clause G of ITB (Doc Ref : SCPV: BOS: ITB - Rev 01)	Acceptable / Not acceptable	
9	Warranty	(a) Warranty for Supply: 18 Months from Supply or 12 Months from I&C, whichever is earlier. (b) Warranty for Workmanship & I&C: 12 months from I&C (c) O&M: 10 Years from date of commissioning	Acceptable / Not acceptable	
10	Pre Shipment Inspection	(a) Pre Shipment Inspection will be carried out by BHEL/Customer for which test report shall be sent one week in advance.	Acceptable / Not acceptable	
		(b) Inspection charges & co-ordination for third party inspection shall be to your account. Please confirm that your quotation for individual item includes inspection charges by any of BHEL approved inspection agencies. In case nothing is mentioned regarding inspection charges, it will be presumed that these are included in quoted prices. Please confirm.	Acceptable / Not acceptable	
11	Penalty	(a) Supply: Penalty of 0.5% per week at the basic price of the good for undelivered quantity of supply portion, subject to a maximum of 10%. For Supply, Pre Shipment Inspection Call Letter Date (Receipt of test report) will be treated as delivery for purpose of penalty.	Acceptable / Not acceptable	
		(b) For any deviation in penalty term, the offer will be liable for loading as per Clause No. G, Point No.(b) of ITB (Doc Ref : SCPV: BOS: ITB - Rev 01)	Acceptable / Not acceptable	
12	PBG	(a) PBG shall be furnished in the BHEL prescribed format. (b) Deviation if any Please specify.	Acceptable / Not acceptable	
13	Validity:	Quotation should remain valid for a period of 90 days from the due date.	Acceptable / Not acceptable	

14	Bank charges (If applicable):	(a) All Bank charges to seller's account	Acceptable / Not acceptable	
		(b) Deviation will be liable for loading as per CLG of ITB	Acceptable / Not acceptable	
15	Reverse Auction:	BHEL reserves the right to conduct Reverse auction.Procedure for the same will be informed by BHEL .	Acceptable / Not acceptable	
16	DUN No.	Please mention Dun & Bradstreet No.(DUN No.)		
17	Consignment Details	Weight and Dimension of consignment with packing	Furnished / To be furnished	

18	Despatch Documents	Despatch documents include AWB, Invoice, Packing list, Warranty certificate, O&M manuals	Acceptable / Not acceptable	
		One copy of Invoice, Packing list and Air Way Bill shall be faxed immediately after despatch. Also one copy of packing list to be kept inside each box for easy identification of material at site.		
19	Other terms & conditions	For any other Terms and Conditions, kindly refer to the following: A: ITB B: GCC	Acceptable / Not acceptable	
20	Integrity Pact	a. IP is a tool to ensure that activities and transactions between the Company and its bidders/ Contractors are handled in a fair, transparent and corruption free manner. A panel of Independent External Monitors (IEMs) have been appointed to oversee implementation of IP in BHEL. The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory who signs in the offer) along with techno-commercial bid. Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification. Details of IEM for this tender is furnished below: Name : Shri D.R.S Chaudhary, IAS (Retd.) Address : Flat No. L-202 & L-203 (1st Floor) Ansal Lake View Enclave, Shamla Hills Bhopal- 462 013 (M.P.) Email : dilip.chaudhary@icloud.com b. Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to the IEM mentioned in the tender. Note: No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department.	Acceptable / Not acceptable	
		For all clarifications/ issues related to the tender, Please contact: Name : UPENDER KUMAR Dept. : SC&PV-MM Address : BHEL, EDN, BANGALORE Phone : 080-26989572, Mobile : 9739801116 Email : upender@bheledn.co.in Fax : 080-26742498 Name : CHENDHIL KUMAR R. Dept. : SC&PV-MM Address : BHEL, EDN, BANGALORE Phone : 080-26998391 Email : chendhil@bheledn.co.in Fax : 080-26742498		
21	BOS %	The percentage of Supply and I&C and O&M values shall be in the range indicated below (approximately, with overall tallying to 100%) : (a) Supply : 25 to 29 % (b) I&C : 18 to 22 % (c) O&M : 50 to 54 % Successful bidder shall submit detailed billing break up for BHEL approval after placement of Purchase order.	Acceptable / Not acceptable	

22	Documents Submission	All the documents pertaining to I&C and O&M as per Annexure-C to be submitted as applicable.	Acceptable / Not acceptable	
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ANNEXURE A1

TECHNICAL BID ENCLOSURE FOR COMPLIANCE OF QUOTE : UNPRICED BID (Foreign Vendors)						
RFQ No. UPK0000978 Dtd. 24-01-2017 Due on 06-02-2017						
Sl No.	Material Code	DESCRIPTION	Quantity	Unit	Quoted	Currency
1	PS0679065024	Supply of MC4 ,Cable tie,HDPE pipe etc.	1	ST	Yes / No	
2	PS0679065032	Supply of earthing items for array,SMBet	1	ST	Yes / No	
3	PS0679065040	Supply of ESE lightning arrestors etc	1	ST	Yes / No	
4	PS0679065059	Supply of items for module cleaning etc	1	ST	Yes / No	
5	PS0679065067	Supply of control cables & accessories	1	ST	Yes / No	
6	PS0679065075	Supply of Aux transformer & accessories	1	ST	Yes / No	
7	PS0679065083	Supply of plant lighting system etc	1	ST	Yes / No	
8	PS0679065091	Supply of cable ties,markers etc	1	ST	Yes / No	
9	PS0679065105	Supply of safety related items etc	1	ST	Yes / No	
10	PS0679065113	Supply of CCTV system	1	ST	Yes / No	
11	PS0679065121	Supply of spare items ..	1	ST	Yes / No	
12	PS0679065130	Supply of Weather monitoring station	1	ST	Yes / No	
13	PS0679065148	Supply of items for security room etc	1	ST	Yes / No	
14	PS0679065156	I&C Interconnection of SPV modules	7	AU	Yes / No	
15	PS0679065164	I&C underground cbl trench for DC cbl	2	AU	Yes / No	
16	PS0679065172	I&C Laying of DC power 1Cx300,RS485 etc	2	AU	Yes / No	
17	PS0679065180	I&C Earthing system for solar array etc	2	AU	Yes / No	
18	PS0679065199	I&C UG cbl trench & laying Aux AC/DC cbl	4	AU	Yes / No	
19	PS0679065202	I&C erection of indoor elec panels	2	AU	Yes / No	
20	PS0679065210	I&C erection of 33kv transformer yards	2	AU	Yes / No	
21	PS0679065237	I&C of 33kv portion of 33/132kv SY	1	AU	Yes / No	
22	PS0679065245	I&C of SCADA system	1	AU	Yes / No	
23	PS0679065253	I&C of aux AC/DC system.	1	AU	Yes / No	
24	PS0679065261	I&C of earthing for IR,CR,Xmer yard etc	1	AU	Yes / No	
25	PS0679065270	I&C lightning arrestors etc	1	AU	Yes / No	
26	PS0679065288	I&C of borewells and associated works	1	AU	Yes / No	
27	PS0679065296	I&C of module cleaning system etc	1	AU	Yes / No	
28	PS0679065300	I&C of plant lighting system & cabling	1	AU	Yes / No	
29	PS0679065318	I&C of security rooms and watchman cbn	1	AU	Yes / No	
30	PS0679065326	I&C misc & safety items etc	1	AU	Yes / No	
31	PS0679065334	I&C of CCTV system	1	AU	Yes / No	
32	PS0679065342	I&C of markings,pre comm. insp etc	1	AU	Yes / No	
33	PS0679065229	I&C:Erection of indoor electrical panels	1	AU	Yes / No	
34	PS0679065350	Operations and Maintenance-Quarterly	40	AU	Yes / No	

Note:

* The above format is to be used for Unpriced bid. Reproducing on letter head is acceptable.

BHEL is trying to avail Customs Duty & Excise duty exemption. Successful bidder shall support with all relevant docum

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PRICE BID (Foreign Vendors)							
RFQ No. UPK0000978 Dtd. 24-01-2017 Due on 06-02-2017							
SI No.	Material Code	DESCRIPTION	Total Quantity	Unit	UNIT RATE	Total value (Rate x Quantity)	Currency
1	PS0679065024	Supply of MC4 ,Cable tie,HDPE pipe etc.	1	ST			
	Unit rate in words :						
2	PS0679065032	Supply of earthing items for array,SMBet	1	ST			
	Unit rate in words :						
3	PS0679065040	Supply of ESE lightning arrestors etc	1	ST			
	Unit rate in words :						
4	PS0679065059	Supply of items for module cleaning etc	1	ST			
	Unit rate in words :						
5	PS0679065067	Supply of control cables & accessories	1	ST			
	Unit rate in words :						
6	PS0679065075	Supply of Aux transformer & accessories	1	ST			
	Unit rate in words :						
7	PS0679065083	Supply of plant lighting system etc	1	ST			
	Unit rate in words :						
8	PS0679065091	Supply of cable ties,markers etc	1	ST			
	Unit rate in words :						
9	PS0679065105	Supply of safety related items etc	1	ST			
	Unit rate in words :						
10	PS0679065113	Supply of CCTV system	1	ST			
	Unit rate in words :						
11	PS0679065121	Supply of spare items ..	1	ST			
	Unit rate in words :						
12	PS0679065130	Supply of Weather monitoring station	1	ST			
	Unit rate in words :						
13	PS0679065148	Supply of items for security room etc	1	ST			
	Unit rate in words :						
14	PS0679065156	I&C Interconnection of SPV modules	7	AU			
	Unit rate in words :						
15	PS0679065164	I&C underground cbl trench for DC cbl	2	AU			
	Unit rate in words :						
16	PS0679065172	I&C Laying of DC power 1Cx300,RS485 etc	2	AU			
	Unit rate in words :						
17	PS0679065180	I&C Earthing system for solar array etc	2	AU			
	Unit rate in words :						
18	PS0679065199	I&C UG cbl trench & laying Aux AC/DC cbl	4	AU			
	Unit rate in words :						
19	PS0679065202	I&C erection of indoor elec panels	2	AU			
	Unit rate in words :						
20	PS0679065210	I&C erection of 33kv transformer yards	2	AU			
	Unit rate in words :						
21	PS0679065237	I&C of 33kv portion of 33/132kv SY	1	AU			
	Unit rate in words :						
22	PS0679065245	I&C of SCADA system	1	AU			
	Unit rate in words :						
23	PS0679065253	I&C of aux AC/DC system.	1	AU			
	Unit rate in words :						
24	PS0679065261	I&C of earthing for IR,CR,Xmer yard etc	1	AU			
	Unit rate in words :						
25	PS0679065270	I&C lightning arrestors etc	1	AU			
	Unit rate in words :						
26	PS0679065288	I&C of borewells and associated works	1	AU			
	Unit rate in words :						
27	PS0679065296	I&C of module cleaning system etc	1	AU			
	Unit rate in words :						
28	PS0679065300	I&C of plant lighting system & cabling	1	AU			
	Unit rate in words :						
29	PS0679065318	I&C of security rooms and watchman cbn	1	AU			
	Unit rate in words :						
30	PS0679065326	I&C misc & safety items etc	1	AU			
	Unit rate in words :						
31	PS0679065334	I&C of CCTV system	1	AU			
	Unit rate in words :						
32	PS0679065342	I&C of markings,pre comm. insp etc	1	AU			
	Unit rate in words :						
33	PS0679065229	I&C.Erection of indoor electrical panels	1	AU			
	Unit rate in words :						
34	PS0679065350	Operations and Maintenance-Quarterly	40	AU			
	Unit rate in words :						

Note:

* The above format is to be used for Unpriced bid. Reproducing on letter head is acceptable.

BHEL is trying to avail Customs Duty & Excise duty exemption. Successful bidder shall support with all relevant documents.

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SPECIAL COMMERCIAL CONDITIONS OF CONTRACT (SCC) - for indigenous vendors				
RFQ No. UPK0000978 Dtd. 24-01-2017 Due on 06-02-2017				
Sl No.	Terms	BHEL Term	Confirmation	Deviation / Remarks
1	PQC	1. Vendor should have executed at least one contract of indoor / outdoor electrical installation of 33kV minimum in power plants or sub-stations in India with scope including both supply and erection for total value, not less than Rs. 2 Crores. As evidence for this, the vendor should submit (a) Certification from clients for completion of supply and erection (b) Copies of Purchase orders from the clients.	Complied	
		2. Vendor should furnish the solvency certificate issued by Nationalised / Scheduled works for minimum worth Rs. 1 Crore with date of issue not before three months from the tender opening date.	Complied	
		3. Vendor should be registered company for a period not less than one year from the date of tender opening. As evidence to this, vendor should submit certificate of registration.	Complied	
2	Bidding	(a) Bid has to be submitted as Two Part – Techno Commercial Bid (Part-1) & Price Bid (Part-II). Bids shall be submitted through e-Procurement portal https://bheleps.buyjunction.in of M/s. Mjunction Services Limited.	Complied	
		(b) SCC (Annexure B) & Annexure B1 to be submitted along with technical bid (Part-I) & Annexure B2 to be submitted along with Price bid (Part-II).	Complied	
		(c) Clause-wise compliance to BHEL Purchase specification along with all documents as called in Technical specification to be submitted along with technical bid (Part-1).	Complied	
3	Price Basis	Firm i.e., from the date of PO to completion of supply if I&C is not applicable. If I&C is in supplier's scope, then the prices shall remain Firm till commissioning & handing-over of the complete system. (PVC clause not acceptable).	Complied	
4	Terms of Delivery	Free On Road Basis to Project site. Present Projects are : BEL, BOLANGIR, ODISHA	Complied	
5	Delivery Period	(a) Supply: 4 Wks from drawing approval Date (b) Drawing Submission: 1 Wk from PO Date (c) I&C: 4 Weeks from supply	Acceptable / Not acceptable	

6	Payment Term	1) 80% of basic Supply value + 100% of taxes, duties and freight charges will be paid with 45 days credit from the receipt of material at site or 15 days credit from the date of submission of complete set of documentation whichever is later. 2) 10% of basic supply value will be paid on completion of I&C against submission of supplementary invoice along with proof of completion of I&C along with I&C charges (if any). 3) Balance 10% (retention money) against submission of supplementary invoice along with PBG valid for Warranty Period+3months Claim Period from BHEL Consortium Bank. I&C/Supervision: 100% on completion of I&C/Supervision and certification line item wise on pro-rata basis. FOR O&M: Quarterly payment of 100% O&M charges shall be done against report certified by BHEL. Note: In exceptional cases, if vendor fails to submit PBG after supplies, vendors can also accept for the final 10% payment, payable after the warranty period + 3 months of claim period against supplementary invoice subject to the completion of commissioning (if applicable) as PBG is linked to Warranty period.	Acceptable / Not acceptable	
		(b) For any deviation in payment term, the offer will be liable for loading as per Clause G of ITB.	Acceptable / Not acceptable	
7	Excise Duty	(a) To confirm whether applicable. If applicable, indicate prevailing rate of Excise duty.	Applicable / Not applicable	Prevailing rate of Excise duty: %
8	Sales Tax	(a) To confirm whether applicable. If applicable, indicate prevailing rate of Sales Tax without Form C .	Applicable / Not applicable	Prevailing rate of Sales Tax without Form C : %
9	Value Added Tax	Both are in the same State, VAT is applicable please indicate VAT applicable.	Applicable / Not applicable	Prevailing rate of VAT: %
10	Service Tax	To confirm whether applicable, if applicable indicate current rate of Service Tax.	Applicable / Not applicable	Prevailing rate of Service Tax: _____%
		Furnish Service Tax Regn. No. Confirmation that Service Tax register is maintained.		Service Tax Regn. No. S.Tax Register maintained : Yes/No
11	Evaluation of L1 vendor	Over all L1 of Supply + Spares + E&C + O&M on "FOR" basis to site will only be considered.	Complied	
12	Warranty	(a) Warranty for Supply: 18 Months from Supply or 12 Months from I&C, whichever is earlier. (b) Warranty for Workmanship & I&C: 12 months from I&C (c) O&M: 10 Years from date of commissioning	Acceptable / Not acceptable	
13	Pre Shipment Inspection	(a) Pre Shipment Inspection will be carried out by BHEL/Customer for which test report shall be sent atleast one week in advance.	Acceptable / Not acceptable	

14	Penalty	(a) Supply: Penalty of 0.5% per week at the basic price of the good for undelivered quantity of supply portion, subject to a maximum of 10%. For Supply, Pre Shipment Inspection Call Letter Date (Receipt of test report) will be treated as delivery for purpose of penalty.	Acceptable / Not acceptable	
		(b) For any deviation in penalty term, the offer will be liable for loading as per Clause No. G, Point No.(b) of ITB.	Acceptable / Not acceptable	
15	Road Permit	Road permit if applicable will be given by BHEL before Dispatch of ordered Items.However, vendor shall give request for road permit 24 hours in advance.	Complied	
16	PBG	(a) PBG shall be furnished in the BHEL prescribed format. (b) Deviation if any Please specify.	Acceptable / Not acceptable	
17	Despatch Documents	Complete set of despatch documents in 3 sets shall be forwarded to BHEL directly. Despatch documents include Commercial Invoice, Excise Invoice (if ED is applicable), Lorry receipt (L/R), Packing list, PSI letter Copy, Proof of delivery such as MRC (Material Receipt Certificate)/ original acknowledged LR, Insurance intimation letter and Warranty certificate. One set of Invoice, Packing list and L/R shall be emailed immediately after despatch to BHEL-EDN, Bangalore.	Complied	
18	Reverse Auction	BHEL reserves the right to conduct Reverse auction.Procedure for the same will be informed by BHEL .	Acceptable / Not acceptable	
19	Other terms & conditions	For any other Terms and Conditions, kindly refer to the following: A: ITB (document ref :SCPV: BOS: ITB - Rev 01) B: GCC (document ref: SCPV: BOS: GCC - Rev 01)	Acceptable / Not acceptable	
20	Validity	Quotation should remain valid for a period of 90 days from the due date.	Acceptable / Not acceptable	
21	Shipment	Kindly indicate the state from where the shipment will take place.	State/Place	
22	Documents Submission	All the documents pertaining to I&C and O&M as per Annexure-C to be submitted as applicable.	Acceptable/ Not acceptable	

23	Integrity Pact	a. IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. A panel of Independent External Monitors (IEMs) have been appointed to oversee implementation of IP in BHEL. The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory who signs in the offer) along with techno-commercial bid. Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification. Details of IEM for this tender is furnished below: Name : Shri D.R.S Chaudhary, IAS (Retd.) Address : Flat No. L-202 & L-203 (1st Floor) Ansal Lake View Enclave, Shamlia Hills Bhopal- 462 013 (M.P.) Email : dilip.chaudhary@icloud.com b. Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to the IEM mentioned in the tender. Note: No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department. For all clarifications/ issues related to the tender, Please contact: Name : UPENDER KUMAR Dept. : SC&PV-MM Address : BHEL, EDN, BANGALORE Phone : 080-26989572, Mobile : 9739801116 Email : upender@bheledn.co.in Fax : 080-26742498 Name : CHENDHIL KUMAR R. Dept. : SC&PV-MM Address : BHEL, EDN, BANGALORE Phone : 080-26998391 Email : chendhil@bheledn.co.in Fax : 080-26742498	Acceptable/ Not acceptable	
24	BOS %	The percentage of Supply and I&C and O&M values shall be in the range indicated below (approximately, with overall tallying to 100%) : (a) Supply : 25 to 29 % (b) I&C : 18 to 22 % (c) O&M : 50 to 54 % Successful bidder shall submit detailed billing break up for BHEL approval after placement of Purchase order.	Acceptable/ Not acceptable	
25	Documents Submission	All the documents pertaining to I&C and O&M as per Annexure-C to be submitted as applicable.	Acceptable/ Not acceptable	

TECHNICAL BID ENCLOSURE FOR COMPLIANCE OF QUOTE : UNPRICED BID (Indigenous Vendors)										
RFQ No. UPK0000978 Dtd. 24-01-2017 Due on 06-02-2017										
Sl. No.	Material Code	DESCRIPTION	QUOTED	QTY	UNIT	TAXES				Remarks
						ED %	CST %	VAT %	S. TAX%	
1	PS0679065024	Supply of MC4 ,Cable tie,HDPE pipe etc.	YES/NO	1	ST	NA			NA	Taxes Included
2	PS0679065032	Supply of earthing items for array,SMBet	YES/NO	1	ST	NA			NA	Taxes Included
3	PS0679065040	Supply of ESE lightning arrestors etc	YES/NO	1	ST	NA			NA	Taxes Included
4	PS0679065059	Supply of items for module cleaning etc	YES/NO	1	ST	NA			NA	Taxes Included
5	PS0679065067	Supply of control cables & accessories	YES/NO	1	ST	NA			NA	Taxes Included
6	PS0679065075	Supply of Aux transformer & accessories	YES/NO	1	ST	NA			NA	Taxes Included
7	PS0679065083	Supply of plant lighting system etc	YES/NO	1	ST	NA			NA	Taxes Included
8	PS0679065091	Supply of cable ties,markers etc	YES/NO	1	ST	NA			NA	Taxes Included
9	PS0679065105	Supply of safety related items etc	YES/NO	1	ST	NA			NA	Taxes Included
10	PS0679065113	Supply of CCTV system	YES/NO	1	ST	NA			NA	Taxes Included
11	PS0679065121	Supply of spare items ..	YES/NO	1	ST	NA			NA	Taxes Included
12	PS0679065130	Supply of Weather monitoring station	YES/NO	1	ST	NA			NA	Taxes Included
13	PS0679065148	Supply of items for security room etc	YES/NO	1	ST	NA			NA	Taxes Included
14	PS0679065156	I&C Interconnection of SPV modules	YES/NO	7	AU	NA	NA	NA		Taxes Included
15	PS0679065164	I&C underground cbl trench for DC cbl	YES/NO	2	AU	NA	NA	NA		Taxes Included
16	PS0679065172	I&C Laying of DC power 1Cx300,RS485 etc	YES/NO	2	AU	NA	NA	NA		Taxes Included
17	PS0679065180	I&C Earthing system for solar array etc	YES/NO	2	AU	NA	NA	NA		Taxes Included
18	PS0679065199	I&C UG cbl trench & laying Aux AC/DC cbl	YES/NO	4	AU	NA	NA	NA		Taxes Included
19	PS0679065202	I&C erection of indoor elec panels	YES/NO	2	AU	NA	NA	NA		Taxes Included
20	PS0679065210	I&C erection of 33kv transformer yards	YES/NO	2	AU	NA	NA	NA		Taxes Included
21	PS0679065237	I&C of 33kv portion of 33/132kv SY	YES/NO	1	AU	NA	NA	NA		Taxes Included
22	PS0679065245	I&C of SCADA system	YES/NO	1	AU	NA	NA	NA		Taxes Included
23	PS0679065253	I&C of aux AC/DC system.	YES/NO	1	AU	NA	NA	NA		Taxes Included
24	PS0679065261	I&C of earthing for IR,CR,Xmer yard etc	YES/NO	1	AU	NA	NA	NA		Taxes Included
25	PS0679065270	I&C lightning arrestors etc	YES/NO	1	AU	NA	NA	NA		Taxes Included
26	PS0679065288	I&C of borewells and associated works	YES/NO	1	AU	NA	NA	NA		Taxes Included
27	PS0679065296	I&C of module cleaning system etc	YES/NO	1	AU	NA	NA	NA		Taxes Included
28	PS0679065300	I&C of plant lighting system & cabling	YES/NO	1	AU	NA	NA	NA		Taxes Included
29	PS0679065318	I&C of security rooms and watchman cbn	YES/NO	1	AU	NA	NA	NA		Taxes Included
30	PS0679065326	I&C misc & safety items etc	YES/NO	1	AU	NA	NA	NA		Taxes Included
31	PS0679065334	I&C of CCTV system	YES/NO	1	AU	NA	NA	NA		Taxes Included
32	PS0679065342	I&C of markings,pre comm. insp etc	YES/NO	1	AU	NA	NA	NA		Taxes Included
33	PS0679065229	I&C:Erection of indoor electrical panels	YES/NO	1	AU	NA	NA	NA		Taxes Included
34	PS0679065350	Operations and Maintenance-Quarterly	YES/NO	40	AU	NA	NA	NA		Taxes Included
35	Freight Charge including Service Tax on Freight: Included in Quoted rates									

Note:

1. The quoted prices shall be on "FOR" basis to project site: **BEL BOLANGIR, ODISHA**
2. The quoted prices shall be inclusive of all Taxes & Duties, Packing & Forwarding charges and Freight.
3. However, the percentage of taxes considered against each item shall be indicated in the column for Taxes for the purpose of availing Tax Credit.
4. **ED shall not be considered as the project is under MNRE approval. Hence all inclusive rate for Supply is to be quoted without ED for Supply. However, the prevailing rate of ED shall be indicated in SCC (Annexure B). In case any item is rejected by MNRE, ED shall be reimbursed for that item at actuals.
5. The above format only shall be used for compliance. (reproducing on your letter head is acceptable).
6. Insurance will be in BHEL scope.

AUTHORISED SIGNATORY WITH SEAL

TECHNICAL BID ENCLOSURE FOR COMPLIANCE OF QUOTE : UNPRICED BID (Indigenous Vendors)											
RFQ No. UPK0000978 Dtd. 24-01-2017 Due on 06-02-2017											
Sl. No.	Material Code	DESCRIPTION	QTY	UNIT	Unit Rate (Rs.)	Total Value (Rs.) (Rate X Qty)	TAXES				Remarks
							ED %	CST %	VAT %	S. TAX%	
1	PS0679065024	Supply of MC4 ,Cable tie,HDPE pipe etc.	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
2	PS0679065032	Supply of earthing items for array,SMBet	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
3	PS0679065040	Supply of ESE lightning arrestors etc	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
4	PS0679065059	Supply of items for module cleaning etc	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
5	PS0679065067	Supply of control cables & accessories	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
6	PS0679065075	Supply of Aux transformer & accessories	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
7	PS0679065083	Supply of plant lighting system etc	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
8	PS0679065091	Supply of cable ties,markers etc	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
9	PS0679065105	Supply of safety related items etc	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
10	PS0679065113	Supply of CCTV system	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
11	PS0679065121	Supply of spare items ..	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
12	PS0679065130	Supply of Weather monitoring station	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
13	PS0679065148	Supply of items for security room etc	1	ST			NA			NA	Taxes Included
	Unit rate in words :										
14	PS0679065156	I&C Interconnection of SPV modules	7	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
15	PS0679065164	I&C underground cbl trench for DC cbl	2	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
16	PS0679065172	I&C Laying of DC power 1Cx300,RS485 et	2	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
17	PS0679065180	I&C Earthing system for solar array etc	2	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
18	PS0679065199	I&C UG cbl trench & laying Aux AC/DC cbl	4	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
19	PS0679065202	I&C erection of indoor elec panels	2	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
20	PS0679065210	I&C erection of 33kv transformer yards	2	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
21	PS0679065237	I&C of 33kv portion of 33/132kv SY	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
22	PS0679065245	I&C of SCADA system	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
23	PS0679065253	I&C of aux AC/DC system.	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
24	PS0679065261	I&C of earthing for IR,CR,Xmer yard etc	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
25	PS0679065270	I&C lightning arrestors etc	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
26	PS0679065288	I&C of borewells and associated works	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
27	PS0679065296	I&C of module cleaning system etc	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
28	PS0679065300	I&C of plant lighting system & cabling	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
29	PS0679065318	I&C of security rooms and watchman cbn	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
30	PS0679065326	I&C misc & safety items etc	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
31	PS0679065334	I&C of CCTV system	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
32	PS0679065342	I&C of markings,pre comm. insp etc	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
33	PS0679065229	I&C:Erection of indoor electrical panels	1	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
34	PS0679065350	Operations and Maintenance-Quarterly	40	AU			NA	NA	NA		Taxes Included
	Unit rate in words :										
35	Freight Charge including Service Tax on Freight : Included in Quoted rates										

Note:

- The quoted prices shall be on "FOR" basis to project site: **BEL BOLANGIR, ODISHA**
- The quoted prices shall be inclusive of all Taxes & Duties, Packing & Forwarding charges and Freight.
- However, the percentage of taxes considered against each item shall be indicated in the column for Taxes for the purpose of availing Tax Credit.
- **ED shall not be considered as the project is under MNRE approval. Hence all inclusive rate for Supply is to be quoted without ED for Supply. However, the prevailing rate of ED shall be indicated in SCC (Annexure B). In case any item is rejected by MNRE, ED shall be reimbursed for that item at actuals.
- The above format only shall be used for compliance. (reproducing on your letter head is acceptable).
- Insurance will be in BHEL scope.

AUTHORISED SIGNATORY WITH SEAL

ANNEXURE - C

List of Documents to be submitted by Vendors/Subcontractors for SPV Contracts.		Confirmation on submission	Deviation / Remarks
IR Documents (Type - A): For all Civil & I&C & O&M			
Sl No.	Documents		
1	Wage Sheet (Form 17)	YES / NO	
2	Attendance Register (w.r.t Sl No.1)	YES / NO	
3	Workman Policy & Additional Insurance (Automotive Liability, Group Servis Insuarncce Policy e	YES / NO	
4	PF Challan	YES / NO	
5	ESI (Employee State Insurance)	YES / NO	
6	ECR (Electronic Challan Receipt)	YES / NO	
7	Bank Statement for PF deposit	YES / NO	
8	RCS (Remittance Confirmation Slip)	YES / NO	
Quality Documents (Type - B): For all MMS Civil Works			
Sl No.	Documents		
1	FQA (Field Quality Assuarance)	NA	
2	Field Content, Slump Test	NA	
3	Gradation of Aggregate (10mm, 20mm)	NA	
4	Fine Aggregate Test (for Sand)	NA	
5	Cube Test Registered	NA	
6	Material Test Certificate for Steel & Cement	NA	
7	Consumption Register for Steel & Invoice	NA	
8	Pour Card for Concreting purpose	NA	
9	Royalty Reports (10mm, 20mm, Sand)	NA	
10	Sand Soundess Test Reports	NA	
11	Slump Test Register	NA	
12	Sieve Analysis, Flakiness Index, Elongation Index - Register to be maintained	NA	
13	Moisture Content Coarse and Fine Aggregate - Register to be maintained	NA	
14	Water Test Report for Concrete	NA	
15	Design Mix Report for Concrete	NA	
Quality Documents (Type - B): For all Civil related Works			
Sl No.	Documents		
1	FQA (Field Quality Assuarance)	YES / NO	
2	Field Content, Slump Test	YES / NO	
3	Gradation of Aggregate (10mm, 20mm)	YES / NO	
4	Fine Aggregate Test (for Sand)	YES / NO	
5	Cube Test Registered	YES / NO	
6	Material Test Certificate for Steel & Cement	YES / NO	
7	Consumption Register for Steel & Invoice	YES / NO	
8	Pour Card for Concreting purpose	YES / NO	
9	Royalty Reports (10mm, 20mm, Sand)	YES / NO	
10	Sand Soundess Test Reports	YES / NO	
11	Warpage of Bricks Test Reports	YES / NO	
12	Core Cutting (Compaction Test) - Roads & Pathways	YES / NO	
13	Slump Test Register	YES / NO	
14	Sieve Analysis, Flakiness Index, Elongation Index - Register to be maintained	YES / NO	
15	Moisture Content Coarse and Fine Aggregate - Register to be maintained*	YES / NO	
16	Brick Test Reports	YES / NO	
17	Plastering profile and thickness	YES / NO	
18	Compaction test beneath floor of all buildings. - Reports	YES / NO	
19	Test Certificates for Paint, Glan, Glazing, etc.	YES / NO	
20	Test Certificates Aluminium Section for doors and windows (Anodisation Certificates also)	YES / NO	
21	BBS for Buildings	YES / NO	
22	Water Test Report for Concrete	YES / NO	
23	Design Mix Report for Concrete	YES / NO	
Quality Documents: for Electrical & Mechanical Installation Works (BOS)			
Sl No.	Documents		
1	FQA (Field Quality Assuarance)	YES / NO	
2	Inspection Reports	YES / NO	
3	Guarantee Certificates	YES / NO	
4	Factory Acceptance Test Reports	YES / NO	
5	Commissioning Reports	YES / NO	

NOTE:

* This list of documents is indicative and intended towards all Solar Projects.

* Apart from the above, any other document required by the Customer and which are mandatory for Billing by BHEL to the Customer, the same needs to be provided by the respective vendors.

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.

For & On behalf of the Principal
(Office Seal)

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

Place-----

Date-----

Witness: _____

(Name & Address) _____

Witness: _____

(Name & Address)_____



ಭಾರತ್ ಹೆವಿ ಎಲೆಕ್ಟ್ರಿಕಲ್ಸ್ ಲಿಮಿಟೆಡ್
भारत हेवी इलेक्ट्रिकल्स लिमिटेड

Bharat Heavy Electricals Ltd.,
(A Government of India undertaking)
Electronics Division

PB 2606 , Mysore Road Bangalore , 560026 INDIA

SCPV: BOS: ITB - Rev 01

INSTRUCTIONS TO BIDDERS (ITB)

Bidders are requested to read the instructions carefully and submit their quotations covering all the points:

A. GENERAL INSTRUCTIONS:

1. Any Purchase Order resulting from this enquiry shall be governed by the Instructions to Bidders (document reference: SCPV: BOS: ITB – Rev 01), General Conditions of Contract (document reference: SCPV: BOS: GCC - Rev 01) and Special Conditions of Contract (document reference: SCPV: BOS: SCC: I - Rev 01/ SCPV: BOS: SCC: F - Rev 01), if any, of the enquiry.
2. Any deviations from or additions to the “General Conditions of Contract” or “Special Conditions of Contract” require BHEL’s express written consent. The general terms of business or sale of the bidder shall not apply to this tender.
3. Bidders (also includes the term suppliers / contractors wherever used in this document) are instructed to quote their most competitive price and best delivery, etc. in the offer. Prices should be indicated in both figures & words. **(Please also refer clause 11 under section B)**
4. Regret letter (either through post or by mail) indicating reasons for not quoting must be submitted without fail, in case of non-participation in this tender. If a bidder fails to respond against 3 consecutive tenders for the same item, he will be liable for removal as a registered vendor of BHEL.
5. Procurement directly from the manufacturers shall be preferred. However, if the OEM / Principal insist on engaging the services of an agent, such agent shall not be allowed to represent more than one manufacturer / supplier in the same tender. Moreover, either the agent could bid on behalf of the manufacturer / supplier or the manufacturer / supplier could bid directly but not both. In case bids are received from the manufacturer / supplier and his agent, bid received from the agent shall be ignored.
6. Consultant / firm (and any of its affiliates) shall not be eligible to participate in the tender/s for the related goods for the same project if they were engaged for consultancy services for the same project.
7. If an Indian representative / associate / liaison office quotes on behalf of a foreign based bidder, such representative shall furnish compulsorily the following documents:
 - a. Authorization letter to quote and negotiate on behalf of such foreign-based bidder.
 - b. Undertaking from such foreign based bidder that such contract will be honored and executed according to agreed scope of supply and commercial terms and conditions.
 - c. Undertaking shall be furnished by the Indian representative stating that the co-ordination and smooth execution of the contract and settlement of shortages / damages / replacement / repair of imported scope till system is commissioned and handed over to customer will be the sole responsibility of the Indian representative / associates / agent / liaison office.
8. In case of imported scope of supply, customs clearance & customs duty payment will be to BHEL account after the consignment is received at Indian Airport / Seaport. Bidders must provide all original documents required for completing the customs clearance along with the shipment. Warehousing charges due to incomplete or missing documentation will be recovered from the supplier’s bill. All offers for imported scope of supply must be made from any of the gateway ports (within the country) indicated. **(Refer Annexure I)**
9. The offers of the bidders who are on the banned list and also the offers of the bidders, who engage the services of the banned firms, shall be rejected. The list of the banned firms is available on BHEL website: **www.bhel.com**.

10. Business dealings with bidders will be suspended if they are found to have indulged in any malpractices / misconduct which are contrary to business ethics like bribery, corruption, fraud, pilferage, cartel formation, submission of fake/false/forged documents, poor quality, certificates, information to BHEL or if they tamper with tendering procedure affecting the ordering process or fail to execute a contract, or rejection of 3 consecutive supplies or if their firms / works are under strike / lockout for a long period.

B. GUIDELINES FOR PREPARATION OF OFFER:

1. Quotation shall be submitted in Single Part Bid, Two Part Bid or Three Part Bid, as called for in the tender:
 - **SINGLE PART BID:** Technical and Commercial Bid with prices along with price summary & filled in BHEL Standard Commercial terms and conditions in a single sealed envelope.
 - **TWO PART BID:** Unpriced offer i.e. "Techno-commercial Bid" with filled in BHEL Standard Commercial terms and conditions in a sealed envelope **along with the copy of the "Price Bid" without the prices** should be enclosed in one cover and the cover must be super scribed "**Techno-commercial offer** and Priced offer i.e. "Price Bid" containing price summary in a separate sealed envelope and must be super scribed "**Price Bid**". Both these envelopes shall be enclosed in a single sealed envelope super scribed with enquiry number, due date of tender and any other details as called for in the tender document.
 - **THREE PART BID:** Pre-qualification Bid (Part-I), Techno Commercial Bid with filled in BHEL Standard Commercial terms and conditions (Part-II), and Price Bid (Part-III). All three envelopes shall be enclosed in a single sealed envelope super scribed with enquiry number due date of tender and any other details as called for in the tender document.

If any of the offers (Part I, Part II or Part III) are not submitted before the due date and time of submission at the venue/place specified or if any part of the offer is incomplete the entire offer of the bidder is liable for rejection.

2. Supplier shall ensure to super scribe each envelope with RFQ number, RFQ Date, RFQ Due date and time, Item Description and Project clearly & boldly. Also mention on the envelope whether it is "Techno Commercial Bid" or "Price Bid" or "Pre-Qualification Bid". Please ensure complete address, department name and purchase executive name is mentioned on the envelope (before dropping in the tender box or handing over) so that the tender is available in time for bid opening.
3. BHEL standard Commercial Terms and Conditions shall be duly filled, signed & stamped and must accompany Technical-Commercial offer without fail and should be submitted in original only. Photocopy will not be accepted. All documents submitted along with the offer shall be signed and stamped in each page by authorized representative of the bidder.
4. Any of the terms and conditions not acceptable to supplier, shall be explicitly mentioned in the Techno-Commercial Bid. If no deviations are brought out in the offer it will be treated as if all terms and conditions of this enquiry are accepted by the supplier without any deviation.
5. Deviation to this specification / item description, if any, shall be brought out clearly indicating "DEVIATION TO BHEL SPECIFICATION" without fail, as a part of Techno-Commercial Bid. If no deviations are brought out in the offer it will be treated as if the entire specification of this enquiry is accepted without deviation.
6. Suppliers shall submit one set of original catalogue, datasheets, bill of materials, dimensional drawings, mounting details and / or any other relevant documents called in purchase specification as part of Technical Bid.
7. "Price Bid" shall be complete in all respects containing price break-up of all components along with all applicable taxes and duties, packing & forwarding charges (if applicable), freight charges (if applicable) etc. Once submitted no modification / addition / deletion will be allowed in the "Price Bid." Bidders are advised to thoroughly check the unit price, total price to avoid any discrepancy.
8. In addition, bidder shall also quote for erection & commissioning charges (I&C charges), documentation charges, service charges, testing charges (type & routine), training charges, service tax, etc. wherever applicable. The price summary must indicate all the elements clearly.
9. Vendors should indicate "lump sum" charges (including To & Fro Fare, Boarding, Lodging, Local Conveyance etc.) for Supervision of Erection, Commissioning and handing over to customer. The quotation shall clearly indicate scope of work, likely duration of commissioning, pre-commissioning checklist and service tax (if any).
10. Wherever bidders require PAC (Project Authority Certificate) for import of raw materials, components required for Mega

Power Projects, Export Projects, MNRE Concession or other similar projects wherein supplies are eligible for customs duty /Excise duty benefits, lists and quantities of such items and their values (CIF) has to be mentioned in the offer. Prices must be quoted taking into account of such benefits.

11. All quotations shall be free from corrections /overwriting. Corrections if any should be authenticated with signature and seal. Any typographical error, totaling mistakes, currency mistake, multiplication mistake, summing mistakes etc. observed in the price bids will be evaluated as per **Annexure VI** "Guidelines for dealing with Discrepancy in Words & Figures – quoted in price bid". BHEL decision will be final.

C. GUIDELINES FOR OFFER SUBMISSION:

1. Offers / Quotations must be dropped in tender box before 13.00 Hrs. on or before due date mentioned in RFQ. The offers are to be dropped in the proper slot of the Tender Box kept in our reception area with caption "CE, SC&PV, DEFENCE." Tenders are opened on 3 days in a week (Monday/Wednesday/Friday). Tender must be deposited in the slot corresponding to the day (Monday - Box no.4/Wednesday - Box no. 6 /Friday - Box no.8) while depositing the offer. **(This clause will not be applicable for e-tenders).**
2. E-Mail / Internet / EDI offers received in time shall be considered only when such offers are complete in all respects. In case of offers received through E-mail, please send the offer to the email IDs within time of submission of tender.
3. In cases where tender documents are bulky, or due to some reasons tender documents are required to be submitted by hand or through posts/couriers, the offers are to be handed over to purchase officers.
4. Tenders will be opened on due date, time and venue as indicated in the RFQ in the presence of bidders at the venue indicated in the RFQ. In case of e-procurement, bidders can see tender results till seven days after due date and time.
5. Vendor will be solely responsible:
 - a. For submission of offers before due date and time. Offers submitted after due date and time will be treated as "Late offers" and will be rejected.
 - b. For submission of offers in the correct compartment of the tender box based on the day of due date (Monday/Wednesday/Friday). Please check before dropping your offer in the correct tender box.
 - c. For depositing offers in proper sealed condition in the tender box. If the bidder drops the tender in the wrong tender box or if the tender document is handed over to the wrong person BHEL will not be responsible for any such delays.
 - d. For offers received through email/courier etc., suppliers are fully responsible for lack of secrecy on information and ensuring timely receipt of such offers in the tender box before due date & time.
 - e. In case of e-tender, all required documents should be uploaded before due date and time. Availability of power, internet connections, etc. will be the sole responsibility of the vendor. Wherever assistance is needed for submission of e-tenders, help line numbers and executives of service provider of BHEL may be contacted.
Service provider: M-junction
Website address: <https://bheleps.buyjunction.in/>
Helpline no.: 033-66106426/6217/6013/6046/6176 (9:30 am to 5:30 pm)
9163348283/9163348284/9163348285/9163348286/8584008116 (5:30 pm to 8:30 pm)

Purchase Executive / BHEL will not be responsible for any of the activities relating to submission of offer.

D. PROCESSING OFFERS RECEIVED:

1. Any discount / revised offer submitted by the supplier on its own shall be accepted provided it is received on or before the due date and time of offer submission (i.e. Part-I bid). The discount shall be applied on pro-rata basis to all items unless specified otherwise by the bidder.
2. Changes in offers or Revised offers given after Part-I bid opening shall not be considered as a part of the original offer unless such changes / revisions are requested by BHEL.
3. In case there is no change in the technical scope and / or specifications and / or commercial terms & conditions by BHEL, the supplier will not be allowed to change any of their bids after Technical bids are opened (after the due date and time of tender opening of Part-1 Bid).

4. In case of changes in scope and/ or technical specifications and/ or commercial terms & conditions by BHEL and it accounts for price implications from vendors, all techno-commercially acceptable bidders shall be asked by BHEL (after freezing the scope, technical specifications and commercial terms & conditions) to submit the impact of such changes on their price bid. Impact price will be applicable only for changes in technical specification / commercial conditions by BHEL. The impact price must be submitted on or before the cut-off date specified by BHEL and the original price bid and the price impact bid will be opened together at the time of price bid opening. Impact price means only for those items which have been impacted by addition / deletion / changes in the technical specifications or commercial conditions. The impact may be +/- incremental value of the currency in which originally quoted. The impact price bid to be submitted on the cut-off date, time & venue as specified by BHEL. The impact price bid shall be opened along with original price bid.
5. Un-opened bids (including price bids) will be returned to the respective bidders after release of PO and receipt of order acknowledgement from the successful bidder.
6. After receipt of Purchase Order, supplier should submit required documents like drawings, bill of materials, datasheets, catalogues, quality plan, test procedure, type test report , O & M Manuals and / or any other relevant documents as per Specification / Purchase Order, as and when required by BHEL / Customer.
7. Any deviation to the terms and conditions not mentioned in the quotation by supplier in response to this enquiry will not be considered, if put forth subsequently or after issue of Purchase Order, unless clarification is sought for by BHEL EDN and agreed upon in the Purchase Order.
8. Evaluation shall be on the basis of delivered cost (i.e. "Total Cost to BHEL"). As per RFQ terms. "Total Cost to BHEL" shall include total basic cost, packing & forwarding charges, taxes and duties, inspection charges, freight charges, test charges, insurance, service tax for services, any other cost indicated by vendor for execution of the contract and loading factors (for non-compliance to BHEL Standard Commercial Terms & Conditions). Benefits arising out of Nil Import Duty on Mega Projects, Physical Imports or such 100% exemptions & MNRE Exemptions (statutory benefits), customer reimbursements of statutory duties (like Excise Duty, CST, VAT) will also be taken into account at the time of tender evaluation. (Wherever applicable and as indicated in SCC document of tender)
9. For evaluation of offers in foreign currency, the exchange rate (TT selling rate of SBI) shall be taken as under:

Single part bids:	Date of tender opening
Two/three part bids:	Date of Part-I bid opening
Reverse Auction:	Date of Part-I bid opening

In case of Performance Bank Guarantee (PBG) also, exchange rate will be considered as mentioned above for converting foreign currency to Indian currency and vice versa.

If the relevant day happens to be a bank holiday, then the exchange rate as on the previous working day of the bank (SBI) shall be taken.
10. Ranking (L-1, L-2 etc.) shall be done only for the techno-commercially acceptable offers and on the basis or evaluation of Total Cost to BHEL.

E. INFORMATION ON PAYMENT TERMS:

1. All payments will be through Electronic Fund transfer (EFT). Vendor has to furnish necessary details as per BHEL standard format (**Refer Annexure IV**) for receiving all payments through NEFT. (Applicable for Indian vendors only)
2. Statutory deductions, if any, will be made and the deduction certificate shall be issued. In case vendor does not provide PAN details, the TDS deduction shall be at the maximum percentage stipulated as per the provisions of Income Tax Act. (Applicable for Indian vendors only). Foreign vendors shall submit relevant details of their bankers like Swift Code, Banker's Name & Address etc.
3. Vendors must submit bills & invoices along with required supporting documents in time. Incomplete documentation / delayed submission of invoice / documents will result in corresponding delay in payment.

F. STANDARD PAYMENT TERMS OF BHEL-EDN**Purchase Orders for indigenous procurement****(a) SUPPLY WITH I&C/SUPERVISION:****Supply:**

- 1) 80% of basic Supply value + 100% of taxes, duties and freight charges will be paid with 45 days credit from the receipt of material at site or 15 days credit from the date of submission of complete set of documentation whichever is later.
- 2) 10% of basic supply value will be paid on completion of I&C against submission of supplementary invoice along with proof of completion of I&C along with I&C charges (if any).
- 3) Balance 10% (retention money) against submission of supplementary invoice along with PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank.

I&C/Supervision: 100% on completion of I&C/Supervision and certification line item wise on pro-rata basis.

O&M: 100% O&M charges are payable as per RFQ terms against report certified by BHEL.

(b) SUPPLY ONLY:

- 1) 100% of Basic value with taxes, duties and freight will be paid with 45 days credit from the receipt of material at site or 15 days credit from the date of submission of complete set of documentation whichever is later)+ submission of PBG valid for Warranty Period+ 3 months Claim Period from BHEL Consortium Bank ,if applicable.

Purchase orders for import procurement:**(c) SUPPLY WITH I&C/SUPERVISION:****Supply:**

- 1) 80% of the basic value (excluding I&C charges) will be paid with 45 days credit, against Sight draft, from the date of AWB/BOL on submission of complete set of documents as in PO.
- 2) 10% of basic supply value will be paid on completion of I&C against submission of supplementary invoice along with proof of completion of I&C along with I&C charges (if any).
- 3) Balance 10% (retention money) against submission of supplementary invoice along with PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank.

I&C: 100% on completion of I&C/Supervision and certification line item wise on pro-rata basis.

(d) SUPPLY ONLY:

- 1) 100% of PO value will be paid against Sight draft with 45 days Credit from the date of dispatch or 15 days credit from the date of submission of complete set of documents whichever is later)+ submission of PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank ,if applicable.

Note for (a), (b), (c) and (d): In exceptional cases, if vendor fails to submit PBG after supplies, vendors can also accept for the final 10% payment, payable after the warranty period + 3 months of claim period against supplementary invoice subject to the completion of commissioning (if applicable) as PBG is linked to Warranty period.

G. LOADING FACTORS FOR PAYMENT TERMS & DELAYED DELIVERY:

Loading factors as detailed below will be added to the quoted price (basic) to evaluate the lowest quote for non-compliance of BHEL standard commercial term.

SI No	Deviation on	Nature of Deviation / Offered Terms	Loading %
1.	Payment Terms	For Purchase within India :-	
		1) Credit period less than 45 days	15
		* For Foreign Purchase :-	
		1) Payment through At Sight Letter of Credit	10
		2) Payment through Letter of Credit with usance credit of 45 days	5
		3) Sight Draft with credit period less than 45 days	5
2.	Penalty for Delayed Delivery	1) Non – Acceptance	10
		2) Partial Acceptance (X%)	(10 – X)

*** All bank charges shall be to seller's account. If bank charges of BHEL banker are to BHEL's account then additional loading of 2% on the quoted basic value is applicable.**

Offer/s with payment terms other than the standard payment terms indicated at Clause No.F or Deviated Payment Terms with loading indicated at Clause No.G above are liable for rejection.

NOTES:

1. ADVANCE PAYMENT/LC: Quotations with "Advance payment/Inland LC" shall be rejected.
2. Basic value of Purchase Order mentioned above will include all components of the purchase order and will exclude only taxes, duties, freight and I&C charges (wherever applicable).
3. Wherever the Purchase Order is split into import portion and indigenous portion of supply the retention money will be 10% (as applicable) of both purchase order values put together.
4. Non-Compliance of Warranty terms. Offers not complying with Warranty terms as per RFQ Terms is liable for rejection.
5. SALE IN TRANSIT/ LOCAL VAT: Sale in transit under section 6(2) of CST is allowed if movement of goods is interstate. In case intra state movement of goods, benefit of sale in transit is not available.
6. In case of intrastate movement i.e. supply within same state and VAT is applicable, the vendor shall furnish the respective BHEL's nodal agency TIN no. and address in their invoice. (Refer **Annexure IX**)

H. BANK GUARANTEE (BG) / PERFORMANCE BANK GUARANTEE (PBG):

1. Bank guarantee (BG) / Performance bank guarantee (PBG) will be applicable as called in the tender documents. Such PBG shall be valid for a period of Warranty Period + claim period of 3 months for a value equal to 10 % of the basic value of the purchase order. No deviation for the duration of PBG / BG will be permitted.
 - a. PBG shall be from any of the BHEL consortium of bankers (**refer Annexure V**).
 - b. PBGs from nationalized banks are also acceptable.

- c. PBG should be sent directly by the bank to the dealing executive mentioned in the purchase order located at the address mentioned in the purchase order. PBG should be in the format indicated. **(Refer Annexure III)**. No deviation to these formats will be allowed.
- d. Confirmation from any of the BHEL consortium of banks or any of the Indian Public Sector Banks is essential for the acceptance of PBGs issued by foreign banks (located outside India).
- e. Expired BGs / PBGs will be returned only after expiry of the claim period or on completion of the contractual obligation.
- f. In case vendor does not accept for submission of PBG, the vendor is liable for rejection on commercial grounds.

I. DOCUMENTS (TRIPLICATE COPIES) REQUIRED AT THE TIME OF DISPATCH FOR PROCESSING OF BILL:

1. FOR INDIGENOUS SCOPE OF SUPPLY:

For Supply: Invoice in Triplicate, Lorry receipt (LR) copy, Packing List, PSI Call Letter Copy, Proof of delivery such as MRC (Material Receipt Certificate)/ original acknowledged LR, Insurance intimation Letter and Warranty Certificate. Note that document pertaining to Proof of delivery shall clearly mention number of boxes/panels etc which shall be in line with the Packing list.

For I&C: Supplementary Invoice in Triplicate with copy of I&C Certificate (Proof of Completion of I&C).

For PBG: Supplementary Invoice in Triplicate with copy of PBG. However, PBG should reach concerned Purchase Officer directly from the Bank.

2. FOR IMPORTED SCOPE OF SUPPLY:

For Supply: Invoice in Triplicate, Air Way Bill/Bill of Lading, Packing List, PSI Call Letter Copy, and Warranty Certificate.

For I&C: Supplementary Invoice in Triplicate with copy of I&C Certificate (Proof of Completion of I&C).

For PBG: Supplementary Invoice in Triplicate with copy of PBG. Both PBG & supplementary invoice should reach concerned Purchase Officer directly from the Bank.

J. PROVISIONS APPLICABLE FOR MSE VENDORS (MICRO AND SMALL ENTERPRISES)

Vendors who qualify as MSE vendors are requested to submit applicable certificates (as specified by the Ministry of Micro, Small and Medium Enterprises) at the time of vendor registration. Vendors have to submit any of the following documents along with the tender documents in the Part I / Technical bid cover to avail the applicable benefits.

- a. Valid NSIC certificate or
- b. Entrepreneur's Memorandum part II (EM II) certificate (deemed valid for 2 years).
- c. EM II certificate with CA certificate **(in the prescribed format given in Annexure VIII)** applicable for the year certifying that the investment in plant and machinery of the vendor is within permissible limits as per the MSME Act 2006 for relevant status where the deemed validity is over.
- d. Documents submitted for establishing the credentials of MSE vendors must be valid as on the date of part I / technical bid opening for the vendors to be eligible for the benefits applicable for MSE vendors. Documents submitted after the Part I / Technical bid opening date will not be considered for this tender.

PURCHASE PREFERENCE FOR MSE VENDORS:

- e. MSE vendors quoting within a price band of L1 + 15% shall be allowed to supply up to 20% of the requirement against this tender provided.
 - 1. The MSE vendor matches the L1 price.
 - 2. L1 price is from a non MSE vendor.
 - 3. L1 price will be offered to the nearest vendor nearest to L1 in terms of price ranking (L2 - nearest to L1). In case of non-acceptance by the MSE vendor (L2) next ranking MSE vendor will be offered who is within the L1 + 15% band (if L3 is also within 15% band).
 - 4. 20% of the 20% (i.e. 4% of the total enquired quantity) will be earmarked for SC/ST owned MSE firms provided conditions as mentioned in (1) and (2) are fulfilled.
 - 5. In case no vendor under SC / ST category firms are meeting the conditions mentioned in (1) and (2) or have not participated in the tender, in such cases the 4% quantity will be distributed among the other eligible MSE vendors who have participated in the tender.

6. Serial no. 1 to 5 will not be applicable wherever it is not possible to split the tendered quantity / items on account of customer contract requirement, or the items tendered are systems. Such information that tendered quantity will not be split will be indicated in the SCC.

K. INTEGRITY COMMITMENT IN THE TENDER PROCESS, AND EXECUTION OF CONTRACTS:

1. Commitment by BHEL:

BHEL commits to take all measures necessary to prevent corruption in connection with the Tender process and execution of the Contract. BHEL will, during the tender process, treat all bidder / suppliers in a transparent and fair manner, and with equity.

2. Commitment by Bidder(s)/ Contractor(s):

- a. The Bidder(s)/ Contractor(s) commit(s) to take all measures to prevent corruption and will not directly or indirectly try to influence any decision or benefit which he is not legally entitled to.
- b. The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding or any actions to restrict competition.
- c. The Bidder(s)/ Contractor(s) will not commit any offence under the relevant Acts. 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 BHEL as part of business relationship.
- d. 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 and shall adhere to the relevant guidelines issued from time to time by Government of India/ BHEL.

If the Bidder(s) / Contractor(s), before award or during execution of the Contract commit(s) a transgression of the above or in any other manner such as to put his reliability or credibility in question, BHEL is entitled to disqualify the Bidder(s) / Contractor (s) from the tender process or terminate the contract and/ or take suitable action as deemed fit.

L. FRAUD PREVENTION POLICY:

The bidder along with its associate/collaborators/sub-contractors/sub-vendors/consultants/service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website <http://www.bhel.com> and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice. Fraud Prevention policy and List of Nodal Officers shall be hosted on BHEL website, vendor portals of Units/regions intranet.

PURCHASE EXECUTIVE



ಭಾರತ್ ಹೆವಿ ಎಲೆಕ್ಟ್ರಿಕಲ್ಸ್ ಲಿಮಿಟೆಡ್
भारत हेवी इलेक्ट्रिकल्स लिमिटेड

Bharat Heavy Electricals Ltd.,
(A Government of India undertaking)
Electronics Division

PB 2606 , Mysore Road Bangalore , 560026 INDIA

SCPV: BOS: GCC - Rev 01

GENERAL COMMERCIAL CONDITIONS FOR CONTRACT (GCC)

These 'General Commercial Conditions for Contract for Purchase' hereinafter referred to as GCC apply to all enquiries, tenders, requests for quotations, orders, contracts and agreements concerning the supply of goods and the rendering of related services (hereinafter referred to as "deliveries") to Bharat Heavy Electricals Limited and any of its units, regions or divisions (hereinafter referred to as "BHEL" or the Purchaser) or its projects / customers.

Any deviations from or additions to these GCC require BHEL's express written consent. The general terms of business or sale of the vendor shall not apply to BHEL. Acceptance, receipt of shipments or services or effecting payment shall not mean that the general terms of business or sale of the vendor have been accepted.

Orders, agreements and amendments thereto shall be binding if made or confirmed by BHEL in writing. Only the Purchasing department of BHEL is authorized to issue the Purchase Order or any amendment thereof.

Definitions: Throughout these conditions and in the specifications, the following terms shall have the meanings assigned to them, unless the subject matter or the context requires otherwise.

- a) 'The Purchaser' means Bharat Heavy Electricals Limited, Electronics division, Mysore road, Bangalore 560 026, a Unit of Bharat Heavy Electricals Limited (A Govt. of India Undertaking) incorporated under the Companies Act having its registered office at BHEL House, Siri Fort, New Delhi-110049, India and shall be deemed to include its successors and assigns. It may also be referred to as BHEL.
- b) 'The vendor' means the person, firm, company or organization on whom the Purchase Order is placed and shall be deemed to include the vendor's successors, representative heirs, executors and administrator as the case may be. It may also be referred to as Seller, Contractor or Supplier.
- c) 'Contract' shall mean and include the Purchase Order incorporating various agreements, viz. tender/ RFQ, offer, letter of intent / acceptance / award, the General Conditions of Contract and Special Conditions of Contract for Purchase, Specifications, Inspection / Quality Plan, Schedule of Prices and Quantities, Drawings, if any enclosed or to be provided by BHEL or his authorized nominee and the samples or patterns if any to be provided under the provisions of the contract.
- d) 'Parties to the Contract' shall mean the 'The Vendor' and the Purchaser as named in the main body of the Purchase Order.
- e) "Bidder" shall mean duly established reputed organisation, manufacturer etc. having requisite financial and technical capability and experience of participating in the bid invited by the purchaser for the tender.
- f) Bid- The term "bid" or "bidding" can also relate to the documented Offer submitted in response to a request for quotation (RFQ) /Tender.

Interpretation:

In the contract, except where the context requires otherwise:

- a) words indicating one gender include all genders;
- b) words indicating the singular also include the plural and words indicating the plural also include the singular;
- c) provisions including the word "agree", "agreed" or "agreement" require the agreement to be recorded in writing, and
- d) "Written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record.

Applicable Conditions:

1. **Price Basis:** All prices shall be firm until the purchase order is executed / completed in all respects. No price variations / escalation shall be permitted unless otherwise such variations / escalations are provided for and agreed by BHEL in writing in the purchase order.
2. **Validity:** The offer will be valid for a period of 90 days from the date of technical bid opening date. Validity beyond 90 days, if required, will be specified in the SCC (special conditions of contract).
3. **Taxes & Duties:** Taxes as mentioned in the Contract Price or Price Schedule shall be paid to the Contractor subject to the Contractor complying with all the statutory requirements and furnishing the relevant documents including error free invoices containing detailed break-up of the taxes. Any duties, levies or taxes not mentioned in Contract Price or Price Schedule but applicable as per any statute(s) shall be deemed to be included in the Contract price and shall be to the account of the Contractor.
The Contractor shall bear and pay all the costs, liabilities, levies, interest, penalties in respect of non-compliances of any legal requirements as per various statutory provisions. The contractor shall keep the owner indemnified at all times from any tax liability, interest, penalties or assessments that may be imposed by the statutory authorities for non-compliances or non-observation of any statutory requirements by the Contractor.
4. **Ordering and confirmation of Order:** Vendor shall send the order acceptance on their company letter head within two weeks from the date of Purchase Order or such other period as specified / agreed by BHEL. BHEL reserves the right to revoke the order placed if the order confirmation differs from the original order placed. The acceptance of goods/services/supplies by BHEL as well as payments made in this regard shall not imply acceptance of any deviations.
The purchase order will be deemed to have been accepted if no communication to the contrary is received within two weeks (or the time limit as specified / agreed by BHEL) from the date of the purchase order.
5. **Documentation:** After receipt of Purchase Order, vendor should submit required documents like drawings, bill of materials, datasheets, catalogues, quality plan, test procedure, type test report , O & M Manuals and/or any other relevant documents as per Specification/Purchase Order, as and when required by BHEL/Customer.
At any stage within the contract period, the vendor shall notify of any error, fault or other defect found in BHEL's documents /specifications or any other items for reference. If and to the extent that (taking account of cost and time) any vendor exercising due care would have discovered the error, fault or other defect when examining the documents/specifications before submitting the tender, the time for completion shall not be extended. However if errors, omissions, ambiguities, inconsistencies, inadequacies or other defects are found in the vendor's documents, they shall be corrected at his cost, notwithstanding any consent or approval.
6. **TERMS OF DELIVERY:**
FOR IMPORTED PURCHASE:
Price offered shall be for goods packed and delivered CIF Seaport/ International Airport (FCA) including packing, forwarding, Handling, Ancillary charges like processing of Sight Draft, negotiation charges of bank, Export declaration, Certificate of origin etc.
Packing shall be Air/Sea worthy, best suitable for trans-shipment and to take care of transit damages. If containerized, no. of containers & size of container shall be mentioned. Packing weight (gross & net) Packing dimensions shall be given prior to shipment to ascertain whether the consignment can be carried on standard cargo in contract or as ODC.
Wooden packing material for all the foreign consignments should be treated as per ISPM-15 & Fumigation / Phytosanitary certificate to be submitted to the freight forwarders/ BHEL along with the invoice, B/L, packing list etc.
Vendors shall indicate the name of International Airport/Seaport. The consignment shall be handed over to BHEL approved freight forwarder as mentioned in PO.

FOR INDIGENOUS PURCHASE:

Equipment shall be delivered on "FOR SITE" basis, inclusive of freight, packing, insurance & forwarding charges.

Packing shall be Road / Rail / Air / Sea worthy, best suitable for transshipment and to take care of transit damages. Smaller consignments can be dispatched through Courier services/ RPP with the prior approval of the purchasing Executive.

Deviation for the delivery term is liable for rejection.

7. Penalty:

For delay in delivery: In the event of delay in agreed contractual delivery as per Purchase Order, penalty @ 0.5 % (half percent) per week or part thereof but limited to a max of 10% (ten percent) value of undelivered portion (basic material cost) will be applicable. Delivery will commence from the date of document approval by customer / BHEL or date of issue of manufacturing clearance, whichever is later. The date for which Inspection call is issued by vendor along with test certificates / test reports / Certificate of Conformance / calibration reports, as proof of completion of manufacturing will be treated as date of deemed delivery for penalty calculation. In the absence of furnishing such document indicated above as proof of completion of manufacturing along with inspection call, actual date of inspection will be considered as date of deemed delivery and BHEL will not be responsible for delay in actual date of inspection.

Penalty for delayed delivery, if applicable, shall be deducted at the time of first payment. If penalty is applicable for duration of less than a week, penalty @ 0.5% (half percent) of the basic material value will be deducted.

8. **Contract variations (Increase or decrease in the scope of supply):** BHEL may vary the contracted scope as per requirements at site. If vendor is of the opinion that the variation has an effect on the agreed price or delivery period, BHEL shall be informed of this immediately in writing along with technical details. Where unit rates are available in the Contract, the same shall be applied to such additional work. Vendor shall not perform additional work before BHEL has issued written instructions / amendment to the Purchase Order to that effect. The work which the vendor should have or could have anticipated in terms of delivering the service(s) and functionality (i.e.) as described in this agreement, or which is considered to be the result of an attributable error on the vendor's part, shall not be considered additional work.
9. **Reverse Auction:** BHEL reserves the right to go for Reverse Auction (RA) (Guidelines as available on www.bhel.com) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. Bidders to give their acceptance with the offer for participation in RA. Non-acceptance to participate in RA may result in non- consideration of their bids, in case BHEL decides to go for RA.

Those bidders who have given their acceptance to participate in Reverse Auction will have to necessarily submit 'Process compliance form' (to the designated service provider) as well as 'Online sealed bid' in the Reverse Auction. Non-submission of 'Process compliance form' or 'Online sealed bid' by the agreed bidder(s) will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com).

The bidders have to necessarily submit online sealed bid less than or equal to their envelope sealed price bid already submitted to BHEL along with the offer. The envelope sealed price bid of successful L1 bidder in RA, if conducted, shall also be opened after RA and the order will be placed on lower of the two bids (RA closing price & envelope sealed price) thus obtained. The bidder having submitted this offer specifically agrees to this condition and undertakes to execute the contract on thus awarded rates.

If it is found that L1 bidder has quoted higher in online sealed bid in comparison to envelope sealed bid for any item(s), the bidder will be issued a warning letter to this effect. However, if the same bidder again defaults on this count in any subsequent tender in the unit, it will be considered as fraud and will invite

action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com).

10. **Pre Shipment Inspection:** Prior written notice of at least one week shall be given along with internal test certificates / COC and applicable test certificates. Materials will be inspected by BHEL-EDN-QS/CQS or BHEL nominated Third Party Inspection Agency (TPIA) or BHEL authorized Inspection Agency or Customer / Consultant or jointly by BHEL & Customer / consultant. All tests have to be conducted as applicable in line with approved Quality plan or QA Checklist or Purchase specification and original reports shall be furnished to BHEL-EDN, Bangalore for verification / acceptance for issue of dispatch clearance.
All costs related to inspections & re-inspections shall be borne by vendor. Whether the Contract provides for tests on the premises of the vendor or any of his Sub-contractor/s, vendor shall be responsible to provide such assistance, labour, materials, electricity, fuels, stores, apparatus, instruments as may be required and as may be reasonably demanded to carry out such tests efficiently. Cost of any type test or such other special tests shall be borne by BHEL only if specifically agreed to in the purchase order.
11. **Transit Insurance:** Transit insurance coverage between vendor's works and project site shall be to the account of BHEL, unless specifically agreed otherwise. However, vendor shall send intimation directly to insurance agency through fax/courier/e-mail, immediately on dispatch of goods for covering insurance. A copy of such intimation sent by vendor to insurance agency shall be given to BHEL along with dispatch documents. Dispatch documents will be treated as incomplete without such intimation copy. BHEL shall not be responsible for sending intimations to insurance agency on behalf of the vendor.
12. **Packaging and dispatch:** The Seller shall package the goods safely and carefully and pack them suitably in all respects considering the peculiarity of the material for normal safe transport by Sea / Air / Rail / Road to its destination suitably protected against loss, damage, corrosion in transit and the effect of tropical salt laden atmosphere. The packages shall be provided with fixtures / hooks and sling marks as may be required for easy and safe handling. If any consignment needs special handling instruction, the same shall be clearly marked with standard symbols / instructions. Hazardous material should be notified as such and their packing, transportation and other protection must conform to relevant regulations.
The packing, shipping, storage and processing of the goods must comply with the prevailing legislation and regulations concerning safety, the environment and working conditions. Any Imported/Physical Exports items packed with raw / solid wood packing material should be treated as per ISPM – 15 (fumigation) and accompanied by Phytosanitary / Fumigation certificate. If safety information sheets (MSDS – Material Safety Data Sheet) exist for an item or the packaging, vendor must provide this information without fail along with the consignment.
Each package must be marked with Consignee name, Purchase order number, Package number, Gross weight and net weight, dimensions (L x B x H) and Seller's name. Packing list of goods inside each package with PO item number and quantity must also be fixed securely outside the box to indicate the contents of each box. Total number of packages in the consignment must also be indicated.
Separate packing & identification of items should be as follows.
 1. Main Scope - All items must be tagged with part no. & item description.
 2. Commissioning spares - All items must be tagged with part no. & item description.
 3. Mandatory spares - All items must be tagged with part no. & item description.
13. **Assignment of Rights & Obligations; Subcontracting:** Vendor is not permitted to subcontract the delivery or any part thereof to third party or to assign the rights and obligations resulting from this agreement in whole or in part to third parties without prior written permission from BHEL. Any permission or approval given by the BHEL shall, however, not absolve the vendor of the responsibility of his obligations under the Contract.
14. **Progress report:** Vendor shall render such report as to the progress of work and in such form as may be called for by the concerned purchase officer from time to time. The submission and acceptance of such reports shall not prejudice the rights of BHEL in any manner.
15. **Non-disclosure and Information Obligations: Vendor** shall provide with all necessary information pertaining to the goods as it could be of importance to BHEL. Vendor shall not reveal confidential information that may be divulged by BHEL to Vendor's employees not involved with the tender/ contract &

its execution and delivery or to third parties, unless BHEL has agreed to this in writing beforehand. Vendor shall not be entitled to use the BHEL name in advertisements and other commercial publications without prior written permission from BHEL.

16. **Cancellation / Termination of contract:** BHEL shall have the right to completely or partially terminate the agreement by means of written notice to that effect. Termination of the Contract, for whatever reason, shall be without prejudice to the rights of the parties accrued under the Contract up to the time of termination.
BHEL shall have the right to cancel/foreclose the Order/ Contract, wholly or in part, in case it is constrained to do so, on account of any decline, diminution, curtailment or stoppage of the business.
17. **Risk Purchase Clause:** In case of failure of supplier, BHEL at its discretion may make purchase of the materials / services NOT supplied / rendered in time at the RISK & COST of the supplier. Under such situation, the supplier who fails to supply the goods in time shall be wholly liable to make good to BHEL any loss due to risk purchase.
In case of items demanding services at site like erection and commissioning, vendor should send his servicemen /representatives within 7 days from the service call. In case a vendor fails to attend to the service call, BHEL at its discretion may also make arrangements to attend such service by other parties at the **RISK & COST** of the supplier. Under such situation the supplier who fails to attend the service shall be wholly liable to make good to BHEL any loss due to risk purchase / service including additional handling charges due to the change.
18. **Shortages:** In the event of shortage on receipt of goods and/or on opening of packages at site, all such shortages shall be made good within a reasonable time that BHEL may allow from such intimation and free of cost.
Transit Damages: In the event of receipt of goods in damaged condition or having found them so upon opening of packages at site, Supplier shall make good of all such damages within a reasonable time from such intimation by BHEL.
19. **Remedial work:** Notwithstanding any previous test or certification, BHEL may instruct the vendor to remove and replace materials/goods or remove and re-execute works/services which are not in accordance with the purchase order. Similarly BHEL may ask the vendor to supply materials or to execute any services which are urgently required for any safety reasons, whether arising out of or because of an accident, unforeseeable event or otherwise. In such an event, Vendor shall provide such services within a reasonable time as specified by BHEL.
20. **Indemnity Clause:** Vendor shall comply with all applicable safety regulations and take care for the safety of all persons involved. Vendor is fully responsible for the safety of its personnel or that of his subcontractor's men / property, during execution of the Purchase Order and related services. All statutory payments including PF, ESI or other related charges have to be borne by the vendor. Vendor is fully responsible for ensuring that all legal compliances are followed in course of such employment.
21. **Product Information, Drawings and Documents:** Drawings, technical documents or other technical information received by Vendor from BHEL or vice versa shall not, without the consent of the other party, be used for any other purpose than that for which they were provided. They may not, without the consent of the Disclosing party, otherwise be used or copied, reproduced, transmitted or communicated to third parties. All information and data contained in general product documentation, whether in electronic or any other form, are binding only to the extent that they are by reference expressly included in the contract.
Vendor, as per agreed date/s but not later than the date of delivery, provide free of charge information and drawings which are necessary to permit and enable BHEL to erect, commission, operate and maintain the product. Such information and drawings shall be supplied in as many numbers of copies as may be agreed upon.
All intellectual properties, including designs, drawings and product information etc. exchanged during the formation and execution of the Contract shall continue to be the property of the disclosing party.
22. **Intellectual Property Rights, Licenses:** If any Patent, design, Trade mark or any other intellectual property rights apply to the delivery (goods / related service) or accompanying documentation shall be the exclusive

property of the Vendor and BHEL shall be entitled to the legal use thereof free of charge by means of a non-exclusive, worldwide, perpetual license. All intellectual property rights that arise during the execution of the Purchase Order/ contract for delivery by vendor and/or by its employees or third parties involved by the vendor for performance of the agreement shall belong to BHEL. Vendor shall perform everything necessary to obtain or establish the above mentioned rights. The Vendor guarantees that the delivery does not infringe on any of the intellectual property rights of third parties. The Vendor shall do everything necessary to obtain or establish the alternate acceptable arrangement pending resolution of any (alleged) claims by third parties. The Vendor shall indemnify BHEL against any (alleged) claims by third parties in this regard and shall reimburse BHEL for any damages suffered as a result thereof.

23. **Force Majeure:** Notwithstanding anything contained in the purchase order or any other document relevant thereto, neither party shall be liable for any failure or delay in performance to the extent said failures or delays are caused by the "Act of God" and occurring without its fault or negligence, provided that, force majeure will apply only if the failure to perform could not be avoided by the exercise of due care and vendor doing everything reasonably possible to resume its performance.

A party affected by an event of force majeure which may include fire, tempest, floods, earthquake, riot, war, damage by aircraft etc., shall give the other party written notice, with full details as soon as possible and in any event not later than seven (7) calendar days of the occurrence of the cause relied upon. If force majeure applies, dates by which performance obligations are scheduled to be met will be extended for a period of time equal to the time lost due to any delay so caused.

Notwithstanding above provisions, in an event of Force Majeure, BHEL reserves for itself the right to cancel the order/ contract, wholly or partly, in order to meet the overall project schedule and make alternative arrangements for completion of deliveries and other schedules.

24. **Guarantee / Warranty:** Wherever required, and so provided in the specifications / Purchaser Order, the Seller shall guarantee that the stores supplied shall comply with the specifications laid down, for materials, workmanship and performance. The guarantee / warranty period as described shall apply afresh to replaced, repaired or re-executed parts of a delivery. If the vendor fails to take proper corrective action to repair/replace defects satisfactorily within a reasonable period, Purchaser shall be free to take corrective action as may be deemed necessary at vendor's risk and cost after giving notice to the vendor, including arranging supply of goods from elsewhere at the sole risk and cost of the vendor. Unless otherwise specifically provided in the Purchase Order, Vendor's liability shall be co terminus with the expiration of the applicable guarantee / warranty period.

25. **Limitation of Liability:** Vendor's liability towards this contract is limited to a maximum of 100% of the contract value and consequential damages are excluded. However the limits of liability will have no effect in cases of criminal negligence or wilful misconduct.

The total liability of Vendor for all claims arising out of or relating to the performance or breach of the Contract or use of any Products or Services or any order shall not exceed the total Contract price.

26. **Liability during guarantee / warranty:** Vendor shall arrange replacement / repair of all the defective materials / services under its obligation under the guarantee / warranty period. The rejected goods shall be taken away by vendor and replaced / repaired. In the event of the vendor's failure to comply, BHEL may take appropriate action including disposal of rejections and replenishment by any other sources at the cost and risk of the vendor.

In case, defects attributable to vendor are detected during first time commissioning or use, vendor shall be responsible for replacement / repair of the goods as required by BHEL at vendor's cost. In all such cases expiry of guarantee / warranty will not be applicable.

27. **Liability after guarantee / warranty period:** At the end of the guarantee / warranty, the Vendor's liability ceases except for latent defects (latent defects are defects / performance issues noticed after the guarantee / warranty has expired). The Contractor's liability for latent defects warranty for the plant and equipment including spares shall be limited to a period of six months from the end of the guarantee / as specified in RFQ.

28. **Compliance with Laws:** Vendor shall, in performing the contract, comply with all applicable laws. The vendor shall make all remittances, give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the laws in relation to the execution and completion of the contract and for remedying of any defects; and the Contractor shall indemnify and hold BHEL harmless against and from the consequences of any failure to do so.
29. **Settlement of Disputes:** Except as otherwise specifically provided in the Purchase Order, decision of BHEL shall be binding on the vendor with respect to all questions relating to the interpretation or meaning of the terms and conditions and instructions herein before mentioned and as to the completion of supplies/work/services, other questions, claim, right, matter or things whatsoever in any way arising out of or relating to the contract, instructions, orders or these conditions or otherwise concerning the supply or the execution or failure to execute the order, whether arising during the schedule of supply/work or after the completion or abandonment thereof. Any disputes or differences among the parties shall to the extent possible be settled amicably between the parties thereto, failing which the disputed issues shall be settled through arbitration. Vendor shall continue to perform the contract, pending settlement of dispute(s).
30. **Arbitration Clause:** In case amicable settlement is not reached in the event of any dispute or difference arising out of the execution of the Contract or the respective rights and liabilities of the parties or in relation to interpretation of any provision in any manner touching upon the Contract, such dispute or difference shall (except as to any matters, the decision of which is specifically provided for therein) be referred by either party to the sole arbitration of an Arbitrator appointed by the Executive Director/ General Manager of the purchasing unit/ region/ division of BHEL. Vendor shall have no objection even if the Arbitrator so appointed is an employee of BHEL or has ever dealt/ had to deal with any matter relating to this Contract. Subject as aforesaid the provisions of the Arbitration and Conciliation Act, 1996 of India or any statutory modification or re-enactment thereof and the rules made there under and for the time being in force shall apply to the arbitration proceedings under this clause. It is a term of contract that the party initiating arbitration shall specify the dispute or disputes to be referred to arbitration under this clause together with the amount or amounts claimed in respect of each such dispute. The venue for the arbitration shall be Bangalore, India. The award of the arbitrator shall be a speaking award and shall be final, conclusive and binding on all parties to this contract.
The cost of arbitration shall be borne equally by the parties. Notwithstanding the existence of any dispute or difference or any reference for the arbitration, the vendor shall proceed with and continue without hindrance the performance of the work under the contract with due diligence and expedition in a professional manner.
31. **Applicable Laws and Jurisdiction of Courts:** Prevailing Indian laws both substantive and procedural, including modifications thereto, shall govern the Contract. Subject to the conditions as aforesaid, the competent courts in BANGALORE alone shall have jurisdiction to consider over any matters touching upon this contract.
32. **General Terms:** That any non-exercise, forbearance or omission of any of the powers conferred on BHEL and /or any of its authorities will not in any manner constitute waiver of the conditions hereto contained in these presents.
That the headings used in this agreement are for convenience of reference only.
That all notices etc., to be given under the Purchase order shall be in writing, type script or printed and if sent by registered post or by courier service to the address given in this document shall be deemed to have been served on the date when in the ordinary course, they would have been delivered to the addressee.

ANNEXURE - I
LIST OF INTERNATIONAL GATEWAY AIRPORTS

SCHEDULE NO	COUNTRY	CURRENCY CODE	AIRPORT
D01	UK	GBP	LONDON (HEATHROW)
D02	UK	GBP	NEW CASTLE
D03	UK	GBP	OXFORD. CHETLAM
D04	UK	GBP	BRISTOL. WELLINGBOROUGH
D05	UK	GBP	BIRMINGHAM
D06	UK	GBP	EAST MIDLANDS
D07	UK	GBP	MANCHESTER
D08	UK	GBP	LEEDS
D09	UK	GBP	GLASGOW
D10	FRANCE	EURO	PARIS (ROISSY) & LYON
D11	SWEDEN	EURO	STOCKHOLM
D12	SWEDEN	EURO	GOTHENBERG & MALMO
D13	ITALY	EURO	ROMA, MILAN
D14	ITALY	EURO	TURIN, BOLOGNA, FLORENCE
D15	NETHERLANDS	EURO	AMSTERDAM, ROTTERDAM
D16	AUSTRIA	EURO	VIENNA, LINZ, GRAZ
D17	BELGIUM	EURO	ANTWERP, BRUSSELS
D18	DENMARK	DKK	COPENHAGEN
D19	JAPAN	JPY	TOKYO, OSAKA
D20	SINGAPORE	SGD	SINGAPORE
D21	CANADA	CAD	TORONTO
D22	CANADA	CAD	MONTREAL
D23	USA	USD	NEW YORK, BOSTON
D24	USA	USD	CHICAGO
D25	USA	USD	SAN FRANCISCO, LOS ANGELES
D26	USA	USD	ALANTA, HOUSTON
D27	GERMANY	EURO	MUNICH, KOLN, DUSSELDORF, HANNOVER, HAMBURG, STUTTGART, DAMSTADT, MANIHIEM, NURUMBERG
D28	GERMANY	EURO	FRANKFURT
D29	GERMANY	EURO	BERLIN
D30	SWITZERLAND	SFR	BASLE, ZURICH, GENEVA
D31	SPAIN	EURO	BARCELONA
D32	AUSTRALIA	AUD	SYDNEY
D33	AUSTRALIA	AUD	MELBOURNE
D34	AUSTRALIA	AUD	PERTH
D35	CZECH	EURO	PRAGUE
D36	HONG KONG	HKD	HONG KONG
D37	NEW ZELAND	NZD	AUCKLAND
D38	RUSSIA	USD	MOSCOW
D39	SOUTH KOREA	USD	KIMPO INTERNATIONAL, INCHEON
D40	FINLAND	EURO	HELSINKI
D41	ROMANIA	EURO	BUCHAREST
D42	NORWAY	EURO	OSLO
D43	IRELAND	EURO	DUBLIN
D44	ISRAEL	USD	TEL AVIV
D45	UAE	USD	DUBAI
D46	OMAN	USD	MUSCAT
D47	EGYPT	USD	CAIRO
D48	TAIWAN	USD	TAIPEI
D49	UKRAINE	USD	KIEV
D50	CHINA	USD	SHANGHAI, SHENZHEN
D51	PHILIPINES	USD	MANILA
D52	MALAYSIA	USD	KUALALUMPUR, PE NANG
D53	CYPRUS	USD	LARNACA
D54	SOUTH AFRICA	USD	JOHANNESBERG, DURBAN
D55	SLOVAKIA	EURO	BARTISLOVA
D56	SAUDI ARABIA	SAR	RIYADH
D57	TURKEY	EURO	ISTANBUL
D58	THAILAND	USD	BANGKOK
D59	BRAZIL	USD	SAO PAULO, RIO DE JANEIRO

ANNEXURE - II
REQUEST FOR C FORM

NAME OF VENDOR :

VENDOR CODE ALLOTTED BY BHEL :

E mail id for c form correspondence :

BHEL PO NO	INVOICE NO	INVOICE DATE	INVOICE AMOUNT	SUPPLY FROM - STATE	SUPPLY TO - STATE	CST TIN NUMBER (SUPPLIER)	INVOICE AMOUNT EXCLUDING FREIGHT	C FORM QTR	YEAR	SUPPLY TO BHEL EDN / SITE
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Please note that one 'C' form will be issued for a quarter.

Any modification and cancellation of c form is not possible from our end since it is generated online therefore include all invoices pertaining to quarter in your request
Also check the data are correct in all respect

General Instruction:

1. C form request should be given only in this file.
2. Amount should be 100% of Invoice value but should Not include freight, Insurance etc.
3. PO No. should be numeric, starting with 4 and has 10 digits
4. For every quarter separate file to be provided
5. All Invoices pertaining to the relevant quarter to be included.
6. No corrections will be entertained once c-form is issued.

ANNEXURE-III

BANK GUARANTEE FOR PERFORMANCE SECURITY

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited ¹ (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at _____ through its Unit at.....(name of the Unit) having awarded to (Name of the Vendor / Contractor / Supplier) having its registered office at _____ ² hereinafter referred to as the 'Contractor/Supplier', which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref No.....dated³ valued at Rs.....⁴ (Rupees -----)/FC.....(in words.....) for⁵ (hereinafter called the 'Contract') and the Contractor having agreed to provide a Contract Performance Guarantee, equivalent to% (.... Percent) of the said value of the Contract to the Employer for the faithful performance of the Contract,

we,, (hereinafter referred to as the Bank), having registered/Head office at and inter alia a branch at being the Guarantor under this Guarantee, hereby, irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer a maximum amount Rs ----- (Rupees -----) without any demur, immediately on a demand from the Employer, .

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment thereunder and the contractors/supplier shall have no claim against us for making such payment.

We thebank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We BANK further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Contractor/Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall remain in force upto and including.....⁶ and shall be extended from time to time for such period as may be desired by Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the⁷we shall be discharged from all liabilities under this guarantee thereafter.

We, BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

- a) The liability of the Bank under this Guarantee shall not exceed.....⁸
- b) This Guarantee shall be valid up to⁹
- c) Unless the Bank is served a written claim or demand on or before¹⁰ all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of
(Name of the Bank)

Dated.....

Place of Issue.....

¹ NAME AND ADDRESS OF EMPLOYER I.e Bharat Heavy Electricals Limited

² NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.

³ DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE

⁴ PROJECT/SUPPLY DETAILS

⁵ BG AMOUNT IN FIGURES AND WORDS

⁶ VALIDITY DATE

⁷ DATE OF EXPIRY OF CLAIM PERIOD

⁸ BG AMOUNT IN FIGURES AND WORDS.

⁹ VALIDITY DATE

¹⁰ DATE OF EXPIRY OF CLAIM PERIOD

Note:

1. In Case of Bank Guarantees submitted by Foreign Vendors-

- a. **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
- b. **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**
 - b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.
 - b.2 **In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank** (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.
 - b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.
 - b.4 The BG should clearly specify that the demand or other document can be presented in electronic form.

ANNEXURE - IV

Electronic Funds Transfer (EFT) OR Paylink Direct Credit Form

Please Fill up the form in **CAPITAL LETTERS** only.

TYPE OF REQUEST(Tick one): _____ CREATE _____ CHANGE

BHEL Vendor / Supplier Code:	
Company Name :	
Permanent Account Number(PAN):	
Address	

City: _____	PINCODE _____	STATE _____	_____
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Contact Person(s)	
Telephone No:	
Fax No:	
e-mail id:	

1 Bank Name:	
2 Bank Address:	
3 Bank Telephone No:	
4 Bank Account No:	
5 Account Type: Savings/Cash Credit	
6 9 Digit Code Number of Bank and branch appearing on MICR cheque issued by Bank	
7 Bank swift Code(applicable for EFT only)	
8 Bank IFSC code(applicable for RTGS)	
9 Bank IFSC code(applicable for NEFT)	

- A I hereby certify that the particulars given above are true, correct and complete and that I, as a representative for the above named Company, hereby authorise BHEL, EDN, Bangalore to electronically deposit payments to the designated bank account.
- B If the transaction is delayed or not effected at all for reasons of incomplete or incorrect information, I would not hold BHEL / transferring Bank responsible.
- C This authority remains in full force until BHEL, EDN, Bangalore receives written notification requesting a change or cancellation.
- D I have read the contents of the covering letter and agree to discharge the responsibility expected of me as a participant under ECS / EFT.

Date:

Authorised Signatory:

Designation:

Telephone NO. with STD Code

Company Seal

Bank Certificate

We certify that _____ has an Account No _____ with us and we confirm that the bank details given above are correct as per our records.

Date: _____ (.....)

Place: _____ Signature

Please return completed form along with a blank cancelled cheque or photocopy thereof to:

Bharath Heavy Electricals Ltd,

Attn:

Electronics Division, Mysore Road,

BANGALORE - 560 026

In case of any Query, please call : 080-26998xxx / 2674xxxx or fax no. 080-2674xxxx

ANNEXURE-V
BHEL MEMBER BANKS (LIST OF CONSORTIUM BANKS)

BANK GUARANTEE (BG) SHALL BE ISSUED FROM THE FOLLOWING BANKS ONLY:

	Nationalised Banks		Nationalised Banks
1	Allahabad Bank	19	Vijaya Bank
2	Andhra Bank		Public Sector Banks
3	Bank of Baroda	20	IDBI
4	Canara Bank		Foreign Banks
5	Corporation Bank	21	CITI Bank N.A
6	Central Bank	22	Deutsche Bank AG
7	Indian Bank	23	The Hongkong and Shanghai Banking Corporation Ltd. (HSBC)
8	Indian Overseas Bank	24	Standard Chartered Bank
9	Oriental Bank of Commerce		
10	Punjab National Bank	26	J P Morgan
11	Punjab & Sindh Bank		Private Banks
12	State Bank of India	27	Axis Bank
13	State Bank of Hyderabad	28	The Federal Bank Limited
14	Syndicate Bank	29	HDFC Bank
15	State Bank of Travancore	30	Kotak Mahindra Bank Ltd
16	UCO Bank	31	ICICI Bank
17	Union Bank of India	32	IndusInd Bank
18	United Bank of India	33	Yes Bank

Note:

- All BGs must be issued from BHEL consortium banks listed above.
- BHEL may accept BG from other Nationalised Banks also which are not listed above.
- BG will not be accepted from Scheduled Banks and Co-operative Banks.
- In case BG is issued from a bank located outside Indian territory and is issued in foreign currency, the BG must be routed through and confirmed by any one of the above mentioned consortium banks or any of the Indian Public Sector Banks.
- This list is subject to changes. Hence vendors are requested to check this list every time before issuing BGs.

ANNEXURE - VI

DISCREPANCY IN WORDS & FIGURES – QUOTED IN PRICE BID

Following guidelines will be followed in case of discrepancy in words & figures-quoted in price bid:

- (a) If, in the price structure quoted for the required goods/services/works, there is discrepancy between the unit price and the total price (which is obtained by multiplying the unit price by the quantity), the unit price shall prevail and the total price corrected accordingly, unless in the opinion of the purchaser there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price corrected accordingly.
- (b) If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and
- (c) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a) and (b) above.
- (d) If there is such discrepancy in an offer, the same shall be conveyed to the bidder with target date upto which the bidder has to send his acceptance on the above lines and if the bidder does not agree to the decision of the purchaser, the bid is liable to be ignored.

ANNEXURE - VII

BENEFITS FOR MSE SUPPLIERS AS PER MSMED ACT 2006 AND PUBLIC PROCUREMENT POLICY 2012

MSE suppliers can avail the intended benefits only if they submit along with the offer, attested copies of either EM II certificate having deemed validity (five years from the date of issue of Acknowledgement in EM II).

Or

Valid NSIC certificate or EM II certificate along with attested copy of CA certificate (Format enclosed: ANNEXURE VIII) where deemed validity of EM II certificate of five years has expired) applicable for the relevant financial year (latest audited).

Date to be reckoned for determining the deemed validity will be the date of bid opening (Part 1 in case of two part bid).

Non-submission of such documents will lead to consideration of their bid at par with other bidders.

No benefit shall be applicable for this enquiry if any deficiency in the above required documents are not submitted before price bid opening. If the tender is to be submitted through e-procurement portal, then the above required documents are to be uploaded on the portal. Documents should be notarized or attested by a Gazette officer.

ANNEXURE - VIII
CERTIFICATE BY CHARTERED ACCOUNTANT ON LETTER HEAD

This is to certify that M/s
.....(Hereinafter referred to as 'Company') having
its registered office at is registered under MSMED Act 2006, (Entrepreneur
Memorandum No ((Part-II) dtd Category:
(Micro/Small). (Copy enclosed).

Further verified from the Books of Accounts that the investment of the company as per the
latest audited financial year **as per MSMED Act 2006 is as follows:**

1. For Manufacturing Enterprises: Investment in plant and machinery (i.e., original cost excluding land
and building and the items specified by the Ministry of Small Industries vide its notification No.S.O.1722
(E) dated October 5, 2006:

Rs.Lacs.

2. For Service Enterprises: Investment in equipment (original cost excluding land and building
and furniture, fittings and other items not directly related to the service rendered or as may be
notified under the MSMED Act, 2006:

Rs.Lacs.

The above investment of Rs. Lacs in within permissible limit of Rs..... Lacs
for.....Micro / Small (Strike off which is not applicable) Category under MSMED
Act 2006.

(or)

The company has been graduated from its original category (Micro/Small) (Strike off which is not
applicable) and the date of graduation of such enterprise from its original category is
.....(dd/mm/yy) which is within the period of 3 years from the date of graduation of such enterprise
from its original category as notified vide S.O.No.3322(E) dated 01.11.2013 published in the gazette
notification dated 04.11.2013 by Ministry of MSME.

Date:

(Signature)

Name -

Membership Number -

Seal of Chartered Accountant

ANNEXURE - IX

In case of intrastate movement i.e. supply within same state and VAT is applicable, the vendor shall furnish the respective BHEL™s nodal agency TIN no. and address in their invoice.

List of Statewise Nodal Officers with Contact Details

Region	State	Nodal Unit responsible for all other units except those in column 4	Contact Details- Landline No.	E-mail	TIN No.	CST No.
1	2	3		7	8	9
Norther States	Jammu & Kashmir	PSNR	0120-2510488/2416452	rahulb@bhelspsnr.co.in / a.chadha@bhelspsnr.co.in	01291101313	
	Himachal Pradesh	PSNR			02011000622	
	Punjab	PSNR			03451148722	
	Haryana	PSNR			06962606884	
	Rajasthan	PSNR			08232903345	
	Uttar Pradesh	PSNR	0120-2416536	rahulb@bhelspsnr.co.in / smittal@bhelspsnr.co.in	09365800914	
	Uttarakhand	Hardwar	01334-285449	alok@bhelhwr.co.in	05001757277 Dated 30th Sep 2005	5000030 Dated 13/03/1965
	Delhi	TBG	0120-6748429	skindal@bhel.in	07472001760	07472001760
Western States	Madhya Pradesh	Bhopal	0755-2503231	meeta@bhelbpl.co.in	23573600001 (HEL/05/01/0001/S dated 15/11/1979 under MPCT)	HEL/05/01/0004/C dated 15/11/1979
	Chattisgarh	PSWR	0712-3048609	mgupta@bhelspswr.co.in	22173202974	
	Gujarat	PSWR	0265-2370321	bhavin@bhelspswr.co.in	24190101571	
	Maharashtra	ROD Mumbai	022-22126061/22187850	mahajani@bhel.in	27060300130V	27060300130C
	Daman & Diu	EDN	080-26998724 / 26998830	theerthagiri@bheledn.co.in	25000009902	
Southern States	Orissa	PSSR	044-28286773	sparida@bhelspsr.co.in / lakshmi@bhelspsr.co.in	21031301916	
	Tamil Nadu	Trichy	0431-2577757/ 2577229	msrao@bheltry.co.in / bharaths@bheltry.co.in	33243560005	239383 dt.11.6.91
	Kerala	PSSR	044-28286773	lakshmi@bhelspsr.co.in	32072043622	
	Karnataka	EDN	080-26998724 / 26998830	theerthagiri@bheledn.co.in	29180069268	00850081
	Telangana	HPEP RC, Puram	040-23185406/ 040-23182238	chand@bhelhyd.co.in / sbsv@bhelhyd.co.in	36360151179	
	Andhra Pradesh	HPVP, Vizag	0891-6681298	sarmaass@bhpvl.com	37418632431	
	Puducherry	PSSR				
Eastern States	West Bengal	PSER	033-23216130-3238	amitavac@bhelpser.co.in	19200936019	19200936213
	Bihar	PSER	0612-2231275	rakesh@bhelpser.co.in	10010994046	10010994046
	Jharkhand	PSER	06549-266351(Sh. Parmanand Swaroop)/06534-292179 (Sh. K.K. Ajeet)	pswaroop@bhelpser.co.in (Bokaro) kk.ajit@bhelpser.co.in (Koderma/Abhijeet/North Karanpura) manishk.jain@bhelpser.co.in (Chandrapura)/ kpsubbu@bhelpser.co.in	20352205642 (Bokaro) 20082005255 (Maithon) 20512405410 (Koderma) 20122200394 (Chandrapura) 20620905730(Adhunik) 20650507026(Abhijeet) 20452110016 (North Karanpura)	TG-729(C)
	Mizoram	PSER	033-23216130-3249	anindya@bhelpser.co.in	15501465017	
	Arunachal Pradesh	PSER	033-23216130-3249	anindya@bhelpser.co.in	12020122182	Not Applied
	Assam	PSER	033-23216130-3249	anindya@bhelpser.co.in	18790101415	18179903204
	Tripura	PSER	03821-265209	mkmahato@bhelpser.co.in	16060947071	16060947273
	Sikkim	PSER				
	Meghalaya	PSER				
	Manipur	PSER				
	Nagaland	PSER				