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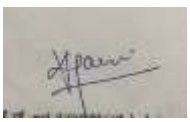
Technical specification

for

Design, Supply, Installation and Commissioning
of 66kV switchyards, underground cables
for 75MW (AC) Solar Photovoltaic Grid-connected Power plant
at

Charanka Solar Park, Gujarat

Revision details :	Prepared by	Approved by	Date
R01 dtd 18.06.2018- Clauses 1.1, 1.5, 2.6, 4.1.1, 4.3, 5.8.2, 5.8.5, 6.0, 8.0 modified, Changes highlighted.	 Varun Jain	 Prachi Rao V	24.05.2018

1.0 INTRODUCTION

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

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

Solar PV modules employed at the plant generates DC electricity that in turn shall be inverted to AC in the range 300-400V. Output of each solar block (5 MWp) with independent inverter room/ transformer yards shall be stepped up to 33kV. Combined AC output is stepped up to 66kV using 60MVA and 30 MVA power transformer. At these outgoer levels, there are two outdoor switchyard bays together with necessary gantries/ towers/ beams/ Cables to facilitate 66kV transmission.

Power generated at the above SPV plant shall be transported to GETCO substation using 66kV underground cables from each of two bays. Distance between SPV plant and substation is ~~3000m~~ **3700m** approximately. At substation, two outdoor switchyard bays exclusive for this plant shall be constructed with necessary equipment to facilitate 66kV transmission.

1.2 Brief outline of vendor scope

Vendor scope includes activities but not limited to design, engineering, drafting of drawings, obtaining approval from BHEL/GIPCL for the drawings, manufacture/ testing/ inspection at manufacturer's works, packing, supply, transportation, transit insurance, delivery to site, unloading, storage, civil activities (foundations for electrical equipment and switchyard structures etc.), erection of switchyard structures/equipment, coordination/ liaison with concerned state/ central authorities such as GETCO/ CEIG etc. for the following three specific portions of the project:

(1) 66kV outdoor switchyard at SPV plant end consisting of 2 nos of 66KV bays including erection and commissioning of 60MVA and 30 MVA 33/66kV power transformer along with NIFPS system for each of two Power Transformers.
(2) 66kV underground cables laying between SPV power plant and STU (GETCO substation).
(3) 66kV switchyard bays (2 Nos.) at GETCO substation.

The vendor shall have design capability for substation / switchyard / transmission line. In case they do not have design/drafting capability, after receiving purchase order from BHEL, the vendor shall tie up with competent design consultants in which case vendor shall submit the credentials of the proposed consultants to BHEL for approval by BHEL. Vendor shall award the work on the consultants only after approval by BHEL. 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/GIPCL), drawing/document number, revision number, number of sheets etc. Details of drawings/ design documents to be submitted are brought out under section 5.0 of this specification.

All civil related works shall be tested as per BHEL/GIPCL approved FQP that will be issued during 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 listed under sections 3.0 and 5.0 and elaborated in various other sections of this specification.

1.3 Location/ address of power plant:

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

1.4 Enclosures to this specification

(a) Tentative AC SLD of the overall SPV plant where the "bidder scope" is clearly marked.
(b) Tentative SPV Plant Array Layout with indicative location of the 66kV Switchyards
(c) Approved vendor list for equipment for 66KV switchyard – SPV plant side
(d) Method of construction of 66KV underground Cable laying work
(e) List of GETCO Approved Cable laying agencies (Annexure-A)
(f) Existing 400kV GETCO Charanka substation SLD
(g) Tentative 66KV cable route from SPV plant to GETCO Substation
(h) Tentative SPV plant Control Room Layout

1.5 Other indicative details to the bidders for tender purpose:

(a) Distance between end of 66kV switchyard at solar plant and start of 66kV switchyard at GETCO substation: ~~3000m~~ **3700m** approx.
(b) At GETCO substation side, AC/DC aux supplies for ABT metering panel and 66kV switchyard equipment in vendor scope shall be taken from the existing main control room of GETCO substation.
(c) Vendor shall visit project site prior to submission of bids so as to make an clear assessment of site conditions such as (1) the land terrain, (2) nature of soil, (3) arrangement of existing bus at GETCO substation to which the feeder extension bay will be hooked up (4) Other details like location of extension bay and the C&R Panel Room/Main Substation Control Room for the purpose of power supply / control cabling works (5) Details of Earth mat extension and cable trenching and laying works (6) Cable Routing for 66kV Underground Cable from Plant to GETCO substation.
(d) ~~**BIDDER SHALL EMPLOY MINIMUM 70% OF LOCAL WORK FORCE (BELONGING TO CHARANKA/GUJARAT) DURING EXECUTION OF WORKS.**~~ **65% of the jobs created due to the project in the supervisory and managerial cadres & 80% of the jobs that will be created in other cadres shall be filled in by employing local persons. The expression "Local person" shall mean a person domiciled in Gujarat State for 15 years prior to applying for employment to vendor. Before engaging the labour in to work, vendor should get the NOC from labours' native police station as well as NOC from Santhalpur, Gujarat police station.**

2.0 LIST OF DELIVERABLES TO BE OFFERED BY VENDOR

#	Deliverables	Qty
2.1	**Supply of all electrical equipments and materials of 66kV switchyard (at SPV plant side)** such as CTs, PTs, surge arrestors/ lightning arrestors, Bus post insulators / Bushings, GOS Isolators/disconnectors, Earth switches, Motors & related controls for isolators/ disconnectors / earth switches, SF6 circuit breakers, ACSR conductors, Electrical cables & cable trays, Marshalling boxes / panels / distribution boards, ABT Metering Panel with Main & Check Meters, Control and Relay panel with BCPU, NIFPS system, SCADA connectivity from switchyard equipment, RTU Panel for SLDC connectivity, Earth wire, Earth mat items (rods/risers etc), Earth strips/ electrodes, stone jelly etc together with all related accessories (disc insulators, clamps, connectors/ bimetallic where required, cable	2 Set

	glands/lugs/ties etc) and complete set of hardware required to meet the electrical requirements of the switchyard. Scope shall also include supply of Neutral CTs (33kV & 66kV side) for BHEL-supplied 60 MVA and 30 MVA 33/66kV, YnYn0 transformer. Detailed scope as per section 5.0 of this spec.	
2.2	**Supply of structural items of 66kV switchyards (SPV plant side**) for mounting the electrical equipment together with all related accessories and complete set of hardware required to meet the structural support requirements of the switchyards.	2 Set
2.3	**Supply of all electrical equipment and materials of 66kV feeder bay at GETCO substation** such as CTs, PTs, Bus post insulators / Bushings, Sheath Voltage limiter (SVL), ACSR conductors, Electrical cables & cable trays, Marshalling boxes / distribution boards, ABT meters & outdoor metering panels, Earth mat items (rods/risers etc), Earth strips/electrodes, together with all related accessories (disc insulators, clamps, connectors/ bimetallic where required, cable glands/lugs/ties etc) and complete set of hardware required to meet the electrical requirements of the switchyard and, also all the related items required to hook up to the existing bay of GETCO substation, communication system as per GETCO requirement, integration of new feeder bays with existing SCADA system at GETCO substation with all required equipment like Ethernet fiber switch, kiosk, LIU etc as per GETCO requirement. Detailed scope as per section 4.0 of this spec.	2 Set
2.4	**Supply of structural items of 66kV switchyards (GETCO substation side**) for mounting the electrical equipment together with all related accessories and complete set of hardware required to meet the structural support requirements of the switchyards.	2 Set
2.5	**Supply of 66kV cable accessories like termination kits, straight through jointing kits etc**. Detailed scope as per section 4.0 of this spec.	1 set
2.6	**Supply of spare items for 66kV switchyards:** Following spares shall be supplied along with main equipment:	1 set

S.No	Item Description	Quantity
1	Surge arrester for 66 KV	3 Nos.
2	Disc Insulators string 66 kV (Each type)	2 Sets
3	Conductor of each type used each type	50 mtr
4	Stringing hardware	01 Set
5	Terminal Connectors on high voltage conductors and equipments each type	01 Set
6	Complete drive mechanism including motor for disconnector switches	02 No.
7	Trip coils for circuit breakers	02 No.
8	Closing coils for circuit breakers	02 No.
9	Complete set of rupture disc	1 Set
10	66kV Current transformer of each rating	02 Nos.
11	66kV Voltage transformer of each rating	1 Nos.
12	66kV Post insulator	01 Set

	13	66kV Isolator contacts set (Male+Female)	02 Set	
	14	Maintenance earthing rod for 66kV	01 Set	
	15	Breaker operating mechanism	01 Set	
	16	SF6 bottle (To fill SF6 in one complete Circuit breaker)	01 No.	
	17	Contactors and relays of each type and rating used in circuit breaker and isolator control cubicle / Mechanism box	01 set.	
	18	Limit switch for the isolator	01 set.	
	19	66kV Earth switch contact assy.	01 Set (For three pole)	
	20	Spring charge motor of SF6 breaker	2 Nos	
	21	MCBs, fuses (each type)	5% of total population	
	22	**66 KV straight through jointing kits**	**10 Nos.**	
	23	**66 KV end termination kits**	**4 Nos.**	
2.7	**Installation of 66kV switchyard bays at SPV plant side** using vendor-supplied electrical equipment's and steel structures, land leveling/ grading, laying of earth mat grid for complete switchyard, cable trenches, laying of cable trays and cables, cable terminations/ interconnections, installation of earthing electrodes, construction of earthing chambers with lids, earthing terminations, stone jelly spreading, cable trenches etc., marking of all electrical equipment / cables, installation of sign / danger boards etc. Scope shall also include installation of (vendor-supplied) control and relay protection panels within the control room at SPV plant including all related electrical cable trenching (from switchyard to main control room), laying, terminations, interconnections and earthing connections. (Note: Construction of Main control room adjoining the 66kV Switchyard is in BHEL scope). Detailed scope as per section 4.0 of this spec.			2 AU
2.8	**Installation of 66kV feeder bays at GETCO substation side** using vendor-supplied electrical equipment's and steel structures, land leveling/ grading, civil foundations for all structures, electrical equipment's, cable trenches, laying of cable trays and cables, cable terminations/ interconnections, installation of earthing electrodes, construction of earthing chambers with lids, earthing terminations extension of earth grid to existing earth mat of GETCO substation, stone jelly spreading, together with all related activities civil foundations/ cable trenches etc, marking of all electrical equipment / cables, installation of sign / danger boards etc and hooking up the switchyard to the existing bus at GETCO substation. Scope shall also include installation of (vendor-supplied) outdoor weather proof ABT metering panel (GETCO approved)in the switchyard nearest to the Metering CT/PTs, including all related electrical cable trenching, laying, terminations, interconnections (including aux AC/DC supply & distribution boards as required for Metering Panels and other equipment), and earthing connections. Detailed scope as per section 4.0 of this spec.			2 AU

2.9	**Installation of underground 66KV cable from 66KV switchyard at SPV end to feeder extension bay at 66kV GETCO substation**. Detailed scope as per section 4.0 of this spec.	2 AU
2.10	**Pre-commissioning inspections** / checks / tests on 66kV switchyard equipment's (both plant and substation ends)/ transmission line/ C&R panel/ ABT metering panel etc and coordination / liaison activities with related state / central departments /GETCO/GUVNL/CEIG/GEDA/SLDC etc as applicable for necessary approvals/ clearances for drawings/ documents/ inspection at equipment manufacturers' works and at site by GETCO/ CEIG / GEDA and also for plant commissioning activities viz line-charging/ grid synchronization. Detailed scope as per section 4.0 of this spec.	2 AU

Note 1: Final scope of supply and installation works for the feeder bay at GETCO substation and the laying and termination of 66kV underground cable shall be as per GETCO requirement.

Note 2: There are no separate charges for design/ drafting of engineering documents viz drawings/ schemes/ layouts/ calculations etc. and consultancy, as these charges shall be deemed to be absorbed in the above line items.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER

a) List of installations of substations / switchyards of 66kV and above in past three years from date of tender opening shall be submitted with details viz client name, project name, rating of installation, scope of supply, scope of installation and year of installation along with Purchase Orders/Completion Certificate.
b) Vendor company profile and brochure
c) Statement expressing compliance to this BHEL specification (NIL deviation statement).
d) List of spares offered (with quantity) and without prices.

4.0 DETAILED SCOPE OF BHEL AND VENDOR

4.1 66kV switchyard at SPV plant end

All 66kV Equipment Ratings shall be as per attached Single Line Diagram.

This switchyard is attached to the main control room (BHEL scope) at SPV plant end. The overall size and **layout of switchyard with 2 bays shall be proposed by the vendor** (for approval by BHEL/GIPCL) based on the space required to accommodate the electrical equipments (including the 60MVA and 30 MVA power transformer and 200kVA aux transformer that are in BHEL scope of supply), neutral CTs for both 33kV & 66kV side of 60MVA and 30 MVA transformer, earth mat grid, earth chambers, various marshalling boxes etc duly considering the spacing / clearances between the various electrical equipment as per relevant standards and Indian electricity rules (1956), CBIP, state electricity board / GETCO/ DISCOM/ CEIG regulations/any other statutory directives etc.

Accordingly, the respective scopes of BHEL and the vendor are listed as below, whereas detailed specifications are provided in other sections of this specification.

4.1.1 BHEL scope

#	Scope description	Quantity
1	Supply of oil-filled, 60 MVA and 30 MVA, 33/66kV transformer.	2 No
2	Supply, civil foundation and installation of oil-filled, 200kVA 33kV/433V aux transformer to be placed in the same 66kV switchyard at SPV plant.	1 No
3	Supply, laying and termination of 33kV cables for the above transformers.	1 set
4	Supply, laying and termination of LT (433V side) cables for the aux transformer.	1 set
5	Construction of main control room at SPV plant.	1 set
6	Supply and installation of aux supply (AC/DC) equipment's viz battery, battery charger, ACDB, DCDB etc in main control room for operation of C&R panel and switchyard equipment's.	1 set
7	Supply of 66 KV Cable **in drum lengths of 700m**	2 Set
8	Construction of Transformer and other equipment foundations in 66KV switchyard at SPV end	2 sets
9	Supply and construction of fencing and gate for 66 KV switchyard at SPV end	1 set
10	Construction of Transformer oil soak pit at SPV end	2 set
11	**Supply of 6.6KV(E), 1CX150 sqmm, Copper Cable for SVL**	**100m**

4.1.2 Vendor scope

(a) Supply, installation, testing and commissioning as per relevant standards, Indian electricity rules (1956), CBIP, State electricity board / GETCO/ DISCOM/ CEIG regulations/ GERC/Electricity Act-2003 etc. shall be approved by BHEL/GIPCL.

1	Design calculations for equipment mounting structure, earth mat grid for 66kV switchyard at SPV plant end.
2	Unloading, Installation, testing and commissioning of 60 MVA and 30 MVA, 33/66 kV, YNyn0 Power transformers of BHEL scope of supply.
3	Supply and installation of 2 Nos. Control and Relay panels with each C&R panel consisting of 1 no of BCPU along with the other numerical relays and other components as required as per SLD. Note: C&R panels shall be installed inside the control room.
4	Supply and installation of following outdoor switchyard items including mechanical operations (bolting, bending, welding etc), electrical cabling, ACSR conductor terminations, terminations at marshalling boxes for CT/ PT/ bay marshalling kiosks, other related panels/ distribution boards and hardware, AB earthing connections etc: (a) 60kV, 10kA station class-3 gapless metal oxide surge arrestor (LA) – 12 Nos (b) 66kV PT (2-core) – 6 Nos (c) 66kV PT (1-core) – 6 Nos (Metering PT) (d) 66kV CT (5-core) – 6 Nos (e) 66kV CT (1-core) – 6 Nos (Metering CT) (f) 66kV GOS Isolator, horizontal central break, triple pole, with earth switch, motor operated (locally) – 4 sets

	(g) 66kV SF6 breaker with local/remote operation – 2 Nos (h) 33kV side Neutral CT (2 core) for 60MVA and 30 MVA 33/66kV transformer – 2 No (i) 66kV side Neutral CT (2 core) for 60MVA and 30 MVA 33/66kV transformer – 2 No (j) Bus post insulators – 8 nos. This includes 2 spare BPI at SPV plant evacuation end (k) NIFPS system for 60 MVA and 30 MVA 33/66 KV Power transformer – 2 Set (l) GI structures with all necessary hardware for mounting the above electrical equipment's. (m) Disc insulators (suspension/ tension) along with other accessories such as clamps, hardware etc – quantity as required. (n) ACSR conductor with related accessories for termination such as connectors/ bimetallic where required, clamps, hardware etc – quantity as required (o) Marshalling boxes for CTs/PTs – quantity as required (p) Bay marshalling kiosks – quantity as required (q) Motors and motor control boxes for GOS isolators/ earth switches (r) LT aux power supply and control cables (s) Cable trays for laying in cable trenches (t) Underground earth mat grid items comprising of risers, electrodes, earth rods etc (u) GI earth strips for earthing of structures, electrical equipment's, panels/ DBs/ marshalling boxes etc (v) Earth pits / chambers with lids. **Note:** LA shall have separate earthing. (w) Any other items considered essential to meet the functional / operational requirements of the 66kV switchyard as per relevant standards or Indian Electricity rules (1956), CBIP, state electricity board/ GETCO/ DISCOM/ CEIG/ any other statutory requirements etc. Note: The above mentioned quantities are total quantities for 2 Nos. 66KV bays at SPV plant end.
6	Supply and installation of 1 No. ABT metering panel for each bay at SPV end consisting of two ABT meters (main, check), together with necessary ACDB/DCDB boards to provide aux AC/DC supply to the panels. Note: Outdoor ABT metering panel in weatherproof MMB/SMC box shall be installed nearest to the metering CT/PTs. ABT Meters & Metering panel shall be as per GETCO requirement – Secure make Model No: APEX 100 / or EDMI make model no. as approved by GETCO ABT Meter for both Plant side and GETCO substation side shall be the same.
7	Construction of cable trenches of precast section/brickwork with RCC lids, GI cable trays etc. and laying of HT/ LT/ control cables from "66kV switchyard equipment's / marshalling boxes/ kiosks/ 33kV & 66kV side Neutral CTs/ 60 MVA and 30MVA, 33/66kV transformer / Transformer NIFPS system etc" to "C&R panels/ ACDB/DCDB boards in control room" as per relevant standards. Supply of all items necessary for this civil activity shall be in vendor scope.
8	Other switchyard related activities such as (a) supply and laying of stone jelly of appropriate size to a layer thickness of 100 mm minimum (b) marking / installation of all the switchyard equipment's and earthing locations, (c) all relevant danger and sign boards, (d) painting of steel structures etc. for protection against erosions and corrosions.
9	Communication System as per GETCO requirement Communication system between the Plant/Substation & GETCO SLDC as per the requirements of GETCO / R&C / SLDC department shall be in the scope of the GETCO licensed contractor including hardware and software required for establishing the communication link.

10	Fire protection and fire-fighting equipment and other safety equipment for protection of the entire 66kV Switchyard as per CEIG requirements

Equipment description	Quantity Nos
CO2 type fire extinguishers	As required
Foam type fire extinguishers	As required
Dry chemical power type extinguishers	As required
Sand buckets: The bucket should be wall-mounted /stand made from at least 24 SWG sheet with bracket fixing on wall conforming to IS 2546. Note: Quantities shall be decided as per site and CEIG norms.	As required

11	Sign boards, danger boards with inscriptions in both Gujarati, Hindi and English language as per final customer requirements
12	Supply shall be as per final approved technical specifications / datasheets/drawings as approved by GIPCL.

(b) Design, drawings, guaranteed technical particulars, quality plan, manuals for 66kV switchyard at SPV plant end

Vendor shall submit the following documents for BHEL/GIPCL approval within 7 days after receipt of purchase order or at every stage of project implementation as applicable and as mutually agreed with BHEL/GIPCL.

1	Design calculations, as per relevant standards, together with drawings, layout and bill of materials shall be submitted for underground earth mat grid required for earthing of 66kV switchyard equipment's of SPV plant end for BHEL/GIPCL approval. Vendor shall also obtain approval from concerned state / central approval agency such as GETCO/ DISCOM/ CEIG etc. as applicable before commencement of supplies and works.
2	Design calculations, as per relevant standards, together with drawings and bill of materials shall be submitted for all civil foundations and GI structures of 66kV switchyard at SPV plant. Indicative soil test report enclosed.
3	Layout drawing of the complete 66kV switchyard at SPV plant end, showing locations of various electrical equipment (including transformers), earth chambers, cable trenches, marshalling boxes, other panels (if any), chain link fencing, stone jelly, steel gates etc.
4	Cross section diagram of 66kV switchyard of SPV power plant, showing the overall dimensions (such as height, width, clearances etc) of various electrical equipment mounted on the structures, gantries / beams etc.
5	Layout diagram for earthing of all structures/ equipment's of 66kV switchyard
6	Detailed bill of materials of 66kV switchyard of SPV plant, with item description, rating, make, model number, item quantity.
7	Drawings of cable trenches including arrangement of cable tray layers etc.
8	Manufacturing quality plan with routine/ type / acceptance tests, sampling plan, applicable test standards shall be submitted for BHEL/GIPCL approval for all the vendor-supplied items including but not limited to 66kV switchyard equipment's (SF6 breaker, CTs, PTs, GOS isolators, Earth switches, SVL, BPI etc), neutral CT of 33KV/66kV side, C&R panels, marshalling boxes of individual electrical equipment, bay marshalling kiosks, other panels (if any applicable), HT/LT/ control cables, ACSR conductors, steel structures, cable trays, towers, gantries, beams, motors & motor control boxes/panels

	and all related accessories such as insulators of all types, clamps, connectors etc.
9	Test reports of all the supply items – type / routine / acceptance test reports as per manufacturing quality plan approved by BHEL/GIPCL.
10	Guaranteed technical particulars, datasheets, GA drawings, O&M manuals of all the electrical equipment's/panels/boxes, structures, towers, beams, cables, cable trays, other accessories such as insulators of all types, clamps, connectors etc.

4.2 66kV switchyard at GETCO substation end

All 66kV Equipment Ratings shall be as per attached Single Line Diagram.

GETCO substation has several bays as shown in SLD. The two new feeder bays for this project shall be constructed by the vendor at the designated location. Existing Bay no. to which the new feeder bays has to be extended shall be confirmed by vendor from GETCO prior to commencement of works. Further, the bay shall be hooked up by the vendor to the existing bay and further hooked up to the existing bus at substation. SLD of switchyard is enclosed.

(1) It shall be the absolute responsibility of the Vendor to make an accurate assessment of the exact requirements of supply and installation as per site conditions. **Accordingly, vendor shall visit the site prior to submission of offer.**
(2) The vendor scope of supplies and works are listed here below, whereas detailed specifications of individual equipment's / activities are provided in various sections of this specification.
(3) All works related to GETCO substation end shall be done only by the GETCO licensed contractor.

4.2.1 BHEL scope

#	Scope description
1	**NIL.** **Note:** Vendor shall carry out the entire scope of work.

4.2.2 Vendor scope

(a) Supply, installation, testing and commissioning as per relevant standards, Indian electricity rules (1956), CBIP, State electricity board / GETCO/ DISCOM/ CEIG / GEDA regulations etc shall be approved by GETCO. All supplies shall be as per GETCO approved vendor list and as per GETCO approved technical specifications and all works shall be carried out under GETCO supervision. SLD of the existing switchyard is enclosed.

1	Design calculations for civil foundations, design calculations for earth mat grid for 66kV switchyard at **GETCO substation**.
2	Supply and installation of 1 No. ABT metering panel for each bay at GETCO end consisting of two ABT meters (main, check), together with necessary ACDB/DCDB boards to provide aux AC/DC supply to the panels. Note: Outdoor ABT metering panels in weatherproof MMB/SMC box shall be installed nearest to the metering CT/PTs at the new feeder bay. ABT Meters/Metering Panel shall be as per the requirements of GETCO R&C dept. Secure make Model No: APEX 100 / or EDMI make model no. as approved by GETCO ABT Meters testing shall be conducted at GETCO approved NABL Lab. Inspection call shall be raised for witness of testing and calibration by GETCO representative. Liasoning for the same is in the scope of the GETCO licensed contractor.

3	Supply and installation of following outdoor switchyard items including mechanical connections, electrical cabling/ ACSR conductor terminations, terminations at marshalling boxes for CT/ PT, bay marshalling kiosks, other related panels/ distribution boards and hardware: (a) 66kV bus post insulators – 8 Nos (including 2 spare to be installed) (b) 66kV PT (1-core) – metering PT – 6 Nos (c) 66kV CT (1-core) - metering CT – 6 Nos (d) 66KV LA – 6 nos (e) GI structures with all necessary hardware for mounting the above electrical equipment's. (f) Disc insulators (suspension/ tension) along with other accessories such as clamps, hardware etc – quantity as required. (g) ACSR conductor with related accessories for termination such as connectors/bimetallic, clamps, hardware etc – quantity as required (h) Earth wire/ Guard wire for laying on top of towers – quantity as required (i) Marshalling boxes for CTs/PTs (j) Motors and motor control boxes for GOS isolators/ earth switches (k) LT aux power supply and control cables (l) GI earth strips for earthing of structures, electrical equipment's/ panels/ DBs/ Marshalling boxes etc (m) Underground earthmat grid items comprising of risers, electrodes, earth rods. (n) Earth pits / chambers with lids. Note: LA shall have separate earthing. (o) Any other items considered essential to meet the functional / operational requirements of the 66kV switchyard and to hook up the power to the existing bus at substation as per relevant standards or Indian Electricity rules (1956), CBIP, state electricity board/ GETCO/ DISCOM/ CEIG etc requirements. Note: The above mentioned quantities are total quantities for 2 Nos. 66KV bays at GETCO Substation end. Vendor shall make an actual assessment of the requirement at site prior to submission of quote.
4	Construction of precast section/brickwork with RCC lids, GI cable trays etc and laying of HT/ LT/ control cables from 66kV switchyard equipment's/ marshalling boxes/ kiosks etc to existing C&R panel in control room and outdoor ABT metering panel as per relevant standards. Supply of all items necessary for this civil activity shall be in vendor scope. Vendor shall make an actual assessment of the requirement at site prior to submission of quote.
5	Construction of RCC civil foundations for mounting the GI structures for the above electrical equipment's: 66kV CTs/PTs/ LA/ Isolators / earth switches, Bus post insulators. Supply of all items necessary for this civil foundation shall be in vendor scope.
6	All necessary land development activities including suitable leveling / grading / drainage in the feeder bay area wherever applicable
7	Other switchyard related activities such as (a) supply and laying of stone jelly of appropriate size to a layer thickness of 100 mm minimum, (b) marking / labeling of all the switchyard equipment's and earthing locations, (c) all relevant danger and sign boards, (e) painting of civil foundations, steel structures etc for protection against erosions and corrosions.
8	Fire protection and fire-fighting equipment as per CEIG requirements
9	Sign boards, danger boards with inscriptions in both Gujarati and English language as per final customer requirements

10	Communication System as per GETCO requirement Communication system between the Plant/Substation & GETCO-SLDC as per the requirements of GETCO / R&C department shall be in the scope of the GETCO licensed contractor including hardware and software required for establishing the communication link.
11	Integration of feeder bays with existing SCADA system at GETCO substation with all required equipment like RTU as per GETCO specification, radio modems, RF antenna, Ethernet Fibre Switch, Kiosk, LIU etc. This activity is in GETCO scope. However, co-ordination activities, if any, shall be ascertained from the concerned GETCO department before submission of bid.
12	Pre-dispatch inspection call shall be provided to BHEL/GIPCL/GETCO for all the supply items in vendor scope.

(b) Design, drawings, guaranteed technical particulars, quality plan, manuals for 66kV switchyard at GETCO substation.

Vendor shall submit the following documents for BHEL/GIPCL/GETCO approval within 7 days after receipt of purchase order or at every stage of project implementation as applicable and as mutually agreed with BHEL/GIPCL/GETCO.

Prior to submission of documents and commencement of works, the GETCO approved electrical contractor shall have to visit GETCO Corporate Office for a kick-off meeting with the Engineering and Projects Depts of GETCO for finalization of technical requirements of 66kV works to be executed, vendor approval, methodology of drawing approval, inspection procedure and pre-commissioning checks and site inspections / other related activities required to be undertaken by GETCO/CEIG/GEDA and co-ordination procedure required for the same.

1	Vendor list for items to be supplied under the scope of this tender as per GETCO approved vendor list
2	Design calculations, as per relevant standards, together with drawings, layout and bill of materials shall be submitted for underground earthmat grid required for earthing of 66kV switchyard equipments at GETCO substation for GETCO approval. Vendor shall also obtain approval from concerned state / central approval agency such as GETCO/ DISCOM/ CEIG etc as applicable.
3	Design calculations, as per relevant standards, together with drawings and bill of materials shall be submitted for all civil foundations and GI structures.
4	Layout drawing of the complete 66kV switchyard at **GETCO substation**, showing locations of various electrical equipment, earth chambers, cable trenches, marshalling boxes, other panels/ DB boards (if any), stone jelly etc.
5	Cross section diagram of 66kV switchyard of **GETCO substation**, showing the overall dimensions (such as height, width, clearances etc) of various electrical equipment mounted on the structures, gantries / beams etc.
6	Layout diagram for earthing of all structures/ equipments.
7	Detailed bill of materials of 66kV switchyard of **GETCO substation**, with item description, rating, make, model number, item quantity.
8	Drawings of stone pitching/ retaining walls etc.
9	Drawings of cable trenches including arrangement of cable tray layers etc.
11	Manufacturing quality plan with routine/ type / acceptance tests, sampling plan, applicable test standards shall be submitted for GETCO approval for all the vendor-supplied items including but not limited to 66kV switchyard equipment's at GETCO

	substation (CTs, PTs, SVL, etc), ABT meters / ABT metering panels, marshalling boxes of individual electrical equipment, bay marshalling kiosk & other panels (if any applicable), HT/LT/ control cables, ACSR conductors, steel structures, cable trays, gantries, beams, motors & motor control boxes/panels and all related accessories such as insulators of all types, clamps, connectors etc.
12	Test reports of all the supply items – type / routine / acceptance test reports as per GETCO requirements- also elaborated in other clauses in this tender spec for CTs and PTs
13	Guaranteed technical particulars, datasheets, GA drawings, O&M manuals of all the electrical equipment's/panels/boxes, structures, towers, beams, cables, cable trays, other accessories such as insulators of all types, clamps, connectors etc.

NOTE:- All 66kV equipment's & related items in vendor's scope shall be as per GETCO technical specifications. Makes of all 66kV equipment's & related items shall be as per GETCO approved vendor list.

4.3 66kV Underground Cable from SPV power plant to GETCO substation

Distance: ~~3000m~~ 3700m approx

4.3.1 BHEL scope

#	Scope description
1	Supply of 1C x 630 sqmm 66KV Cable

4.3.2 Vendor scope

Supply, installation, testing and commissioning as per relevant standards, Indian electricity rules (1956), CBIP, GETCO/ DISCOM/ CEIG/GEDA regulations etc. and as shall be approved by BHEL/GIPCL/GETCO

1	Supply 66 KV termination kits, straight through cable jointing kits and other cable accessories and hardware required for laying and termination of cable at SPV Plant end and GETCO substation end. **Note: Quantity of straight through jointing kits shall be 40 Nos. and end termination kits shall be 16 Nos. The type and make of straight through jointing and end termination kits shall be as per GETCO requirements.**
	Laying and Installation works for 66kV Grade, XLPE, 1Cx630 sqmm (6+2 runs), Aluminum, Armored, Earthed grade Underground Cable as per relevant standards, along with termination kits, straight through cable jointing kit and other cable accessories and hardware required for laying and termination of cable at SPV Plant end and GETCO substation end. Technical specifications of the items for completion of the cable laying works shall be as per relevant standards and as per GETCO requirements. Erection of cable shall be done under GETCO supervision only by the GETCO approved cable laying agencies as per the attached approved GETCO list (Annexure-A).
2	During the execution of the line, statutory permissions, if any, raised from Govt/GIDC, other agencies shall have to be obtained by the GETCO licensed contractor.

3	The corridor, after laying the 66kV underground cable, shall be kept intact and reserved for GETCO.

(a) Design, drawings, guaranteed technical particulars, quality plan, manuals

Vendor shall submit the following documents for BHEL/GIPCL/GETCO approval within 7 days after receipt of purchase order or at every stage of project execution as applicable and as mutually agreed with BHEL/GIPCL/GETCO.

1	Design calculations as per relevant standards, results, together with GA drawings and bill of materials shall be submitted for the cable accessories. BoM shall include all with item-wise particulars such as item description, quantity, rating, type, make etc for GETCO approval.
2	Guaranteed technical particulars, datasheets, GA drawings, O&M manuals
3	Test reports of all the supply items – type / routine / acceptance test reports as per manufacturing quality plan approved by GETCO.
4	Inspection call to GETCO and GIPCL for witness of all tests as per approved MQP.
5	Pre-dispatch clearance shall be obtained from GETCO
6	Tests as required at site for the underground cable works shall be offered for witness by GETCO
7	Make of 66kV U/G cable accessories shall be as per attached GETCO approved vendor list

4.4 Pre-commissioning / commissioning / State, CEIG clearances / Liaison etc

#	Scope description
1	Pre-commissioning inspections / checks / tests, MRT tests and coordination / liaison activities with state / central departments / GETCO/ DISCOM/ CEIG/GUVNL/GEDA etc for necessary approvals / clearances for commissioning, synchronization with grid and post-commissioning operation of plant. (Clearances shall include obtaining prior approvals for all applicable drawings / documents etc from concerned state / central departments / Transco/ DISCOM/ CEIG/ GUVNL/GEDA etc.). GETCO licensed contractor shall obtain necessary approvals for the 66KV SLD, its protection system, PLCC/VHF system and 66kV Switchyard from CEIG/E&P Department/GoG Gandhinagar before actual commissioning of the switchyard. **Note: CEIG application liasoning and obtaining clearance for entire plant is in vendor scope. All necessary documents related to 33KV and LT/DC works will be provided by BHEL.**

A	Basic checks	
	A1	Tightness checks:
		1) Terminations of HT(33kV)/LT/Control cables at 33/66kV transformer, C&R panels, ABT metering panels, marshalling boxes, bay marshalling kiosks, motor/ control boxes etc 2) ACSR conductor terminations 3) Fasteners of all the switchyard structures: bolts/nuts/washers 4) Fasteners of transmission towers: bolts/nuts/washers 5) Fasteners at earthing chambers: bolts/nuts/washers

	A2	Electrical continuity checks
	A3	Cable megger checks: All LT cables
	A4	AC/DC power supply checks at all electrical equipments/ panels/ DBs
B	Pre-commissioning electrical tests:	
	B1	33/66kV transformer
		1) Oil filtration: Equipment of adequate evacuation/ heating/ oil circulation capacity shall be deployed at site for this purpose. Filtration shall be carried out adequately in order to achieve the BDV, ppm, tan delta values within the limits as per relevant standards and as measured by NABL accredited laboratory. The machine shall have built-on BDV measuring set up for in-situ checking of BDV during filtration process. 2) IR tests on windings LV-HV, HV-E, LV-E 3) IR test on oil 4) Vector group 5) Voltage ratio 6) Tap changer operation check 7) Magnetizing current 8) Magnetic balance 9) Winding resistance at all taps 10) Capacitance, tan delta of HV/LV bushings 11) Neutral connection to earth effectively. 12) Fault simulation checks from C&R panel: Buchholz, OTI, WTI, PRV, LOLA, REF etc.
	B2	Outdoor CT
		1) IR tests (all cores): Pri-Sec, Sec-Sec, Pri-E, Sec-E 2) Ratio tests / primary injection
	B3	Outdoor PT
		1) IR tests (all cores): Pri-Sec, Sec-Sec, Pri-E, Sec-E 2) Voltage ratio test 3) Polarity test
	B4	SF6 breaker
		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 C&R panel/ SCADA: open/close, command/status, lamp indications
	B5	GOS isolator / Earth switch
		IR tests Contact resistance measurement (CRM) Functional checks: open/close manual, open/close motorized operation
	B6	Surge arrestor (LA)
		1) IR tests
	B7	Bus post insulator
		IR tests
	B8	Neutral CT for 33kV and 66KV sides of transformer
		IR tests

	B9	Numerical & Electro-mechanical relays at C&R panel
		1) Relay calibration using applicable secondary injection kit/ software 2) Overcurrent/ earth fault pickup/ tripping time tests
	B10	Earth resistance measurements for all chambers
		1) With electrode connected to grid 2) Without connecting electrode to grid
	B11	Transmission line U/G Cable
		Physical checking of laying & termination Checking continuity of connections I.R. Test All other tests as required by GETCO during supervision
C	Testing agency	
		Credentials of testing agency to 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 prepare and submit the drawings/ schemes/ layouts/ calculations (earth mat etc.) to the concerned state/central agency GETCO/ DISCOM/ CEIG/ CEA etc. for their approval after clearance from BHEL. 2) Submission of site test reports to customer (GIPCL/GETCO/CEIG etc.) after obtaining approval from BHEL. 3) Preparation of application (along with supporting documents: drawings, factory test reports, site test reports etc.) to concerned agency (CEIG, GEDA, SLDC, GETCO etc.) for site inspection, obtaining signatures from customer (GIPCL/GETCO) and submission to the inspection agency. 4) Coordination with customer (GIPCL) and liaison with inspection agency (CEIG/GETCO/GEDA etc.) for inviting the inspectors for site inspection prior to plant commissioning. 5) Vendor shall organize inspection at site by above agency with all suitable technical and commercial arrangements. All necessary testing kits/ instruments shall be arranged as per the requirements of inspection agency. Basic instruments such as digital multimeter, 5kV digital megger, earth resistance meter etc. shall be organized at site at the time of inspection. Competent electrical technical shall also be made available at the site. 6) Subsequent to site inspection, vendor shall follow-up with the inspection agency, coordinate with the customer to obtain early clearance for plant commissioning. 7) Vendor shall implement all the observations of CEIG so as to secure their final approval that is mandatory to continue with regular operation of the plant. **Notes:** 1. Vendor shall take frontline lead in obtaining the clearance of inspection agency. 2. Vendor shall suitably interact with the contractors of BHEL executing the other portions of solar plant (from solar array up to 33kV sides of 33/66kV transformer) and mobilize all necessary inputs/ documents required from them in the process of getting approval of the inspecting agency for commissioning. 3. Scope of coordinating with concerned state/central electricity

			departments, Transco/ DISCOM/ CEIG/ CEA/GEDA etc. to get their clearances / approvals for licensed/ statutory operation of the power plant on a continuous basis includes all transactions required for successful liaison and clearances. Application fees and renewal fees (say, in the form of DD/ web-based online payment) to be enclosed with application/ renewal documents shall be in the scope of BHEL/GIPCL. All other expenses in the above process shall be in the scope of vendor.
	E	Commissioning of power plant	
			1) Vendor shall organize all necessary tools/ measuring instruments required to operate the various electrical equipment's on 66kV side of power plant at the time of commissioning. 2) It is the responsibility of the vendor to interact technically with the substation for successful charging of 66kV grid lines followed by charging of 33/66kV transformers at SPV plant end. 3) Vendor shall suitably interact with the contractors of BHEL executing the other portions of solar plant (from solar array up to 33kV side of 33/66kV transformer) to enable successful grid synchronization of inverters. 4) Vendor shall participate actively in the commissioning until it is established that there is successful flow of power through the 66kV portion of power plant following the synchronization of inverters with grid. 5) Vendor shall deploy competent technicians at site to effectively interact with the substation on every technical aspect so as to ensure resolution of any technical problems related to grid encountered during commissioning.

4.5 General conditions applicable during supply, installation and commissioning phase

1	Vendor shall arrange for safe storage of all the vendor supplied materials. For this purpose, vendor shall construct appropriate storage shed with gates, locks and keys. Security watch and ward shall be deployed round the clock. Insurance of the vendor-supplied items shall be in vendor scope until the end of trial run following the commissioning of the power plant.
2	Vendor shall organize power supply on their own. Accordingly, DG sets of suitable capacity shall be deployed by the vendor for construction works.
3	Similarly, water required for construction works shall be organized by vendor.
4	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.
5	All necessary tools and tackles such as crimping tool, 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 for RCC works, spade, shovel, hammer etc shall be organized by the vendor.
6	All necessary measuring instruments such as digital multimeters, electrical testers, digital meggers (1kV, 2.5kV, 5kV) with feature to display PI, earth resistance meters, weighing machines, water level indicators etc shall be organized by the vendor.
7	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.
8	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.
9	Vendor shall maintain updated labour register, with name, age, qualification, salary, attendance details etc at the site.
10	Vendor shall use danger boards, appropriate warning/sign boards, wherever required, to ensure safety of the persons during the work at site.
11	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.
12	Vendor shall, at the completion of every work, clear off the debris, which resulted out of the work. In case of excavation work such as cable trench etc, vendor shall finish the land neatly with necessary leveling, rolling etc.
13	Vendor shall carry out the work without causing inconvenience to other contractors of BHEL at site. In case of conflicts with other contractors, it is the responsibility of the vendor to ensure that the matter is resolved at once amicably so that the progress of work is not affected.
14	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.
15	No child labour shall be employed for execution of the present contract.
16	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.
17	BHEL/GIPCL shall witness routine/ acceptance/ type tests performed at manufacturer works for the items supplied by vendor. Vendor shall accordingly provide inspection call to BHEL with submission of internal test results 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/GACL for procurement of the item from dealers.
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 civil construction materials in accordance with FQP (Field quality control plan) that shall be submitted to BHEL for approval by BHEL/GIPCL. Similarly, FQP for electrical works in respect of switchyards / transmission tower line shall also be submitted to BHEL. Vendor shall deploy a well experienced quality control engineer to monitor all QC activities at site as per approved FQP. Specifically with reference to civil works, vendor shall submit all concrete mix designs and bituminous mix designs for BHEL/GIPCL approval before starting of work. All the third party testing's should be conducted in laboratories approved by BHEL/GIPCL for which relevant details shall be submitted to BHEL prior to taking up work with the laboratory.
19	Any deviations shall be discussed with BHEL/GIPCL site engineers and implementation shall be taken up only after approval from BHEL/GIPCL.
20	Vendor shall submit periodic status report, on daily as well as weekly consolidated basis, to BHEL on the progress of the contract.

5.0 SWITCHYARD ELECTRICAL

5.1 SCOPE AND GENERAL INFORMATION

1. The intent of this specification for various electrical equipment's shall cover the following scope:

2. Contractor shall be responsible for design and engineering of overall system/station, and all elements, systems, sub-systems, facilities, equipment's, material, etc. The Contractor shall submit design calculations, drawings, codes, codes of practices, construction drawings, etc. for BHEL approval.

3. The basic design shall include, but not limited to, the following:

4. Development of general arrangement.
5. Development of detailed layout (plan & section/elevation) drawings.
6. Development of single line diagram with parameters of equipment and details of protection.
7. Protection and control philosophy and selection of protection, control and annunciation schemes.
8. Development of interlocking schemes.
9. Development of switchyard structure loading details.
10. Development of earthing system.
11. Insulation coordination of the EHV equipment.
12. Calculation of static and dynamic force load, and selection of spacer spans and equipment terminal loading.
13. Development of clearance diagrams.
14. Lighting design, Lux level calculation and conduit wiring diagram.
15. Development of power & control cable laying and termination schedules.
16. Relay setting calculations.
17. Development of erection key diagram with bill of material.
18. Foundation design and construction drawings.
19. Development of cable trench layout and sections and construction drawings.
20. Contractor shall furnish detailed drawings for the various equipment's covered in their scope for BHEL approval. The equipment shall conform to type tests as per specification and applicable standards, and reports of the same shall be furnished for approval.
21. Contractor shall furnish the schematics, general arrangement drawings, cable schedules, interconnection schedules, panel wiring diagrams, etc. for various control and relay panels for BHEL approval. Contractor shall also furnish the recommended relay settings to be adopted.
22. The Contractor shall note that the list of standards specified elsewhere in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specification, IS & IEC. In case governing standards for the equipment is different from IS or IEC, the salient points shall be clearly brought out along with English language version of the same.

23. Exposed live parts shall be placed high enough above ground to meet the requirements of Indian Electricity Rules and other statutory codes. All responsibilities regarding co-ordination with Electrical Inspection Agencies and obtaining clearance certificate from them rests with the Contractor. The necessary fees for such clearances shall be borne by BHEL.

24. All equipment shall be supplied with suitable terminal connectors. The terminal connector shall be well coordinated with the rating/type/size of equipment to be connected. The conductor terminations for equipment shall be either rigid or expansion type suitable for 3“ IPS tube or horizontal or vertical take-off suitable for single ASCR conductor. The type of terminal clamps would be finalized by the Contractor in consultation with BHEL based on layout requirement. The terminal pads shall preferably be capable of taking the required conductor span under normal, short circuit and meteorological conditions, without effecting the performance of the equipment.

25. The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 meters.

26. All the cables used for the switchyard shall be armored type.

27. All equipment shall be suitable for hot line washing.

28. The Contractor shall cooperate in all respects and exchange the necessary technical data/ drawings with other agencies and BHEL’s other Contractors under intimation to BHEL to ensure proper coordination and completion of work in time.

29. The sag tension, conductor spacing, short circuit forces, spacers location, conductor swing and clearances shall be carried out in accordance with IEC 60865 to achieve the specified clearances.

30. Post insulators shall be provided at line entry so as to avoid mechanical forces on the LA's etc.

31. The towers and gantries shall be suitable for a normal conductor tension of minimum 2T/conductor. The foundations and structures etc shall be designed accordingly. The minimum height of 66kV gantry and equipment shall be as required to match with existing levels / as per GETCO requirements

32. The illumination level shall be 20 lux in general and 50 lux on equipment boxes. No lighting fixture shall be mounted on gantries, they shall be mounted on lighting masts only. Existing Lighting mast can also be used for the purpose.

33. The connectors and clamps shall be rated same as the connected equipments.

5.3 CLEARANCES

The minimum clearances for 66kV switchyard shall be as per relevant IS standards
The Contractor shall supply the structures suitable to meet the above clearances.

5.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING SUPPLIED

All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under normal operating voltage conditions.

5.5 SITE SUPERVISION OF EQUIPMENTS

The contractor shall ensure that, erection, testing and commissioning of Circuit Breaker, Isolator, Instrument Transformer, Surge Arrestor, Substation Automation System &

Protective relays is carried out under the supervision of manufacturer of respective equipment.

5.6 SYSTEM PARAMETERS FOR 66 KV SWITCHYARD

The following are the main features, parameters of the 66kV switchyard:

i)	Nominal system voltage	:	66 kV
ii)	Highest system voltage	:	72.5 kV
iii)	System neutral earthing	:	Effectively earthed.

The following parameters shall be considered for spacing of the equipment, conductors, etc., for the design purposes. The values of clearances to be furnished by VENDOR, complying with the necessary Electrical / safety considerations..

	Clearances in air:	Vendor to furnish
i)	Between phases	:
ii)	Phase to earth	:
iii)	Section clearance to the live parts	
iv)	Ground clearance to the live parts	:

Voltage withstand levels:

i)	One minute power frequency	:
ii)	1.2/50 micro second impulse	:
iii)	Creepage distance for equipment	:
iv)	No. of phases	:
v)	Frequency	:
vi)	Short circuit current	:
vii)	Co-efficient of seismic	
	a) Acceleration in horizontal	:
	b) Acceleration in vertical	:

5.7 TYPE TEST REQUIREMENTS FOR EQUIPMENTS AND TRANSMISSION LINES

(i) All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for BHEL approval the reports of all the type tests as listed in this specification and carried out within last 5 years from the date of bid 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.

(ii) However if contractor is not able to submit report of the type test(s) conducted within last 5 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 and within the scheduled contract time) to BHEL either at third NABL party lab or in presence of client/ BHEL representative and submit the reports for approval.

(iii) 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 equipment price.

5.8 RATING AND TECHNICAL SPECIFICATIONS OF 66KV SWITCHYARD EQUIPMENT:

All 66kV Equipment Ratings shall be as per attached Single Line Diagram.

Technical specifications shall be as detailed below:

5.8.1 66 KV CIRCUIT BREAKER:

The Circuit breaker shall be of sulphur hexafluoride SF6 type and comply with the requirements of latest issue of IEC: 62271-100 (latest edition) and any other equivalent International Standards. The circuit breaker shall be suitable for outdoor operation.

GENERAL:

i) The circuit breaker shall be of modular construction with all components manufactured to assure the maximum inter-changeability of standard basic elements. All parts of the breaker unit shall be mechanically designed to withstand all electrical, mechanical and other stresses which may be experienced in the operation of the unit including those under short circuit conditions. Suitable lock nuts and locking plates shall be provided for bolts and nuts inside the mechanism housing to avoid loosening of the bolts & nuts due to vibrations.

ii) The breaker shall comprise of three identical single pole units, ganged together mechanically, complete in all respects with the associated accessories including fittings.

iii) The design and construction of the equipment valves, couplings, connections shall be such that leakage of any SF6 gas shall be limited to a minimum. Similarly, valves, couplings and pipe work shall be so arranged that accidental loss of gas to the atmosphere shall also be limited to a minimum.

iv) The circuit breakers shall be provided with two trip coils for the system.

v) Weather proof and corrosion proof rating plates showing all the details as per clause 13 of IS: 2516 (Part III/Sec2) of latest edition shall be provided on all circuit breakers and its operating devices.

vi) The circuit breakers shall be reasonably quiet in operation.

vii) All fittings and accessories which may not have been specifically mentioned, but which are necessary and essential for the efficient working, shall be deemed to be included in the contract.

viii) <u>DUTY REQUIREMENTS</u>

a) The circuit breakers shall be totally re-strike free under all duty conditions and shall be capable of performing their duties.

b) The circuit breakers shall be so constructed that they would fail safe in the event of loss of SF6 gas pressure below a certain level.

c) The circuit breaker shall meet the duty requirements for any type of fault or fault location.

d) The circuit breaker shall be capable of carrying, continuously under site conditions, the rated rms value of the current without deterioration at its rated frequency with the temperature rise of the various parts not exceeding the values specified in IEC-62271-100 latest edition.

e) The circuit breaker shall be capable of rapid and smooth interruption of current, completely suppressing all undesirable phenomena under all the conditions such as severe and persistent short circuit, interruption of steady and transient magnetising current of

transformers, small inductive currents, fault current under phase opposition condition etc.

f) The circuit breaker shall be suitable for three phase and single phase auto re-closing duty of O-0.3 Sec –CO-3 min-CO where dead time is 300 m sec.

g) The circuit breaker shall be of single break and the breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energisation of lines with trapped charges. The breaker contacts (Main & arcing) shall be of high erosion resistant and the erosion of contacts shall be limited to a minimum.

CONSTRUCTIONAL FEATURES

i) The features and constructional details of circuit breakers shall be in accordance with requirements stated here under.

ii) **CONTACTS**

a) All making and breaking contacts shall be sealed and free from atmospheric effects. The contacts shall be permanently under the pressure of SF6 gas. The gap between open contacts shall be such that it can withstand the rated dielectric stresses at zero gauge pressure of SF6 gas due to its leakage.

b) Main contacts shall be the first to open and the last to close so that there will be little contact burning and wear.

c) Arcing contacts shall be the first to close and the last to open and shall be easily accessible for inspection and replacement. If there are no separately mounted arcing contacts, the main contacts shall be accessible for inspection and replacement.

d) Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding.

e) Tips of arcing and main contacts shall be silver plated or have a tungsten alloy tipping.

iii) INSULATING SUPPORTS AND HOUSING

Porcelain used in the manufacture of insulating supports / housing shall be homogenous, free from cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Glazing of the porcelain shall be of uniform brown colour, free from blisters, burns and similar other defects. Porcelain supports / housings shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which these will be used. All insulator housings of identical ratings shall be interchangeable. The puncture strength shall be greater than the dry flashover value. When operating at normal rated voltage, there shall be no electric discharge between the conductor and the porcelain parts which may cause corrosion or injury to conductors / insulators or supports by the formation of substances produced by chemical action. The insulating supports / housings shall be free from radio disturbances when operating at rated voltage and shall also be free from external/internal corona. The insulating supports / housing shall satisfactorily withstand the insulation level specified for circuit breakers.

iv) SULPHUR HEXAFLOURIDE GAS (SF6 GAS)

a) SF6 gas shall comply with IEC: 60376 and be suitable in all respects for use in the switch

gear under the operating conditions. The necessary test certificates shall be furnished during inspection of breakers.

b) The high pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with requirements of the following standards and regulations:

IS: 4379 - Identification of the contents of Industrial Gas Cylinders.
IS: 7311 - Seamless high carbon steel cylinders for permanent and high pressure liquifiable gases.

c) Absorbent shall be provided in the interrupter unit of each phase (where SF6 gas is used) to absorb any traces of moisture. These shall be permanent facilities.

d) The precise procedure to be adopted by maintenance personnel for handling equipment, who are exposed to the products of arcing in SF6 gas, so as to ensure that they are not affected by possible irritants of the skin and respiratory system.

v) SUPPORT STRUCTURE

The contractor shall supply the SF6 breaker along with support structures of self-supporting type and foundation bolts required. Support structure and foundation bolts shall be supplied along with each breaker.

OPERATING MECHANISM

i) GENERAL

a) Circuit breaker shall be spring operated for both opening and closing operations. The mechanism shall be strong, positive, quick in action and shall be removable without disturbing the other parts of the circuit breaker. The mechanism shall operate simultaneously without requiring any critical adjustment.

b) The operating mechanism shall be suitable for high speed re-closing of the breaker over a wide range of parameters. It shall be anti-pumping and trip free. In case of failure of a pole to close properly, all the three poles should trip.

c) A mechanical indicator along with operation counter shall be provided in addition to facilities for remote electrical indication to show open and close position of breaker. It shall be located in a position where it will be visible to a man standing on the ground with the mechanism housing closed and easily accessible from the ground for the O&M personnel to operate and maintain locally.

d) The control circuit shall be designed to operate on 110 V DC +/- 10%. Closing coil and trip coil shall operate correctly at all values of voltage between 85% to 110% and 70% to 110% of the rated voltage respectively. Arrangements shall be made for providing two sources of control supply to the 2 trip coils.

e) Working parts of the mechanism shall be of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fittings. Bearing pins, bolts, nuts and other parts shall be adequately locked by split pins, lock nuts, plates wherever required to prevent loosening or changing adjustment with repeated operation of the breaker.

f) Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. Provisions shall be made for local electrical control. `Local/remote' selector switch and close and trip push buttons shall be provided in the breaker control cabinet on a hinged panel with position locked with bolt and nuts to provide access to the rear of panel for maintenance purpose. The relay trip should act independent of the position of local/remote selector switch. In the event of failure of

auxiliary supply, manual emergency trip lever shall also be provided to trip the circuit breaker.

g) The circuit breaker shall be gang operated and mechanically linked for tripping and closing. The Group operating mechanism housing along with all pressure switches, gauges, indication and other equipments and all the necessary controls are housed in a marshalling box, which is common for all three phases. The operating mechanism housing / marshalling box shall be of outdoor type and weather proof. The box shall be fabricated out of not less than 12 SWG thick mild steel cold rolled sheet of tested quality complying with the latest edition / amendment of IS 513/1973. The operating mechanism housing / marshalling box shall have hinged door, which could be easily closed without applying excessive pressure on the doors. The door hinges shall operate at ease and strong enough to withstand the self-weight of the door and to keep the door properly aligned. The complete box shall be fabricated in such a way that when closed it shall be perfectly water tight, dust proof and vermin proof and conform to IP55 as per IS:2147. All Marshalling box shall be provided with necessary fixtures for fixing the cable entry and exit pipes with check nuts on all the sides of the marshalling box. Thermostatically controlled space heaters, a light point with a door switch shall be provided and MCBs shall be used for protection of supply to space heaters. The mounting height of the box shall be easily assessable for a person standing on the ground for operation and maintenance.

h) Provisions shall be made on breakers for attaching an operation analyser to perform speed tests after installation at site to record contact travel against time and measure opening time.

i) The circuit breaker shall be provided with pole position discrepancy detector with an associated timer of 0.1 Sec. to 2 minutes adjustable time delay.

j) The contractor shall furnish along with Test Certificates, curves supported by test data indicating opening time under close-open operation with combined variation of trip coil voltage and operating pressure.

ii) SPRING OPERATING MECHANISM FOR BOTH CLOSING AND TRIPPING

a) Closing and tripping operations shall be by spring charging. When the closing signal energises the Closing coil, the trigger shall release and the charged closing spring shall close the Breaker and also recharge the opening spring. When opening signal is given, the energy accumulated in the opening spring shall be released and cause the main contacts of the breaker to separate.

b) The spring operating mechanism shall have adequate energy stored in the operating springs to close/open and latch the Circuit Breaker against the rated making current and also to provide required energy for both closing and tripping mechanism.

c) The spring charging motor shall not take more than 10 seconds for fully charging the closing springs and provision shall be made for automatic charging of the closing springs as soon as they are discharged in a closing operation. For this, the mechanism shall be such that the charging of the springs by the motor does not interfere with the operation of the Breaker.

d) The motor shall be adequately rated to carry out a minimum of 5 close and open operations continuously. Also provision shall be made to protect the motor against over loads. The motor shall be rated for 110VDC.

e) Mechanical inter locks shall be provided in the operating mechanism to prevent discharging of the closing springs when the Breaker is already in the closed position. Provision shall also be made to prevent a closing operation to be carried out with the spring partially charged.

f) Facility shall be provided for manual charging of the closing springs and it shall be possible to operate the same standing on the ground.

g) The pole units shall be filled with SF6 gas at atmospheric pressure of 0.5-1 kg/sq. cm before despatch and sufficient SF6 gas shall be supplied with the breaker to fill all the circuit breakers installed to the required pressure plus an additional 20% of the quantity to compensate for losses. Vendor shall arrange for the necessary tools and tackles such as adaptor for lock out test, tools for refilling of SF6 gas at site etc.

h) Breaker OPEN/CLOSE shall be operated either from Local and Remote through C&R panel and SCADA. Suitable no. of contacts of main breaker shall be provided and termination done accordingly.

RATING PLATE

Weather proof and corrosion proof rating plates showing year of manufacture and other values as per IS: 2516 shall be provided on all circuit breakers and its operating devices.

TERMINAL CONNECTORS AND EARTHING TERMINALS

The terminal connectors shall be either bi-metallic or aluminium as the case may be and shall be suitable for ACSR conductor for both vertical and horizontal take off. Suitable terminals for earthing connectors for earthing connections shall also be provided for the structures, operating cubicles and marshalling boxes. The grounding conductors shall be 50 x 6 mm steel flat.

TERMINAL BLOCKS

Terminal blocks shall be 1100 V grade and of current capacity 10 Amps with insulated barriers and stud type terminals, spring washers, nut and lock nuts and identification strips. All wiring terminations shall be with suitable tinned copper crimped lugs. All wiring shall be carried out with flameproof insulated wires made up of tinned or annealed copper conductor.

AUXILIARY SWITCHES

Positively driven (in both directions) auxiliary switches (contacts) each of the normally open and normally closed types and a continuous current carrying capacity of at least 10 Amps shall be provided on each circuit breaker for use in the remote indication for control of the circuit breaker and for providing safety interlocking.

They shall be capable of breaking at least 2 Amps at 110V DC with circuit time constant of not less than 20 milli seconds. If installed on the frame of breakers, it shall be suitably protected against accidental arcing from the main circuit. The insulating materials of the switches and terminals shall be of ceramic or other non-tracking and non-hygroscopic materials.

Special contacts for use with trip coils and single shot re-closing operation which permit relative adjustment with respect to the travel of the circuit breaker shall also be provided wherever required. Required number of auxiliary switches shall be provided.

INTERLOCKS

Necessary interlocks to prevent the closing of the breaker (manual and remote) under low gas/air pressure and devices for initiating alarm for low gas pressure shall be provided.

Provision shall also be made to enable electrical interlocking with the opening or closing of the isolator when the breaker is closed with the spare auxiliary contacts wired up to the terminal block.

FITTINGS AND ACCESSORIES

The vendor shall furnish the following fittings and accessories as an integral part of the equipment:

a. Operating Mechanism Housing
b. Pad locks and duplicate keys
c. Local/remote change over switch
d. Operation counter
e. Terminal board with minimum 10% spare terminals
f. MCB/MCCB to cut off control power supply, wherever required.
g. Two earthing terminals
h. Auxiliary relays required for satisfactory operation
i. Breaker local control switch for opening and closing of breaker Terminal connectors
j. 3 pin 15A socket outlet
k. Earthing pads
l. Foundation bolts
m. Galvanised steel structures/Steel frames for mounting of the breakers.
n. Necessary cables from respective Control cubicles to marshalling box/Central control cubicle of the Breaker.
o. Apart from the above, one set of SF6 Gas regulator along with hose for Gas filling/evacuating shall be supplied.

TESTS

i) The circuit breaker shall comply with the type test and the routine tests prescribed in IEC-62271-100. The routine acceptance tests shall be carried out on each breaker before despatch.

ii) Report of all type tests as stipulated in IEC and the line charging current and transformer charging current, interrupting tests shall be furnished if already carried out within the last 5years as on date of bidding. Otherwise, the type tests shall be carried out at no additional cost to BHEL.

iii) No equipment shall be despatched without prior approval of the test certificate and despatch instructions are conveyed by the purchaser.

iv) Routine acceptance tests shall be carried out on each breaker in the presence of BHEL representative if so desired. Test certificates in six sets shall be furnished to BHEL for approval. Also BHEL/KPCL representative shall have access to the manufacturer's works for the purpose of inspecting the manufacture of the equipment.

SITE TESTS ON CONTROL AND AUXILIARY CIRCUITS

The following site tests shall be carried out at the time of commissioning of the breakers:

i) Voltage tests on control and auxiliary circuits
ii) Measurement of resistance in the main circuit.
iii) Mechanical operating tests.
iv) Speed curves shall be obtained with the help of a suitable operation analyser to determine breaker contact movement during opening, closing, auto-re closing and trip free operation under normal as well as limiting operating conditions (control voltage, gas pressures etc). The tests shall show the speed of contacts at various stages of operation,

travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at break-make operation etc.

v) Tests to measure the difference in the instance of closing/opening of contacts between poles.

TEST ON SF6 GAS

The test certificates as obtained from the SF6 gas supplier shall be furnished during inspection of the circuit breakers.

PAINTING

The operating housing mechanism, Control cubicle shall be painted both inside and outside as per standard "seven tank" method with one coat of French grey paint in the inside and light grey paint to shade 635 of IS:5 on the outside surfaces as per relevant standards.

GUARANTEED TECHNICAL PARTICULARS

The SF6 gas circuit breaker supplied shall comply with the guaranteed technical particulars as indicated below.

1	Number of poles	3
2	Class	Out Door Type
3	Nominal System Voltage	66 kV
4	Rated Voltage	72.5 kV
5	Rated Insulation Level	350 kV (peak)
6	Rated Frequency	50 Hz
7	Rated normal current	1250Amps.
9	Rated Cable Charging breaking current	Vendor to furnish the details.
10	Rated S.C. breaking current	31.5 kA
11	First pole to clear factor	Vendor to furnish the details.
12	S.C. making current	Vendor to furnish the details.
13	Rated Operating Sequence	O-0.3sec-CO-3min.-CO
14	Duration of short circuit	3 sec.
15	Rated out of phase breaking current	Vendor to furnish the details.
16	Automatic rapid re closing	3 Ph.
17	Total break time for any current up to the rated breaking current with limiting conditions of operating coil voltage, operating &quenching media pressures.	< 60 ms
18	No. of auxiliary contacts for purchasers use	10 NO & 10 NC on each pole
19	System neutral earthing	Effectively earthed
20	Closing time (max.)	<150 ms
	Opening time (max.)	<50 ms
21	Trip & Closing coil Voltage	110 V+/-10% DC

22	Arcing time	<=25 micro sec.
23	Creepage distance (min.)	Vendor to furnish the details.
24	1.2/50 micro sec. lightning impulse withstand voltage.	
	i) to earth	Vendor to furnish the details.
	ii)across the open circuit voltage applied to one terminal	Vendor to furnish the details.
25	Power frequency withstand voltage	
	i) to earth	Vendor to furnish the details.
	ii) across terminals of open circuit breaker	Vendor to furnish the details.
26	Type of operation	Spring
27	Rated values of transient recovery voltage for terminal faults	As per IEC:62271-100
28	Rated values of transient recovery voltage for short line faults	As per IEC:62271 - 100
29	Rated characteristics for out of phase breaking current	As per IEC:62271 - 100
30	Small inductive current interrupting capacity	Vendor to furnish the details.
31	Rated terminal load	Vendor to furnish the details.
32	Difference in the instants of closing/opening of contacts at rated voltage and rated operating and quenching media pressure.	
	i) within a pole	Vendor to furnish the details.
	ii) between poles	Vendor to furnish the details.
33	Insulation level of bushings	
	i) 1 min. p.f. withstand voltage	Vendor to furnish the details.
	ii) 1.2 / 50 microsecond lightning impulse with standing voltage	Vendor to furnish the details.
34	Partial discharge level	As per IEC:62271 - 100
35	Controls of switching surges	Vendor to furnish the details.
36	Noise level of equipment	Vendor to furnish the details.
37	Auxiliary power supply	415V+/-10%,3ph,50Hz+/-5%,AC
		240V+/-10%,1ph,50Hz+/-5%,AC
		110V +/-10% DC

NOTE: The above details are tentative. Vendor shall submit complete details to BHEL for approval during detailed engineering.

5.8.2 66 KV ISOLATORS WITH EARTH SWITCH:

TYPE AND RATING

Isolating switches are used to isolate the equipment. The Isolators shall be suitable for outdoor operation.

STANDARDS

The isolator switches shall comply in all respects with IS:9921 or IEC publication No.129 latest edition.

CONSTRUCTIONAL FEATURES OF HORIZONTAL DOUBLE BREAK TYPE

i) The Horizontal double break type, three phase isolators shall be centre pole rotating, gang operated through **motor operated mechanism**. The design of the isolators shall be such that the switch can be changed to right or left hand operations. The live parts shall be designed to eliminate sharp points, and other surfaces likely to produce corona and adequate shield shall be provided. Live parts shall be manufactured from non rusting, non corroding metal. Current carrying parts shall be of hard drawn electrolytic grade copper. Bolts, screws and pins shall be provided with lockwashers, keys or other equipment locking facilities and if used on current carrying parts, shall be made of copper silicon alloy or equivalent material. The isolator shall not require lubrication of any part at freequent intervals.

ii) The isolators shall be suitable for being mounted in upright positions (with blades moving in the horizontal plane) on the steel support structures and also suitable for mounting on the high type structures in the outdoor yard.

iii) The double break isolator shall consist of three identical pole units. Isolators are required to be double break, three posts per phase, triple pole, single throw, rotating center post through double tandem pipe, silver plated contacts, with horizontally operating blade and insulator posts arranged vertically.

iv) The isolators shall have rotating blades feature and pressure relieving contacts with turn and twist mechanism. The isolators shall be **motor operated with emergency manual operating mechanism.** The manual operating mechanisms shall be of robust construction, conveniently located for operation and easily operatable by a single person. The length of the operating rod shall be such that the height of the manual operating handle above the ground is 1500 mm. The isolator shall be so constructed that the switch blades will not fall to the closed position, if the operating shaft gets disconnected.

v) The moving blades of double break isolator shall be HDEC (hard drawn electrolytic copper) tube of suitable thickness or one solid copper piece with contact surface silver plated to carry continous / short time current. Construction shall be so designed that no part of the blade can move relative to the other parts. The thickness and section of the blade shall be such that it retains its form and straightness under all conditions of operation including the flow of system fault current for the specified period. It shall also be capable of withstanding all torsional and bending stress due to operation of the isolators. Wherever necessary, the blades shall be counter balanced by weights or springs. Fixed guides shall be provided so that proper seating of contacts will be achieved while closing even when a blade is out of alignment by 3 cm or less. Further, the main blade shall pass through the main actuator assembly without any joints so that there is no necessity of shunting by flexible copper conductors.

vi) The design and construction shall be such as to provide positive control of blades in all positions with minimum mechanical stress on insulators. Fixed guides shall be provided so that proper seating of contacts shall be obtained.

CLEARANCES

Clearances between live parts and grounded structures shall not be less than those specified in the latest edition of IS(Standard followed to be indicated in the offer). Length of break in full open position shall be such that there is absolutely no possibility of arc over from the live parts to the de-energised parts on which any maintainance works may have to be done. The speed of opening or closing the switch shall be designed to ensure that the arcing during the operation is reduced to the minimum. The necessary arcing contacts shall be provided on the moving blades.

ISOLATOR INSULATION

i) Insulation to ground, insulation between open contacts and the insulation between phases of the completely assembled isolator shall be capable of withstanding the di-electric test voltages specified in the data sheets enclosed. Insulation between open contacts of a pole shall be atleast be 15% more than the insulation between live parts of a pole to ground so that if any flash over occurs when isolator is open, it shall be to the ground.

ii) The post type insulators, which should be solid core of multiple stack, shall conform to IS:2544 or other internationally recognised standards. The insulators selected shall be for use in heavilly polluted atmosphere and shall be specifically suited to meet the particular requirements of ultimate torsional strength and cantilever loads, which they will be called upon.

iii) The porcelain shall be homogenous and free from all cavities and flaws. Design of the insulators shall ensure ample insulation, mechanical strength and rigidity for satisfactory operation under site conditions. The design, shall also ensure that the losses caused by capacitive currents or conduction through dielectric are minimum and that the leakage due to moist and dirty insulators surface is least.

iv) All metal caps and supports shall be connected to the porcelain where as the blades and contact blocks shall be bolted to the metal parts of insulator thus making the replacement of damaged insultor easy.

OPERATING MECHANISM

i. The design of operating mechanism shall be such that minimum of energy is required for operation and one man shall be able to operate the switch without undue effort. The operating mechanism and its controls shall be so designed that under no circumstances the switch blade travel is interrupted before it reaches the fully close or open position

ii. **Each isolator shall be remote controlled from the control room**. **Provision shall also be made for local electrical control**. The operating mechanism shall also be equipped with local manual operating device intended for emergency operation in case motor operating mechanism fails. It shall be possible to padlock the manual operating handle both in open and closing positions of the isolators. Additional electro-magnetic type interlock shall be provided on the manual operating handle and control cubicle for motor so as to prevent the operation of the isolator manually and locally when the corresponding circuit breaker is 'ON'. Isolator inclusive of their operating mechanism should be such that they cannot come out of their open and close positions by gravity, wind pressure, vibration and shocks etc.

iii. The motor operating mechanism shall actuate 3 pole group operated double break isolators.

The operating mechanism shall be capable of providing a quick, simple and effective operation. The motor mechanism shall be connected to the torsional control of isolator through a suitable coupling assembly. Suitable means to limit over travel shall be provided. Motor shall conform to IS: 325 and shall develop a starting torque equal to atleast 2.5 times the torque required to operate the isolator. The local/remote selector switch and set of open/ close push button shall be provided on the control cabinet of the isolator to permit local and remote operation.

iv. Two Nos. of earthing terminals shall be provided on the motor operating mechanism, to enable proper grounding. Flexible conductors of adequate cross section shall be provided at the lower end of the vertical operating shaft for connection to the station ground.

v. Push button for local control shall be provided on the mechanism housing and the control switch for remote control from the main control board shall be provided by the control panel manufacturer. A local/remote change over switch shall also be provided in the mechanism cubicle.

vi. The operating motors for electrically operated isolators shall be of the totally enclosed, outdoor type, suitable for **230V +/-10%, AC 1 phase or** 415+/- 10% Volts, AC 3 phase, 50 Hz supply. The motor shall be adequatly rated sufficient to operate the isolator smoothly.

vii. The gear shall be made of aluminium and bronze alloy or EN8 material and lubricated for life with graphite or non drying and non hardening grease.

viii. In the operating mechanism, mechanical stoppers shall be provided during both opening and closing operations of the driving motor shaft, in order to prevent over travel of the switch blade. This has to be demonstrated at the time of inspection/testing.

ix. A lamp with a door switch and single phase preventer shall be provided on the motor operated mechanism. The space heater with thermostat control supply, On & Off switches as shall be provided.

x. One set of extra NO/NC contacts for local/remote status shall be provided.

xi. One set of contacts for thermal overload relay and single phase preventer shall be provided. A power socket of Industrial type shall be provided.

xii. Gland plates shall be provided at the bottom of the motor operated mechanism box for cable connections. The required cable glands shall be supplied.

xiii. The limit switches to be provided in the isolator covered under this order shall be of reputed make which are sturdy and moisture proof and reliable. The contacts of the limit switch shall be silver plated, sturdy and free from rusting.

xiv. Operating mechanism housing box shall be outdoor type and weather proof to IP55 and fabricated out of not less than 12 SWG MS sheet tested quality with hinged doors. The housing shall be painted with inside and out side with two coats of enamel paint shade after treatment with 7 tank process. (Min. 70 microns).

TEMPERATURE RISE

The temperatuer rise for various parts shall be tested according to IS:9921 and IEC publication No.129.

INSULATION LEVEL

The isolators shall have minimum insulation levels as per IS:9921 and IEC publication No. 129.

CONTACTS

i) The isolator shall be provided with high pressure self aligning adjustable silver plated copper contacts. The contacts shall be designed such that the contact pressure is released

before any movement of the blades in the opening direction takes place and is applied after the closing travel is completed. The blades shall have a turn and twiist movement in case of double break isolators so that there shall be sufficient wiping action of the contacts to make them self cleaning.

ii) The earthing switches should be provided with three sets of suitable type of fixed contacts below the fixed contacts assemblies of the main switch on the incoming supply side and three sets of moving contacts having ganged operation. These contacts too should be fabricated out of electrolytic copper and dimensioned to withstand the rated currents.

iii) The temperature rise of the contacts and other current carrying parts shall not exceed value specified in IS:9921 at an ambient air temperature of 40 Deg. C while carrying the rated current continuously. The temperature rise due to the passage of the rated short circuit current for a period of 1 sec shall not cause any annealing or welding of the contacts.

iv) ARCING CONTACTS :
Arcing contacts provided shall close first and open last so that no damge due to arcing shall be caused to the main contacts.

TERMINAL CONNECTORS

Each isolator shall be provided with rigid type aluminium / bimetallic alloy connectors suitable for ACSR Aluminium conductor. The terminal connectors shall be suitable for horizontal or vertical take off. The required quantity of terminal connectors shall be supplied.

ISOLATOR BLADES AND JAWS:

i) The isolator blades shall be HDEC (hard drawn electrolytic copper) tube of suitable thickness or one solid copper piece with contact surface silver plated. Construction shall be so designed that no part of the blade can move relative to the other parts. The thickness and section of the blade shall be such that it retains its form and straightness under all conditions of operation including the flow of system fault current for the specified period. It shall also be capable of withstanding all torsional and bending stress due to operation of the isolators. Wherever necessary, the blades shall be counter balanced by weights or springs. Fixed guides shall be provided so that proper seating of contacts will be achieved while closing even when a blade is out of alignment by 3 cm or less. The isolators to be supplied aginst this contract shall be employed with turn and twist motion and shall have no problem with the contact alignment. Further the main blade shall pass through the main actuator assembly without any joints so that there is no necessity of shunting by flexible copper conductors.

ii) The sharp edges in the fixed contact terminal casting and bolt heads have to be rounded off to minimize the corona discharges. The ends of the blade arm pipes shall be suitably plugged by metal or nylon plugs to prevent entry of water or insects and corona discs shall be provided where ever necessary.

AUXILIARY SWITCHES

Auxiliary switches with a continuos current carrying capacity of 10 Amps and adequate thermal and breaking capacity shall be provided for all isolators and earthing switches for the remote position indication on the control board and for electrical interlocking with other equipments. The auxiliary switches shall be positively driven in both directions by rigid members. Ten pairs each of the normally open,nomally closed contacts each for the main/earthing switches shall be provided. All contacts should be brought out on terminals. Provision shall be made for adding auxiliary switch contacts at a later date for isolators and earth switches. Separate auxiliary switches shall be provided for isolators and earth switches. The auxiliary switches shall be of robust construction and housed in weather proof

and dust tight covers mounted on the respective operating mechanism and accessible even when the isolator is live.

INTERLOCKS

i) For the purpose of making the operation of the isolator depending upon the position of the associated circuit breaker or other equipment as may be required at site, a suitable interlock should be provided on each isolator. The interlocks should be of robust design and contained in a weather proof and dust tight housing. The line isolator should close only when the corresponding circuit breaker and the earthing switch of the corresponding line are open. Electro magnetic type interlocking should also be provided to avoid wrong local operation of the isolator (manual or motor) when the corresponding circuit breaker is in closed position.

ii) Besides the electrical interlocks, the earthing switches should be provided with mechanically operated interlock so as to ensure that: -

a) It should be possible to close the earthing switch only when the isolating switch is in the fully open position.
b) It should be possible to close the isolating switch only when the earthing switch is in the fully open position.
c) The earth switch should not open automatically while attempting to close the isolator.
d) The operation of the earth switches should also be interlocked with the PTs/CTs supplies from the transmission line i.e. it should be possible to close the earth switch only when the line is dead from the feeding end, and there is no supply from the secondaries of the line PTs/CTs.

e) The operation of earth/isolating switch should not take place when the corresponding isolator/earth switch is in operating stroke.

BEARINGS

The design and construction of the various bearings shall embody all the features required to withstand climatic conditions specified so as to ensure dependable and effective operations even after long periods of inaction of these isolators and switches. Facilities should be provided for lubrication of the bearings. All bearings shall be filled with first filling of grease and provided with grease nipples for greasing during servicing.

GALVANISED SUPPORT STRUCTURES

The required quantity of galvanized steel support structures for mounting the isolator on the ground shall be supplied for mounting the isolators in upright positions.The galvanized steel support structures shall in general conform to the latest issue of IS2629.

DESIGN, MATERIALS & WORKMANSHIP

The contractor shall assume full responsibility for co-ordination and adequate design. All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and make. All similar parts should be accurately finished and interchangeable.

All ferrous parts shall be hot dip galvanized. Bolts, nuts, pins and washers etc., used on the isolators shall also be galvanized. Special attention shall be paid to give tropical treatment to all the equipment as they will be subjected during service to extremely severe exposure to atmospheric moisture and to long period of high ambient temperature. All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp points, edges and similar sharp faces.

FASTENERS

Nuts, bolts, studs and washers for use in the plant shall conform to the requirements of the appropriate standards, where the contract includes nuts and bolts of different standards,

the necessary tools shall be provided in compliance with this specification and shall include spanners, taps and dies for these nuts and bolts.

TESTS

Each isolator and earth switch shall strictly comply with the requirements of all the approved type tests and shall be subjected to all routine/acceptance tests stipulated in the relevant standard.

GUARANTEED TECHNICAL PARTICULARS

The isolator supplied shall comply with the guaranteed technical particulars as indicated below.

1	Rated voltage	72.5 kV
2	Nominal System voltage	66 kV
3	Rated frequency	50 Hz
4	System neutral earthing	Effectively earthed
5	Installation	Out door
6	Type of disconnect	Horizontal double break * Type of disconnect is indicative and shall be as per final drg approval by BHEL/GETCO
7	Number of poles	3
8	Rated normal current	To be furnished by vendor as per design requirement.
9	Rated short time with-stand current (KA rms)	31.5 kA for 3 sec.
10	Rated peak withstand current for both main and earth switch (KA) peak	To be furnished by vendor as per design requirement
11	Rated insulation level 1.2/50 micro second lightning impulse withstand voltage (kV) peak	
	a)between live parts and ground	To be furnished by vendor as per design requirement.
	b)across the open terminal of the same phase	To be furnished by vendor as per design requirement.
12	One minute dry/wet power frequency withstand voltage for complete assembled isolator / isolator cum earthing switch.	
	a) against ground (kV) rms	To be furnished by vendor as per design requirement.
	b) across terminals of open isolator (kV) rms	To be furnished by vendor as per design requirement.
13	Minimum clearance in open air (mm)	
	a) Between phases	To be furnished by vendor as per design requirement.

	b) Live parts and ground	To be furnished by vendor as per design requirement.
14	Rated magnetizing current/ capacitive current make/break capacity	To be furnished by vendor as per design requirement.
15	Rated mechanical terminal load	
	a) Straight load (Kg)	To be furnished by vendor as per design requirement.
	b) Across load (Kg)	To be furnished by vendor as per design requirement.
16	Operating mechanism	Motor operated
17	Operating time	10 – 12 sec
18	Particulars of insulators	
	a) Creepage distance (mm)	To be furnished by vendor
	i) Total	To be furnished by vendor
	ii) Protected	At least 50% of total Creepage distance
	b) Dielectric strength(kV)	Wet: and Dry: To be furnished by vendor
	i) Minimum one minute power frequency withstand voltage (kV) rms	To be furnished by vendor
19	No. of auxiliary switch contacts (NO , NC)	10 nos. each

NOTE: The above details are tentative. Vendor shall submit complete details to BHEL for approval during detailed engineering.

5.8.3 INSTRUMENT TRANSFORMERS (CURRENT TRANSFORMERS, POTENTIAL TRANSFORMERS, MARSHALLING BOXES)

5.8.3.1 CURRENT TRANSFORMERS

A) TYPE AND RATING

The 72.5 kV Current transformers shall be Outdoor, Dead tank type, Copper wound, single phase, 50 Hz, oil immersed, self-cooled and suitable for operation under site climatic conditions without any protection from sun and rain.

B) STANDARDS

The Current transformers shall comply with the latest issue of IS 2705 (Part I, II, III and IV) or IEC 185 or the latest revised standards such as IEC61869 Part2 except where specified otherwise. Equipment meeting any other authoritative standard, which ensures an equal or better quality than the standard mentioned above, is also acceptable.

C) GENERAL

i) The Current transformers shall be of single phase, oil immersed and self-cooled, suitable for the services indicated, complete in all respects, conforming to the modern practice of design and manufacture.

ii) The core shall be of high grade, non-ageing, electrical grade silicon laminated

steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over-currents or voltages.

iii) The current transformers shall be sealed to eliminate breathing and prevent air and moisture from entering the tank. These shall be provided with oil level gauge and a pressure relieving device capable of releasing abnormal internal pressure. The temperature rise shall be as specified in the latest IS 2705.

iv) Secondary terminals of current transformers shall be brought out in a weatherproof terminal box. Glands and lugs for terminating cable connections shall be provided.

v) Terminal and polarity marks shall be indelibly marked on each current transformer on the associated terminals and these marks shall be in accordance with relevant standards.

vi) The current transformers shall be provided with the following accessories.
   a) Primary terminal connectors suitable for ACSR conductor.
   b) Two earthing terminals on tanks on opposite sides for connecting earthing conductors.
   c) Oil level gauge.
   d) Filling and draining plugs.
   e) Power factor testing terminal
   f) Facility for lifting bushings and tank.
   g) The quantity of insulating oil required for first filling. Di electric dissipation factor of the oil shall not exceed 0.005. Insulating oil shall comply with applicable standards.
   h) Rating and diagram plate as per relevant standards.
   i) Pressure relieving device.

vii) Current transformers shall be given tropicalized treatment for satisfactory operation in hot and humid condition.

viii) The temperature rise shall not exceed the figures given in applicable standards for operation under ambient temperature conditions.

ix) The tanks/bases and all exposed ferrous parts shall be hot dip galvanized and painted conforming to applicable standards.

x) In the case of multi-core CTs, it shall be possible to adjust the tap settings on any core independent of the setting on the other cores, for which purpose these tapings will have to be provided on the secondary windings.

xi) In case of multi-ratio current transformers, min specified requirements for VA, accuracy, knee-point voltage and max secondary resistance shall be met at all taps.

xii) Magnetizing characteristics (extending well beyond knee point voltage) and secondary impedance values shall be furnished for all protection cores.

xiii) Termination: No scissor type lugs to be employed. Only round lugs shall be used.

D) INSULATORS/BUSHINGS

i) Insulators / bushings shall conform to applicable standards and shall be made of homogeneous vitreous porcelain, the glazing of which shall be of uniform brown or dark brown in colour.

ii) Oil filled insulators/bushings shall be hermetically sealed to prevent ingress of moisture. Metallic bellows/Nitrogen gas shall be used for cushioning and to allow

for expansion.

E) TESTS:

i) The following routine tests shall be carried out on all the current transformers in the presence of BHEL / BHEL customer representative as per the relevant latest IS and 6 sets of test certificates shall be furnished for approval before despatch. No equipment shall be despatched before the approval of test certificates and despatch instructions are conveyed by the purchaser.

a) Verification of terminal markings and polarity.
b) Power frequency voltage with stand test on primary windings.
c) Power frequency voltage with stand test on secondary windings.
d) Over voltage inter turn test.
e) Determination of errors according to the requirements of the appropriate accuracy class.
f) Partial discharge test.

ii) The following type tests shall be carried out on one of the current transformers. If the contractor has already carried out type test on similar equipment in last 3 years, a copy of the same shall be furnished for purchaser's reference. If type test is not carried out, the same shall be conducted free of cost and test certificates furnished for purchaser's approval.

a) High voltage power frequency test on primary windings.
b) High voltage power frequency test on secondary windings.
c) Determination of errors according to the requirements of the appropriate accuracy class.
d) Short time current test.
e) Temperature rise test.
f) Impulse voltage test.

iii) A copy of the type test certificate for the following type tests carried out on one of the bushings shall be furnished for BHEL / BHEL customer reference.

a) Power frequency visible discharge test.
b) One minute power frequency withstand test.
c) Full wave impulse voltage withstand test.
d) Under oil flash over or puncture withstand test.

F) GUARANTEED TECHNICAL PARTICULARS :

The current transformers supplied shall comply with guaranteed technical particulars as below.

#	Particulars	Guaranteed values
1	Nominal system voltage	66 KV
2	Rated Voltage	72.5 KV
3	Rated frequency	50 Hz
4	System neutral earthing	Effectively earthed
5	Installation	Out door
6	Rated short circuit current	31.5 KA
7	Rated insulation level	
	i)Impulse With stand voltage	350 KV Peak

	ii)1 min power frequency withstand voltage	160 KV rms				
8	Continuous current rating	120% of rated primary current				
	Description	**CORE1**	**CORE2**	**CORE3**	**CORE4**	**CORE5**
	Ratio	To be furnished by vendor as per design requirement.				
	Rated primary current					
	Rated sec. current					
	Purpose					
	Adopted ratio					
	Accuracy Class					
	Rating of VA burden					
	Min Knee point voltage					
	RCT @ 200/1A					

NOTE: The above details are tentative. Vendor shall submit complete details to BHEL for approval during detailed engineering.

5.8.3.2 POTENTIAL TRANSFORMER

A) Potential transformer, design, Temperature rise and testing etc. should be in accordance with IEC: 186 or the latest revised standards such as IEC61869

B) The PTs should be single phase oil immersed self-cooled type suitable for outdoor installation of kV class required. The core should be of high grade non ageing electrical silicon laminated steel of high permeability. The PTs should be hermetically sealed to eliminate breathing and prevent air and moisture entering the tank. Oil level and pressure releasing device etc. should be provided.

C) Temperature Rise

The maximum temperature of the windings, cores etc. should not exceed 45°C over ambient, while max. Temperature of oil at top should not exceed 35°C over ambient. The PTs should be suitable for mounting on steel structures. All nuts, bolts, flanges and base should be hot dip galvanized. The terminal connectors should be such as to give intimate contact between conductor & terminal and offer protection against and effects of electrolytic and atmospheric corrosion and should also have sufficient mechanical strength. The connectors should conform IS 5556: 1970.

D) Termination: No scissor type lugs to be employed. Only round lugs shall be used.

E) GUARANTEED TECHNICAL PARTICULARS :

The potential transformers supplied shall comply with Guaranteed technical particulars as indicated below.

1	Rated voltage	72.5 kV
2	Rated frequency	50 Hz
3	Accuracy class of Winding	as required
4	Number of cores	For metering and Protection as per attached single line diagram
5	Voltage ratio	66 kV/√3,110V/√3
6	Grade of oil	As per IS: 335
7	Max phase angle error with 25% and 110% of rated burden at 0.8 p.f. lagging at any voltage between 80% and 120%	To be furnished by vendor as per design requirement.
8	Temperature rise at 1-1 times rated voltage with rated burden (OC)	As per IS: 3156
9	Rated voltage factor & time (based on system studies) Continuous & 30 seconds:	To be furnished by vendor as per design requirement.
10	Insulation Level (based on system insulation coordination)	i) 1 minute power frequency (wet/dry) withstand test voltage (As per IS: 3156): To be furnished by vendor as per design requirement.
		ii) 1.2/50 micro seconds impulse withstand test voltage: To be furnished by vendor as per design requirement.
11	One minute power frequency withstand test voltage on secondary sides	To be furnished by vendor as per design requirement.
12	Minimum creepage distance of bushings	To be furnished by vendor as per design requirement.

NOTE: The above details are tentative. Vendor shall submit complete details to BHEL for approval during detailed engineering.

5.8.3.3 MARSHALLING BOXES:

i) The Marshalling boxes shall be suitable for mounting on the support structures. The Marshalling box is required for connecting the secondary windings of the corresponding individual core of the CTs and PT's of the three phases in star or delta as the case may be and to take leads from the marshalling box to the Control and Protection Panel. The quantity of marshalling boxes shall be supplied to meet the requirement. The size of cables used for connecting CT and PT leads upto the marshalling box shall be of 16 mm^2, copper cable.

ii) STANDARDS:

The marshalling boxes shall conform to modern design practice and shall be strictly in line with the specification described here in below.

iii) DETAILED TECHNICAL SPECIFICATION**:**

The marshalling boxes shall consist of completely enclosed cubicle type steel boxes suitable for outdoor mounting. These boxes shall be fabricated out of not less than 12 SWG thick mild steel cold rolled sheet of tested quality complying with the latest edition/ amendment of IS: 513/1973.

The marshalling boxes shall have a single door hinged at two places. The hinges shall be of such construction that the door can swing open by not less than 150 deg. The door shall also be provided with suitable size best quality mortise lock. The complete box shall be fabricated in such a way that when closed it shall be perfectly water tight, dust proof and vermin proof and enclosure shall conform to IP 55 as per IS: 2147.

All marshalling boxes shall be provided with necessary fixtures for fixing the cable entry and exit pipes with check nuts on all the sides of the marshalling box and accessories.

iv) TERMINAL BLOCKS :

The materials used for the terminal blocks shall possess excellent mechanical and electrical properties. The terminal blocks shall be rigid and shall withstand handling while making repeated terminations. The terminal blocks shall be of stud type (Bolt and nut type) and shall be suitable for 16 sq. mm cable of reputed make. Each unit shall be complete with copper terminal studs, nuts and washers together with label carriers, with blank label strips and suitable cable lugs. The terminal block shall be mounted on galvanized rolled steel strip of sufficient length and size which acts as a support bar for fixing on hylem sheet of 10 mm thick brass studs. Each terminal block shall be suitably numbered. Spare terminals shall also be provided for future use.

Then terminal studs, nuts, washers and links shall be made of best quality copper and shall be suitable for copper conductor of size 16 sq. mm.

Sufficient quantity of suitable size cable lugs for copper conductor of size 16 sq. mm shall be supplied.

All terminal blocks shall be designed for voltage rating of 1100 volts and continuous current rating of 25 A, AC or DC.

The terminals shall be of good mechanical construction providing adequate electrical contact for the appropriate size of the copper cable used.

Terminal connectors shall be such that the conductors may be connected by screw or other equivalent means to maintain the necessary contact pressure permanently.

Terminals shall not run or be displaced when the connecting screws are tightened and the conductor shall not become displaced.

Terminals shall be so mounted that the appropriate wire or cable may be connected without impairing the normal performance of the unit. No contact pressure shall be transmitted through insulating material and the gripping of the conductor shall take place between metal faces.

v) EARTHING TERMINAL:

Two numbers of 12 mm diameter brass bolts and nuts with spring washers for each box shall be provided by the side of the body of the marshalling box for fixing copper / GI 50x6 mm flat. The earthing terminal shall be identified by means of the sign marked, in a legible and indelible manner on or adjacent to the terminal. The terminals shall be provided inside the marshalling box for connection of earthing leads. Earthing terminal shall have provision for terminating the earthing leads from neutral connection at the inside of the box.

Suitable size cubicle heater and illuminating lamp with independent control switch shall

be provided inside each marshalling box. The illuminating lamp shall be automatically switched on when the door is opened.

The auxiliary supply voltage available is 240 +/-10% V, AC.

The general arrangement and other drawings pertaining to the marshalling boxes shall be submitted. The Bill of materials shall be indicated in the general arrangement drawing of marshalling box.

vi) TESTS AND TEST CERTIFICATE:

The marshalling boxes shall withstand the insulation test of 2kV AC(RMS) between terminals and earth or between adjacent terminals for one minute.

All tests shall be conducted on the CT marshalling boxes in accordance with relevant IS(IS standard considered to be furnished in offer) in presence of the purchaser or his representative or else reports of the tests conducted on similar type of marshalling boxes in the last 3 years shall be submitted.

vii) PAINTING :

The marshalling boxes shall be painted both inside and outside so as to with stand highly humid atmosphere.

GENERAL NOTES FOR METERING CTs/PTs AS PER GETCO REQUIREMENTS

a) All CTs and EMPTs must be provided with stainless steel bellows and no nitrogen gas filling or rubber gasket will be acceptable in case of 66kV class of voltage.

b) Copies of all type test certificates in respect of sample CT and EMPT as specified under Cl. No. 9.1.1 of IS: 2705 (Part-1) for CTs and Cl. No. 9.1.1 of IS:3156 (Part-1) for PTs, of similar class of accuracy, similar design, rating and technical specification conducted on prototype sample by the supplier at any Govt or Govt approved test house (within 5 years) shall have to be submitted for approval at DISCOM Corporate Office before procurement/ placement of procurement orders.

c) All the CTs procured and to be installed for tariff metering purpose shall have to be tested at ERDA, Vadodara/NABL accredited laboratory for all routine tests as specified under Cl. No. 9.1.2 of IS: 2705 (Part-1) including the test for 'ISF' as per Cl. No: 7.1.2 of IS:2705 (Part-2). The copy of OGA drg, name plate drg and the secondary terminal drgs of the above CTs shall have to be submitted to DISCOM Corporate office for final approval.
The original along with one copy of the ERDA routine test certificates along with the ERDA test certificate for the ISF test shall have to be submitted for final approval before actual commissioning of CTs at site.

d) Routine testing of all EMPTs as specified under Cl. 9.1.2 of IS: 3156 (Part-1) shall have to be arranged at supplier's works provided the supplier has NABL accredited lab facility to ensure all the tests. Otherwise, the EMPTs will have to be tested at ERDA or equivalent NABL accredited lab. The acceptance tests will have to be witnessed by GETCO at supplier's works. The accuracy test on PTs shall not be conducted with simultaneous burden of all cores, instead the tariff metering core shall be tested separately for 10VA and 2.5VA burden, i.e, as per Cl.No.5 of IS: 3156 (Part-II). The original with one copy of the acceptance test certificates (witnessed and signed by GETCO officer) shall have to be submitted for final approval before actual commissioning of the same. Copy of OGA, name

plate drg and secondary terminal box drg shall have to be submitted for necessary approval along with the acceptance test certificate.

5.8.4: LIGHTNING ARRESTOR:

(1) Arrestor rating: 60kV, 10kA, Class-3 with IB
(2) Type: Metal oxide Gapless lightning arrestor
(3) Standard: IS 3070 (part-3) 1993 & IEC 60099-4 of 2004
(4) Minimum acceptance tests that shall be witnessed by BHEL
  (a) Power frequency reference voltage test at 3mA
  (b) Partial discharge test at MCOV x 1.05
  (c) Lightning impulse residual voltage test at 100% NDC
  (d) Functional tests on surge monitor
  (e) Galvanization test on exposed metal parts
    - Uniformity, mass, thickness of Zn coating
  (f) Visual examination and dimensional verification

60 KV ZINC OXIDE LIGHTNING ARRESTERS

TYPE AND SYSTEM DATA

The lightning arresters shall be of 60 KV, gapless zinc oxide and suitable for outdoor operation without protection from sun and rain.

STANDARDS:

The lightning arresters and associated accessories shall conform to the requirement of the latest IS: 3070 (part-I), IEC: 60099-4 for the gapless zinc oxide lightning arresters.

DEFINITIONS:

For the purpose of this specification, all technical terms used herein shall have the meaning as defined in IS: 3070 (part-I), IEC: 60099-4 for gapless zinc oxide lightning arresters with latest revision thereof, if any.

CONSTRUCTIONAL FEATURES

i) The arresters shall be of modern design consisting of hermetically sealed units incorporating non-linear resistors (metal oxide) stacked vertically. The arresters shall be designed to have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes. The arresters shall be suitable for mounting on outdoor structures.

ii) Supporting structures, terminal connectors, grading ring and other components shall form part of the arresters. All metal parts shall be of non-rusting and non-corroding metal. Bolts, screws and pins shall be provided with lock washers, keys or equivalent locking facilities. All similar parts, particularly removable ones shall be interchangeable. Self-contained **discharge counter**, requiring no auxiliary battery supply shall be provided for each single pole unit. The terminals shall be robust and shall be located such that incoming and outgoing connections could be made with minimum possible bends. Suitably sized by-pass shunts of copper to facilitate by-passing the discharge counter shall be designed and supplied. The design of the terminal connectors shall permit the connection of these units.

iii) A leakage current detector as an integral part of the discharge counter shall be provided. The value of the leakage current beyond which the operation is prohibitive shall be clearly indicated in red colour on the detector.

iv) The arresters shall be provided with pressure relief diaphragm at both ends. Corona rings wherever used shall be of non-magnetic materials.

v) Lightning arresters shall be gapless metal oxide hermetically sealed type, of self-supporting construction and base mounted suitable for mounting on steel structures. They shall have adequate thermal discharge capacity for various types of surges. The lightning arresters shall be capable of withstanding the internal pressures developed during discharges without operation of the pressure relief devices or should safely vent the internal pressures associated with arrester failure without shattering

vi) Insulator housing shall be porcelain having adequate mechanical strength and integrity. Arrester housing shall withstand short circuit, wind, seismic and other forces during operation.

i) Arresters shall incorporate anti contamination feature to prevent arrester failure consequent to uneven voltage gradient across the stack in the event of contamination of the porcelain. The arrester shall be protected against the ingress of moisture.

ii) Surge counter should be supplied with the insulating bases for connection. No radio interference shall be caused by the arresters operating at the normal rated voltages.

RECTANGULAR WAVE SHAPE CURRENT

The arrester shall withstand surges of low magnitude rectangular wave shape currents of long duration arising from switching surges or accumulation of static charges from atmosphere.

INSULATING CASING:

The insulating casing shall conform to relevant IS standards (IS standard considered shall be indicated in the offer) with latest amendments. Insulating casing shall be made of wet process, non-porous electrical porcelain, free from imperfection and moisture absorption, vitrified and finished with brown glaze and designed to keep the insulator surface from contamination by natural action of wind and rain. The leakage distance along with external surface shall be large to ensure that the surface contamination likely to deposit in the specified weather conditions shall minimize radio interference.

The complete bushing insulator casing per pole of the arrester shall withstand the following insulator insulation tests:

i) Insulation class of bushing : 66 kV
ii) Power frequency withstand
  1 Min dry : 160 kV rms
  1 Min wet : 160 kV rms
iii) 1.2 / 50 micro second wave : 350 kV peak

NOTE: The insulator of each unit arrester of which the pole arrester is stacked shall withstand pro rata voltage specified above in proportion with the ratio of the number of elements housed in the unit arrester to the total number of them in each pole arresters.

TYPE OF MOUNTING

Lightning arresters shall be suitable for mounting on steel support structures to be supplied. The necessary flanges, foundation bolts or clamp, nuts washers etc., for the base of arresters shall be supplied and these shall be hot dip galvanized. Insulating bases required for mounting of the arresters with attachment of surge counters shall be supplied.

GALVANISED SUPPORT STRUCTURES

The contractor shall supply along with the LAs all the support structures and foundation bolts, nuts and washers required. The galvanized steel support structures shall in general conform to the latest edition of IS 2629.

FITTINGS AND ACCESSORIES:

i) Arresters shall be complete with insulating base for connection of discharge counter and provision for bolting to the supporting structure (pedestal).

ii) Self-contained discharge counter, suitably enclosed for outdoor use weather and waterproof and requiring no external supply shall be provided for each 60 kV arrester. The discharge counter shall have a glass window. Suitably sized links of copper to facilitate bypassing of discharge counter shall be provided. The terminal connectors shall have provision for connection of these links.

iii) The conductor between lightning arrester earth terminal to the discharge counter terminal shall be insulated for a minimum of 4 kV and required length of insulated conductor shall be supplied along with the arrester. It shall not require sealing ends or plumbed joints at their ends for terminations.

iv) A leakage current detector as an integral part of the discharge counter shall be supplied.

v) Arresters shall be supplied with clamps/connectors on line terminal, earth terminal and the discharge counter terminals along with galvanized steel support structures with bolts, nuts etc., including foundation requirements. Suitable bimetallic type connectors, if any, to receive ACSR conductor shall be provided and shall be suitable for both horizontal and vertical connections.

5.8.5 REQUIREMENT OF AUXILIARY / MISCELLANEOUS ITEMS:

1) ACSR CONDUCTOR: To be selected by vendor as per design requirement.

2) CABINETS, BOXES, KIOSKS, PANELS, ETC.

All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC: 60439 as applicable. They shall meet all other requirements specified elsewhere in the specification.

3) BAY MARSHALLING BOX

Bay Marshaling Box located at a convenient location to receive and distribute cables shall be provided as required. It shall meet all the requirements as specified for cabinets/boxes.

It shall have three separate distinct compartments for following purposes:

-To receive two incoming 415V, three phase, AC supplies controlled by 100A four pole MCBs with auto changeover provision, and to distribute five (5) three phase ac supplies controlled by 32A four pole MCBs. It shall also be provided with 63A, 3 phase 4 pin industrial grade receptacle with rotary switch. Ratings are indicative and shall be finalized during detailed engineering.

-To receive three phase incoming from first compartment and to distribute ten (10) single phase ac supplies controlled by 16A two pole MCBs.

-150 nos. terminal blocks in vertical formation for interlocking facility.

4) AUXILIARY SWITCH FOR CIRCUIT BREAKERS

The auxiliary switch shall conform of following type tests:

Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant

greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.

Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination

Heat run test on contacts

IR/HV test, etc.

5) Nitrogen Injection Fire Protection System (NIFPS): NIFPS to be provided for both power transformers - 30MVA and 60 MVA. NIFP system shall be provided with automatic control for fire prevention and fire extinction. The system shall be tested by UL, FM, LPCB or national testing body of BIS accredited laboratory's Test Report required. NIFPS shall have provision for AI / DI / Communication for Information / Records / Logging in SCADA of plant.

Type tests

All equipment with their terminal connectors, control cabinets, main protective relays, etc. as well as insulators, insulator strings with hardwares, clamps and connectors, marshalling boxes, etc., shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with the requirements stipulated under respective equipment sections.

5.9 INSTALLATION

1) EARTHING

The earthing shall be done in accordance with requirements given in Annexure-I of this section and drawing enclosed with the specifications. Earthing of panels shall be done in line with the requirements given in respective equipment section of this specification.

2) STRUCTURAL STEEL WORKS

The structural steel works shall be done in accordance with requirements stipulated elsewhere in the specification.

3) BAY EQUIPMENT

The disposition of equipment to be supplied is shown in enclosed tender drawings.

The Contractor shall prepare layout drawings and submit the same for approval of the BHEL. The approval of drg. shall not absolve Contractor from his responsibility regarding designing & engineering of switchyard and Contractor shall be fully responsible for all works covered in the scope of this specification.

4) EQUIPMENT ERECTION NOTES

a) All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity.

b) Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading,

transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense. The contractor shall strictly follow manufacturer's recommendations for handling and erection of equipment.

c) The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment, sling ropes etc. should be tested before erection and periodically thereafter for strength.

d) Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation.

e) Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.

f) For cleaning the inside and outside of hollow insulators only Muslin or leather cloth shall be used.

g) The rigid busbars for equipment interconnections shall have rigid connections at one end and expansion / flexible at the other end. The tubular aluminium connections shall have not more than one joint per span. Since no wastages are permissible, the bidder shall work out the cut lengths of aluminum tube based on finalized layout and dispatch the same to site without requiring BHEL approval. Corona bells shall be provided at the end of the rigid busbars.

5) CABLING

a) Cabling shall be on cable racks, in trenches, vertical shafts, excavated trenches for direct burial, pulled through pipes and conduits run clamped on steel structures etc. in accordance with the requirements specified elsewhere in the specification.

b) Cables inside the switchyard shall be laid on GI angle supports at 600mm spacing with separate tiers for control and power cables. The GI angles shall be bolted / welded to galvanized insert plates inside cable trenches.

c) Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the ground. In the case of equipment located away from cable trench either pipe inserts shall be embedded in the ground connecting the cable trench and the equipment or in case the distance is small, notch/opening shall be provided. In all these cases necessary bending radii as recommended by the cable supplier shall be maintained.

d) Cabling in the control room shall be done on ladder type cable trays with supports at an interval of 2000mm.

e) All inter pole cables (both power & control circuit) for equipment's shall be laid in cable trenches/G.I. Conduit Pipe of NB 50/100mm which shall be buried in the ground at a depth of 300mm.

6) EARTHING FOR SWITCHYARD

Vendor prepare and shall submit the earthing layout and design for SPV side for BHEL/GIPCL approval. For Substations side earthing shall be done as per GETCO requirement.

a) EQUIPMENT AND STRUCTURE EARTHING

i. The connection between earthing pads and the earthing grid shall be made by short and direct earthing leads free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with engineer.
ii. Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.
iii. Metallic conduits shall not be used as earth continuity conductor.
iv. A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.
v. Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.
vi. Cable and cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running along with the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points, whether specifically shown or not.
vii. Railway tracks within switchyard area shall be bonded across fish plates and connected to earthing grid at several locations.
viii. Earthing conductor shall be buried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop by one lead.
ix. Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.
x. Equipment earthing (Riser & welding of two conductors) shall be done as per standard drawing enclosed in this part.

b) JOINTING

i. Earthing connections with equipment earthing pads shall be of bolted type. Contact surfaces shall be free from scales, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint/compound.
ii. Connection between equipment earthing lead and between main earthing conductors shall be welded/brazed type. For rust protections, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.
iii. Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingression.
iv. Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
v. All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.
vi. Bending of large diameter rod/thick conductor shall be done preferably by gas heating.

vii. All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.

c) POWER CABLE EARTHING

Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.

d) SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS

i. Earthing terminal of each surge arrester, capacitor voltage transformer and lightning down conductors shall be directly connected to rod electrode which in turn, shall be connected to station earthing grid.
ii. Earthing mat comprising of closely spaced (300mm x 300mm) conductors shall be provided below the operating handles of the isolators.

5.10 SITE TESTING AND COMMISSIONING

1 INTRODUCTION

An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field QP/ instructions of the equipment supplier or BHEL without any extra cost to the BHEL. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall get the list of instruments approved from the BHEL.

2 GENERAL CHECKS

a) Check for physical damage.
b) Visual examination of zinc coating/ plating
c) Check from name plate that all items are as per older/ specification.
d) Check tightness of all bolts, clamps and connecting terminals using toque wrenches.
e) For oil filled equipment check for oil leakage, if any. Also check oil level and top up.
f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces.
g) Check cleanliness of insulator and bushings.
h) All checks and tests specified by the manufactures in their drawings and manuals as well as all tests specified in the relevant code of erection.
j) Pressure test on all pneumatic lines at 1.5 times the rated pressure shall be conducted.

3 CIRCUIT BREAKERS

a) Insulation resistance of each pole.
b) Check adjustments, if any, suggested by manufacturer.
c) Breaker closing and tripping time.
d) Slow and power closing operation and opening
e) Trip free and anti pumping operation.
f) Minimum pick up volts of coils
g) Contact resistance
h) Functional checking of compressed air plant and all accessories
i) Functional checking of control circuits, interlocks, tripping through protective relays

j) Insulation resistance of control circuits, motor etc.
k) Resistance of closing and tripping coils.

4 ISOLATORS

a) Insulation resistance of each pole
b) Manual and electrical operation on interlocks
c) Insulation resistance of control circuits and motors.
d) Ground connections
e) Contact resistance
f) Proper alignment to minimise the vibration to the extreme possible during operation.
g) Measurement of operating torque for isolator and Earth switch
h) Resistance of operating and interlocking coils.

5 CURRENT TRANSFORMERS

a) Insulation Resistance Test
b) Polarity test.
c) Ratio identification test-checking of all ratios on all cores by primary injection of current.
d) Dielectric test of oil (wherever applicable).
e) Magnetizing characteristics test.
f) Capacitance and tan delta measurement at minimum 10kV.

6 VOLTAGE TRANSFORMERS/CAPACITOR VOLTAGE TRANSFOREMER

a) Insulation resistance test.
b) Polarity test.
c) Ratio test.
d) Dielectric test of oil (if applicable).
e) Capacitance and tan delta measurement at minimum 10kV.

7 SURGE ARRESTER

a) Grading leakage current.
b) Resistance of ground connection.
c) Resistive current drawn at rated voltage after energisation.

8 PHASING OUT

The phasing out of all supplies in the station system shall be carried out.

9 STATION EARTHING

a) Check soil resistivity
b) Check continuity of grid wires
c) Check earth resistance of the entire grid as well as various sections of the same.
d) Check for weld joint and application of zinc rich paint on galvanised surface.
e) Dip test on earth conductor prior to use.

10 CONDUCTOR STRINGING AND POWER CONNECTORS

a) Physical check for finish
b) Electrical clearance check
c) Testing of torque by torque by torque wrenches on all bus power connectors and other accessories.
d) Sag and tension check on conductors.

11 INSULATORS

a) Visual examination for finish damage, creep age distance, etc.

12 FINAL CHECKING TESTING AND COMMISSIONING

After completion of the works, final checking of the line shall be done by the Contractor to ensure that all the foundation works, tower erection, and stringing have been done strictly according to the specifications and as approved by the Owner. All the works shall be thoroughly inspected keeping in view of the following main points:

a) Sufficient backfilled earth is lying over each foundation pit and it is adequately compacted.
b) Concrete chimneys and their copings are is good finally shaped conditions.
c) All the tower members are correctly used, strictly according to final approved drawing and are free of any defect or damage, whatsoever.
d) All bolts are properly tightened and punched/tack welded.

e) The stringing of the conductors and earth wire has been done as per the approved sag and tension charts and desired clearances are clearly available.

f) All conductor and earth wire accessories are properly installed.

g) All other requirements to complete the work like fixing of danger plate, phase plate, number plate, anti climbing device etc., are properly installed.

h) Wherever required it should be ensured that revetment is provided.

i) The original tracings of profile route alignment and tower, design, structural drawings, bill of material, shop drawings of all towers are submitted to the Owner for reference and record.

j) The insulation of line as a whole is tested by the Contractor by providing his own equipment, labour etc. to the satisfaction of the Owner.

k) All towers are properly grounded.

l) The line is tested satisfactorily for commissioning purpose.

6.0 CONTROL & PROTECTION OF 66 kV line & transformer at Solar Plant End

The Bidder's scope of work shall include the supply, delivery, installation, testing and commissioning of the following including full protection, control, metering, monitoring, mimic diagram and all other equipment required as detailed in this specification:

1. Conventional hardwired Control Panel including control, metering, monitoring, annunciation windows, mimic diagram, and all other equipment required.
2. Control and Relay Panels shall be provided with Bay control and Protection Unit (BCPU) in line with SLD. Approved make for BCPUs are ABB, Siemens, Areva. Model no. shall be as approved GIPCL/GETCO.
3. All relays shall be of numerical type.
4. Sufficient numbers of inputs and outputs shall be available in BCPU and Numerical relays for providing input to annunciation and SCADA.
5. ~~Scope also covers other items like Event logger, time synchronizing equipment, dynamic relay test kit, furniture etc also as mentioned at relevant portions of the specification.~~
6. All associated power and control cabling as detailed in the specification shall be in the scope.

7. The testing of all control & protection functions for the 66 bays shall be the responsibility of the bidder.
8. It shall be possible to monitor and control all the Switchyard bay equipment from the control panel in Switchyard Control Room.
9. Interlocking to prevent unsafe operation of Switchyard equipment such as circuit breakers, isolators, earth switches etc. shall be implemented. Proper interfacing with the existing scheme shall be ensured.
10. The Employer shall approve the list of alarms and plant status (Analog and Digital) to be wired for Sequence of Events log, existing RTU and annunciation system during detailed engineering stage.
11. The historical data logs received from Bay Protection Relays shall include Digital Fault Records and Sequence of Events.
12. All Protection Relays shall be provided with self-diagnosis and supervision functions to ensure maximum availability. An alarm contact shall be provided for hardware failures, failures of internal and external auxiliary supplies etc.

6.1 Control Panels for HV Switchyard

Conventional Control Panels shall be provided for the 66kV Switchyard bay at Solar Plant end for Line Protection and Transformer feeder Protection.
Control Panels for various feeders shall comprise minimum of the equipment as listed below:

2 Annunciation System

The annunciation system shall be either relay based or based on state of the art static system of proven design. The annunciation facia shall be at least of 35mm x 50mm size for each point. The system shall have accept, reset and test facilities for alarms in each control
panel. Annunciation alarm shall be provided for failure of annunciation dc supply by means of separate AC supply. No of annunciation windows per control panel shall be decided during detailed engineering.

Any contact multiplication relays required to multiply the contacts of existing isolators, CBs, trip relays etc to be used in the scheme logics related to bays under present scope shall be provided by the bidder. Any cabling between the bidder's panels and existing control & relay panels for this purpose shall also be in bidder's scope. Any modification and associated cabling in existing scheme logics required due to addition of new bays in the existing switchyards shall also be in the bidder's scope. All such existing schemes shall be revised to show the modifications and submitted to BHEL for reference.

3 General Requirements of protection system

i) The manufacturer of the offered numerical protection system shall carry out complete engineering, testing & commissioning at site of the offered protections including the associated relay & protection panels.

ii) The protection system shall be arranged to provide two independent, high performance and reliable systems with separate monitored DC supplies, separate CT/PT cores, separate cables and trip relays to obtain 100% redundancy. Associated trip relays of the two systems shall be separate, having sufficient number of contacts for all the functions. Each protection shall energize both trip coils of the circuit breakers to be tripped.

iii) All numerical relays shall be supplied with all protection functions / features in disabled condition. Relevant features / protection functions shall be enabled at the time of commissioning at site as per approved logic and relay settings.

iv) The total critical fault clearance time from fault initiation in any part of the system shall be 80 m sec for phase to phase fault in the generator-transformer unit and for phase to phase and phase to earth faults in the EHV system inter-connection.

v) Modification and interfacing with the existing protection scheme, including supply of any hardware/ software, such as bus bar protection shall be in bidder's scope.

4 Operational Requirements for Numerical Relays and Auxiliary Relays

i) All protection relays and BCPU to be supplied under this package shall be Numerical type and IEC 61850 compliant.

ii) All numerical relays, auxiliary relays and devices shall be of latest version, reputed make and types proven for the application, satisfying requirement covered elsewhere and shall be subject to Owner's approval. Relays and timers shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide required sensitivity to the satisfaction of the Owner.

iii) Numerical relays shall be suitable for efficient and reliable operation of the protection scheme. Necessary auxiliary relays, timers, trip relays, etc. required for complete scheme, interlocking, alarm, logging, etc. shall be provided. No control relay, which shall trip the circuit breaker when relay is de-energized, shall be employed in the circuits.

iv) Relays shall be provided with self-reset contacts except for the trip lockout relays, which shall have manual reset facility. Suitable measures shall be provided to ensure that transients present in CT & pT connections due to extraneous sources in EHV system do not cause damage to the numerical and other relays. CT saturation shall not cause mal-operation of numerical relays.

v) Except for event logging, alarm and annunciation type of non-trip functions, protective relay contact multiplier relay shall be high speed trip relay only.

vi) Only DC/DC converters shall be provided in the solid state devices / numerical relays wherever necessary to provide a stable auxiliary supply for relay operation. DC batteries in protective relays and timers necessary for relay operation shall not be acceptable. Equipment shall be protected against voltage spikes in auxiliary DC supply.

vii) Pick up range of the Binary inputs shall be minimum 70 V DC /AC."

viii) The numerical relays offered shall have self-diagnostic features to reduce the down time of the relay and provide useful diagnostic information on detection of an internal fault to speed up the maintenance. Necessary support documentation explaining the self-diagnostic features of the numerical relays in detail shall be furnished for owner's use.

ix) The numerical protection shall have continuous self-monitoring & cyclical test facilities. The internal clock of all the numerical relays being supplied under this package shall be synchronized through the GPS Time Synchronizing System, under present scope. A timing accuracy of 1ms shall be achieved for all the numerical relays.

x) The sampling rate of analog inputs, the processing speed and processing cycle of digital values shall be selected so as to achieve the operating times of various protection functions specified.

xi) Display of various measured parameters during normal as well as fault condition on segregated phase basis shall be provided. In addition to a local HMI, Numerical relays shall also have LEDs and back lit LCD screen shall be provided for visual indication and display of messages related to major trips / alarms generated in the relays.

xii) All the numerical relays shall have adequate processor capability to carry out programmable scheme logics (PSL) required for implementing approved protection and control schemes over and above its inbuilt protection functions algorithm.

xiii) The numerical relays shall be provided with built-in disturbance recorder. The data from DR function shall be available in IEEE/COMTRADE format and compatible with the dynamic relay test system being supplied in this contract.

5 Panels

- The dimensions of control / relay panel shall be matching with the existing panels at site, details of which shall be furnished during the detailed engineering.
- Each panel shall be provided with a 240V AC fluorescent lighting fixture controlled by door switch as well as a 5A, 240V AC switch-socket unit.
- Synchronizing socket matching with the existing trolley shall be provided else separate synchronizing trolley shall be provided.
- Shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of AC & DC supplies for various circuits for control, signaling, lighting, interlocking, etc. Selection of main and sub-circuit fuse rating shall ensure selective clearance of the sub-circuit faults.
- Voltage circuits for protection and metering shall be protected by fuses. Suitable fuse failure relays shall be provided to give an alarm for voltage circuits of protection/metering. Voltage selection scheme based on relays shall be provided for meters wherever possible.
- The DC supplies at the individual relay and protection panels shall be monitored by suitable relays and failure of DC supplies shall be annunciated.
- All equipments mounted on front and rear side of the panels should shall have individual name-plates with equipment designation engraved.
- Each panel shall also have circuit/feeder designation name plate
  - (a) All panels shall be free standing, floor mounting type and completely metal enclosed. Cable entries shall be from the bottom. Panels shall be of IP 31 class or better.
  - (b) Panels shall have removable gland plates with glands made of brass and shall be suitable for armoured cables.
  - (c) Panels shall be painted. The colour of paint for exterior of the panels shall be matching with other panels in the station & shall be decided during detail engineering
  - (d) Panels shall have a lockable front Plexiglas door and a swing frame. Panels shall facilitate direct access to any component mounted inside and shall have at least 20% free space for future expansion.
  - (e) All equipment mounted on the panels shall have individual name-plates with equipment designation engraved.
  - (f) Internal wiring to be connected to external equipment shall terminate on terminal blocks. Shall have 20% terminals as spare terminals in each panel.
  - (g) The terminal blocks for CTs and VTs shall be provided with test links and isolating facilities. The CT terminal blocks shall be provided with short circuiting and earthing facilities.
  - (h) Contractor shall be solely responsible for completeness and correctness of all the wiring, and for proper functioning of the connected equipment.

6 Earthing

- (a) The panels shall be equipped with an earth bus of at least 50x6mm2 galvanized steel flat bar or equivalent copper.
- (b) Earth buses of adjoining panels shall be connected for continuity. The continuous earth bus so formed shall be connected to the main earth grid at one end only.
- (c) All metallic cases of the mounted equipment shall be separately connected to the earth bus by 2.5mm2 copper wires. No loops in the earth wiring shall be permitted.
- (d) CT/VT neutral secondary shall only be earthed at the terminal block of the panel

through links, such that the earthing of one group may be removed without disturbing others.

(e) An independent Electronic Earth System shall be provided as per bidder's standard. The electronic earth shall be connected to the substation earth mat through a dedicated riser.

7 Control Cabling Philosophy

(a) Each three phase secondary core of each CT/PT shall be brought to the associated relay panel through independent cables.

(b) Duplicated cores with at least 2 x 2.5 sq.mm2 CU/equivalent core cross-sectional area per connection shall be used for connection of all CT/PT circuits.

(c) PT leads used for tariff metering shall have an equivalent core cross-sectional area of at least 10 mm2 CU/equivalent per phase/neutral connection.

(d) Duplicate channels of protection shall have independent cables for tripping, DC supply, etc. Duplicated cores shall be used for ALL closing/tripping commands and interlocking signals involving long (more than 500 m) cable lengths.

(e) For the following applications multiple cores with at least 2 x 2.5 mm^2 CU / equivalent core cross - sectional area per connection shall be used:

- DC supply to Bay Marshalling box
- DC supply to circuit-breaker cubicle
- DC looping for closing and tripping circuits of circuit-breaker

(f) All the interconnections (both AC/DC) within the switchyard and between switchyard and other systems required for the successful implementation of the control, interlocks and protection schemes under present package, as shown in the tender drawings for control & protection SLD, shall be in the scope of the bidder. Such interconnections between switchyard and other system shall include but not limited to the following:

- Extension of switchyard bus voltages to Control & Protection Panels.
- Necessary interconnections for the Inter tripping / closing interlocking between upstream and down stream systems of transformer.
- Necessary interfacing between Transformer MBs & Control Panel for various Transformer monitoring systems shall also be in bidder's scope
- Any screened cable required for connecting 4-20 mA analog signals.
- Cables for interfacing different protections & control schemes of the new bay to the existing 66 kV SWYD protections & schemes.

(g) Spare cores shall be provided as per following norms:

- Up to 3-core cable - Nil
- 5 Core Cable - Min. 1 core
- 7 to 14 core cables - Min. 2 cores
- More than 14 core - Min. 3 cores

Mimic Diagram

Colour mimic diagram showing the exact representation of the system shall be provided in front of the control panel.

Mimic colour shall be matching with that of the existing control panels and the details shall be furnished by the Owner during detailed engineering.

Auxiliary Equipment

All control and instrumentation switches shall be rotary operated type with escutcheon plate showing the operating position and circuit designation. All switches shall be flush mounted. Handles of different shapes shall be provided as approved by Owner.

Control switches for breaker or disconnecting switch shall be of spring return to neutral type, while all other shall be stay-put type all the synchronizing switches shall have a removable common handle, removable only in off-position.

Lockable type switches shall be provided for same application as specified by the Owner. The contact combination and their operation shall ensure completeness of the scheme function and interlock requirements. Contact ratings of the switches shall be as per relevant standards. Contacts shall be spring assisted and contact faces shall be made pure silver.

Cluster type LED indicating lamps shall be provided.

Position indicators for the earth switches of semaphore type shall be provided as specified in the mimic diagram.

It shall be suitable for DC operation.

Indicating Instruments

a) Shall conform to IS: 1248
b) Shall be suitable for the instrument transformers as indicated in the drawings enclosed and shall be calibrated to read directly the primary quantities.
c) Shall be calibrated and adjusted at works and shall also be tested and calibrated at site before commissioning. All these instruments shall be flush mounted.
d) Shall be transducer operated, having 240 deg. scale and a dial of 96x96 mm2, have an accuracy of 1.5 class and resolution of at least 50% of accuracy class
e) Current coils shall be 120% of rated current and 10 times for 0.5 sec. without loosing accuracy.

Recording Instruments (if applicable)

The recorders shall

a. Shall be draw out type and suitable for back connection.
b. Provision for automatic shorting of CT leads shall be provided when recorder is drawn out.
c. Shall be dual pen employing potentiometric servo principle.
d. Shall record continuously on a calibrated 100mm (min) wide plain paper chart.
e. The accuracy of the recording shall be 0.5 % span. Full span response time shall not be less than 2 sec.
f. Shall include an inverter for operating on AC supply in case of DC supply failure. Switching shall be automatic.

Transducers

a) Shall conform to IEC: 688-1.
b) The output of the transducers shall be 4-20mA/0-10mA/10-0-10mA dc as necessary for the instruments.
c) Accuracy class shall be 0.5 or better except for frequency transducer, which shall have an accuracy of 0.2.
d) Summation transducer shall be suitable for taking multiple inputs from individual MW/MVAR transducers.
e) Shall have dual output. One output shall be used for the indicating instrument/recorder provided and other shall be wired up to terminal block of the panel for Owner's use in future.
f) Energy transducers shall be suitable for 3 phase, 4 wire connection.

8 Site / Commissioning Tests

TYPE TEST REQUIREMENTS

Test reports for following type tests shall be submitted for all BCUs / BPUs / Energy Meter. Test reports / certificates of tests conducted in accredited laboratories (accredited by the national accreditation body of the country where the lab is located) are also acceptable.

BPU /BCU

A. Insulation Tests:

Sl. No.	Description	Standard
1.	Dielectric Withstand Tests	IEC 60255-5 2kV rms for 1 minute between all case terminals connected together and the case earth. 2kV rms for 1 minute between all terminals of independent circuits with terminals on each independent circuit connected together. **ANSI/ IEEE C37.90-1989** 1kV rms for 1 minute across the open contacts of the watchdog relays. 1kV rms for 1 minute across open contacts of changeover output relays.
2.	High Voltage Impulse Test, class III	1.5kV rms for 1 minute across open contacts of normally open output relays. IEC 60255-5 5 kV peak; 1.2/50 sec; 0.5 J; 3 positive and 3 negative shots at intervals of 5 sec

B. Electrical Environment Tests:

Sl. No.	Description	Standard
1.	DC Supply Interruption	IEC 60255-11
2.	AC Ripple on DC supply	IEC 60255-11
3.	AC voltage dips and short Interruptions	IEC 61000-4-11
4.	High Frequency Disturbance	IEC 60255–22–1, class III At 1MHz, for 2s with 200 source impedance: 2.5 kV peak; 1 MHz; T = 15 sec; 400 shots/sec; duration 2 sec between independent circuits and case earth. 1.0kV peak across terminals of the same circuit.
5.	Fast Transient Disturbance	IEC 60255-22-4, class IV 4kV, 2.5kHz applied directly to auxiliary Supply 4kV, 2.5kHz applied to all inputs.
6.	Surge Withstand Capability	IEEE/ANSI C37.90.1 (1989) 4kV fast transient and 2.5kV oscillatory applied directly across each output contact, optically isolated input and power supply circuit.
7.	Electrostatic Discharge	IEC 60255-22-2 Class 4 15kV discharge in air to user interface, display and exposed metal work.
8.	Surge Immunity	IEC 61000-4-5: 1995 Level 4 4kV peak, 1.2/50ms between all groups and case earth. 2kV peak, 1.2/50ms between terminals of each group.

C. EMC Tests:

Sl. No.	Description	Standard
1.	Radiated Immunity	C37.90.2: 1995 25MHz to 1000MHz,
2.	Radiated Electromagnetic Field Disturbance Test	IEC 60255-22-3 80-1000 MHz, Amplitude Modulated
3.	Disturbances Induced by Radio Frequency fields, Amplitude Modulated (Conducted Immunity)	IEC 60255-22-6 150kHz– 80 MHz;
4.	Power Frequency Magnetic Field	IEC 61000-4-8, class IV
5.	Interference Voltage, Aux. Voltage (Conducted Emission)	EN 50081-2, 1994 or equivalent 150 kHz to 30 MHz
6.	Interference Field Strength (Radiated Emission)	EN 50081-2, 1994 or equivalent 30 MHz to 1000 MHz

D. Atmospheric Environment Tests:

Sl. No.	Description	Standard
1.	Humidity	IEC 60068-2-3
2.	Temperature	IEC 60255-6 IEC 60068-2-1 for Cold IEC 60068-2-2 for Dry heat

E. Mechanical Stress Tests:

Sl. No.	Description	Standard
1.	Vibration (during Operation and Transportation)	IEC 255-21-1; IEC 68-2-6
2.	Shock (during Operation and Transportation)	IEC 255-21-2, IEC 68-2-27
3.	Seismic Vibration (during Operation	IEC 60255-21-3

9 Settings

The bidder shall provide the Employer with a philosophy document clearly setting out the philosophy the bidder will use in determining setting levels. Each setting will have a brief description of the specific function or element. The setting calculation and formula will also be shown on the document. All relevant system parameters, line data, transformer data additionally used for calculating the setting will appear in the setting document. The bidder will conduct system studies in determining fault levels on different locations. These study results will also form part of the setting document. Any additional information required to complete this exercise shall be timely requested by the bidder.

The setting document will be presented and discussed with the Employer prior to final issue of the document. The final accepted setting document should be made available to the Employer in PDF format.

It is the bidder's responsibility to configure each protection relay to provide the protection and control facilities required. A full set of relay configuration and setting files shall be included in the design and documentation submissions. The bidder will issue three sets of setting documents once accepted by the client and consultant

7.0 TYPE, ROUTINE AND ACCEPTANCE TESTS

FOR 66 KV CABLES &ACCESSORIES:
Reports for type tests on 66kV cables accessories as per IEC 60840/ IEC 61462.
Routine tests and Acceptance tests shall be conducted on cables as per IEC 60840, QA table and other relevant standards.

SITE TESTS:
Following site tests shall be carried out by the bidder and all the equipment required for the site tests shall be arranged by the bidder.
HV test as per clause 15.2 IEC 60840.
After completion of installation non-metallic outer sheath shall be tested in accordance with clause- 5 IEC 60229.

The insulation resistance of the cable shall be checked before & after the HV test on cable.
The core resistance shall be measured and the value corrected in accordance with clause 5 of IEC 60228.

1 INSTALLATION WORK AT SITE

I. Cable installation shall be carried out generally as per applicable standard/ manufacturer guidelines under GETCO supervision by the GETCO licensed contractor. Cable shall be laid buried. All necessary work like cable tagging, marking, dressing etc. as required shall be in contractor's scope.

II. All Hume pipes, precast RCC slabs, trefoil clamps, cable route markers etc required for cable laying shall be in vendor's scope of supply.

III. All road crossing of cable shall be done through Hume pipes GETCO approved grade.

IV. The cable termination and jointing work shall be carried out by an experienced cable jointer who shall have adequate experience in jointing and termination of 66kV or higher grade XLPE cables. The successful bidder shall submit, sufficiently in advance, the bio-data of the cable jointer giving the details of his qualification and experience for employer's approval.

V. The above activities are indicative and all works shall be done as per GETCO requirements.

8.0 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. Instrumentation / signal cable shall be of ~~225~~ **600V** grade. MV / HV cables shall be manufactured using dry curing method.
All cables shall be of Armored type.

9.0 Miscellaneous

1. 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.

2 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 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.

4 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

5 Receptacles

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

receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity.

6 Galvanising

Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & 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

7 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

10.0 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 and the same shall be finalized at pre-award stage.

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.

11.0 Metering System

Each 66 KV feeder bay shall consists of 2 sets of metering system, one at plant end other one at GETCO substation end. Thus for 2 feeder bay a total 4 nos of metering system shall be installed. Each metering system shall consist of 1 set of metering CT PT and metering panel containing one main meter and one check meter. All the Metering CT, PT, Metering Panel and ABT meter shall be as per GETCO approval for both plant side and GETCO substation side.

12.0 EARTHING SYSTEM

Earthing system shall be in strict accordance with IS: 3043 and Indian Electricity Rules/Acts.

12.1 Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All off-site areas shall be interconnected together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system.

12.2 The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects

12.3 The material of the earthing conductors shall be as follows :

1) Conductors above ground level and in built up trenches. -Galvanized steel

2) Conductors buried in earth -Mild steel

3) Earth electrodes -Mild steel rod

12.5 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed

by flexible insulated cable.

12.6 Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available , necessary connections shall be done by driving an earth electrode in the ground

12.7 Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors.

12.8 Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing.

12.9 Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.

12.10 Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.

12.11 Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.

12.12 Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.

12.13 Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.

12.14 Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.

12.15 A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.

12.16 Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.

12.17 Earth pit shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal if average resistance of soil is more

than 20 ohm meter.

12.18 On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.

12.19 Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.

12.20 Other Requirements of Earthing System:

Standard/Code	IEEE 80, IS 3043

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN mm

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

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66KV CABLE TO GETCO SUBSTATION

60 KV, 10KA LA

PT-1 60kV / 110V

CHECK METER / ABT / MAIN METER

CT-1 600/1A CL-0.2S 10VA

66 KV,1200A DISCH.ISOLATOR WITH E/S.

PT-2 60kV / 110V / 110V

MFM

BCPU

CT-2 600/1-1-1-1A

CORE-1 CL 5P20,15VA

CORE-2 CL 5P20,15VA

CORE-3 CL PS

CORE-4 CL 0.5S, 5VA

CORE-5 CL PS

TO 646

To MFM

SPARE

72.5 KV,1250A SF6 CB 25KA/3 SEC

18 WINDOW ANNUNCIATOR

66KV, 1200A, ISOLATOR

60 KV, 10KA LA STATION CLASS-III

POWER TRANSFORMER 66/33 kV, 36/600MA, ONAF YYyn0, %Z = 12% OLTC -10% TO +10%

INTERTRIP INTER TRIP 33 KV CB

FROM 33 KV CT

3RX 1CX 300 sqmm 33KV CABLE FROM MCR

TO 66/33KV POWER TRF

BAY EXTENSION SCOPE IN GETCO SUBSTATION

66KV Cable From 50MW FEEDER AT SPV END

60 KV, 10KA LA

METERING PT AS PER GETCO

METERING CT AS PER GETCO

TO EXISTING GETCO BAY

66KV Cable From 25MW FEEDER AT SPV END

60 KV, 10KA LA

METERING PT AS PER GETCO

METERING CT AS PER GETCO

TO EXISTING GETCO BAY

66KV CABLE TO GETCO SUBSTATION

60 KV, 10KA LA

PT-1 60kV / 110V

CHECK METER / ABT / MAIN METER

CT-1 600/1A CL-0.2S 10VA

66 KV,1200A DISCH.ISOLATOR WITH E/S.

PT-2 60kV / 110V / 110V

MFM

BCPU

CT-2 600/1-1-1-1A

CORE-1 CL 5P20,15VA

CORE-2 CL 5P20,15VA

CORE-3 CL PS

CORE-4 CL 0.5S, 5VA

CORE-5 CL PS

TO 646

To MFM

SPARE

72.5 KV,1250A SF6 CB 25KA/3 SEC

18 WINDOW ANNUNCIATOR

66KV, 1200A, ISOLATOR

60 KV, 10KA LA STATION CLASS-III

POWER TRANSFORMER 66/33 kV, 36/300MA, ONAF YYyn0, %Z = 12% OLTC -10% TO +10%

INTERTRIP INTER TRIP 33 KV CB

FROM 33 KV CT

2RX 1CX 300 sqmm 33KV CABLE FROM MCR

TO 66/33KV POWER TRF

66KV SWITCHYARD VENDOR SCOPE

TO AUXILIARY TRF

50MW Block

CONTROL ROOM

Line PT 33kV / 110V

Core-1: CL-0.5,100VA
Core-2: CL-3P,100VA

CT 1250/1-1-1-1A
CORE-1: CL-0.5,5VA
CORE-2: CL-5P20,5VA
CORE-3: 5P20,5VA
CORE-4: PS CLASS

For REF FOR TRF DIFF

VCB O/G 33kV, 1250A 25KA/1SEC

FROM O/G PT

CT 30/1-1A
CORE-1: CL-0.5,5VA
CORE-2: CL-5P20,5VA

VCB 33kV,630A 25kA/1SEC

33KV, 1250A, 25KA/3 SEC AL BUS BAR

1/C-3 TO 1/C-8

CT 1250/1-1A
CORE-1: CL-5P20,5VA
CORE-2: CL-0.5,5VA

FROM O/G PT

INVERTER ROOMS 3 TO 8

INVERTER ROOM-1 / INVERTER ROOM-2 / INVERTER ROOM-3 / INVERTER ROOM-10

1.5MWp DC 1.5MWp DC 1.5MWp DC 1.5MWp DC

PV ARRAY

25MW Block

CONTROL ROOM

Line PT 33kV / 110V

Core-1: CL-0.5,100VA
Core-2: CL-3P,100VA

CT 600/1-1-1-1A
CORE-1: CL-0.5,5VA
CORE-2: CL-5P20,5VA
CORE-3: 5P20,5VA
CORE-4: PS CLASS

For REF FOR TRF DIFF

VCB O/G 33kV, 1250A 25KA/1SEC

33KV, 1250A, 25KA/3 SEC AL BUS BAR

CT 1250/1-1A
CORE-1: CL-5P20,5VA
CORE-2: CL-0.5,5VA

FROM O/G PT

INVERTER ROOM-1 / INVERTER ROOM-2 / INVERTER ROOM-3 / INVERTER ROOM-4 / INVERTER ROOM-5

1.5MWp DC 1.5MWp DC 1.5MWp DC 1.5MWp DC

PV ARRAY

LEGEND:

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

REV.	DATE	ALTERED	CHECKED	APPROVED
00		FIRST ISSUE		

	NAME	SIGN	DATE
DRAWN	--		
CHECKED			
APPROVED			

DISTRIBUTION OF PRINTS

DEPT. SC&PV | CODE 439

PROJECT : 75MW SOLAR POWER PLANT
CUSTOMER : GIPCL

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

TITLE: AC SINGLE LINE DIAGRAM

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

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

SIZE A0

SUPERSEDED BY

INVENTORY NO.

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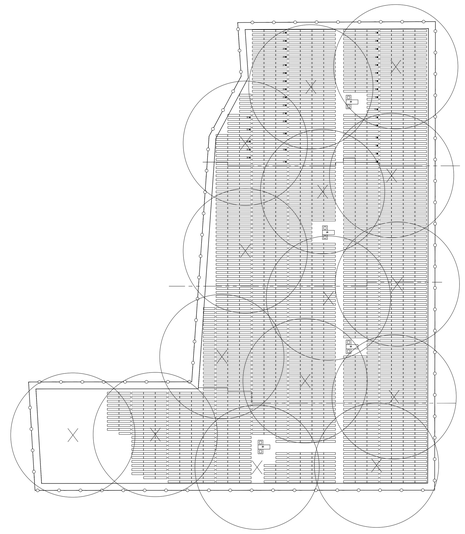


PLOT-B2

B → 2000 TABLES

C → 5291 TABLES

PLOT- C

239.147 Acer
96.77 HA

boundary and area

NOTES

a. Module Tilt Angle: 26°
b. Tables populated: 7556nos
c. Each MMS Table =40–(PV Modules)
d. Total number of Inverter Rooms :15
e. Total number of Control Room :1
f. Road Width :14 Mts
g. Plan of MMS table at 26 deg–(20x3.57)m
h. Inter row spacing from tip of one table to tip of another table (clear distance) – 3.36m
i. Invertor Room Size – 20.5m X 7.5m
j. Control Room Size – 36m X 11m
k. Switch Yard Size – 40m X 40m
l. Invertor Rooms in Plot B2 – 4
Invertor Rooms in Plot C – 11
m. No.of Tables in Plot B2 – 2000
No. of Tables in Plot C – 5291
n. All around Periphery – 12m offset maintained.

IMPORTANT NOTES

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

LEGEND

IR Room →

Control Room → 12 × 34

Switchyard → 40 × 40

MMS → 3.57 × 20

Road → 14

Boundary of plot B2 →

Boundary of plot C →

ALL DIMENSIONS ARE METER

REV.	DATE	ALTERED / CHECKED / APPROVED
00		FIRST ISSUE

	NAME	SIGN	DATE
DRAWN	SAN		220518
CHECKED	VJ		220518
APPROVED			
DISTRIBUTION OF PRINTS			

DEPT. SC&PV | CODE 439

PROJECT : 75MWp SOLAR POWER PROJECT
CUSTOMER : GIPCL

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

TITLE: ARRAY LAYOUT OF SPV PLANT

No. OF SHEETS 01 | SHEET No. 01 | REV 01

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

REF. DRG.NO. | SIGN & DATE | INVENTORY NO.

A0 SIZE

shall be UL 9th edition Approved/Listed and in conformance with international standards such as NFPA 72 2010 edition National Fire Alarm and Signalling Code for Human Life Safety. The complete system as a solution must be supplied from the same make/OEM manufacturer components conforming to these standards. The panel shall have the capability to integrate with SCADA on open protocol.

Smoke Detector: Analog Addressable Multi-Criteria Sensing Type Detector or Heat Detector as per application must be with mounting based LED, Address Switch inclusive of detector base and complete as required. All Detectors must be UL Listed & FM Approved.

Sounder : UL Listed Directional Sounders with 20 hz to 20 khz operating frequency with minimum 8 distinct sound patterns to indicate corridors, Exit doors, Move upward, move down ward etc. to direct Occupants for fast & safe Evacuation as specified in NFPA 72 - 2007 edition complete as per all requirements of technical specifications & contracts works.

Manual Call Point / Glass Break Device: UL listed, Flush or surface mounted Manual Call Point in manufacturers prescribed matching red enamel outlet box complete. All components must be of same manufacturing origin.

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

5.3.39 Vendor List

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

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

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

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

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

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

NOTES:

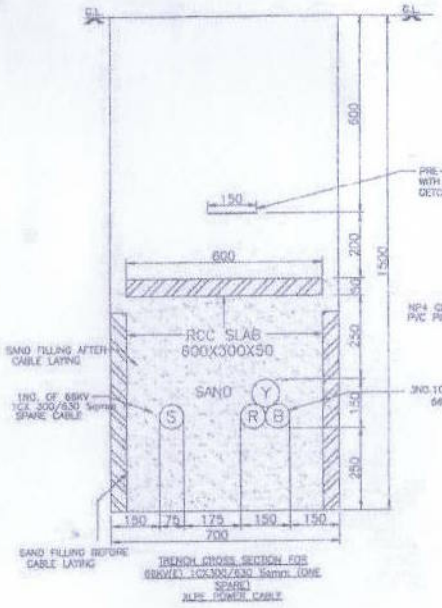
(1) The final make selected out of the recommended makes listed above shall be subject to the Owner's approval during detailed Engineering.

(2) Wherever the make is not specified for any other items, the contractor shall submit credential for vendors for relevant items / equipments, out of which Owner shall decide acceptance of vendor based on review of credentials. This shall have no price implication. Owner reserves the right to reject the proposed vendor without assigning any reason.

(3) Bidder may suggest /request for approval of Additional vendor with credentials and details for review and approval of Owner. Owner may consider the request in case proposed additional vendor is reputed and meeting the tender specification requirements. Owner reserves the right to reject the proposed vendor without assigning any reason.

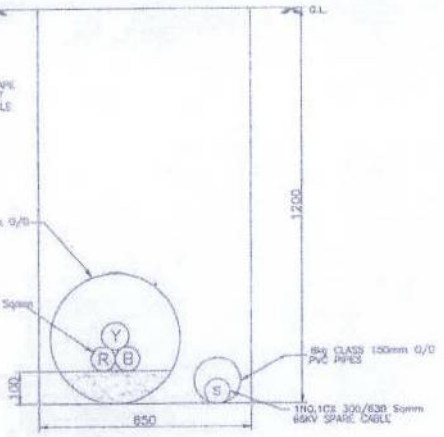
(4) For SCADA system common make of PLC / SCADA system is envisaged for all Plots allotted to GIPCL& GSECL i.e.2x75 MW. GIPCL/GSECL will provide required co-ordination for matching vendor of SCADA system for 2x75 MW projects.

METHOD OF CONSTRUCTION FOR 66KV U/G CABLE LAYING WORK AT GETCO,



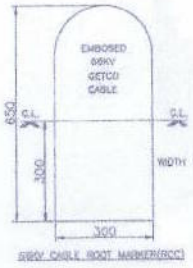
TRENCH CROSS SECTION FOR 66KV(E) 1CX300/630 Sqmm (ONE SPARE) XLPE POWER CABLE

(A) CABLE LAYING AT NORMAL EXCAVATION



TRENCH CROSSING SECTION FOR CABLES IN RCC HUME/PVC PIPES AT ROAD CROSSING FOR 66KV(E) 1CX300/630 Sqmm (ONE SPARE) XLPE POWER CABLE

(B) CABLE LAYING AT ROAD /NALA CROSSING



66KV CABLE ROOT MARKER(RCC)

NOTE:
1. ALL DIMENSION ARE IN MM.

TENDER PURPOSE

GUJARAT ENERGY TRANSMISSION CORPN.LTD.
S.P.VIDYUT BHAVAN, RACE COURSE,
VADODARA - 390 007

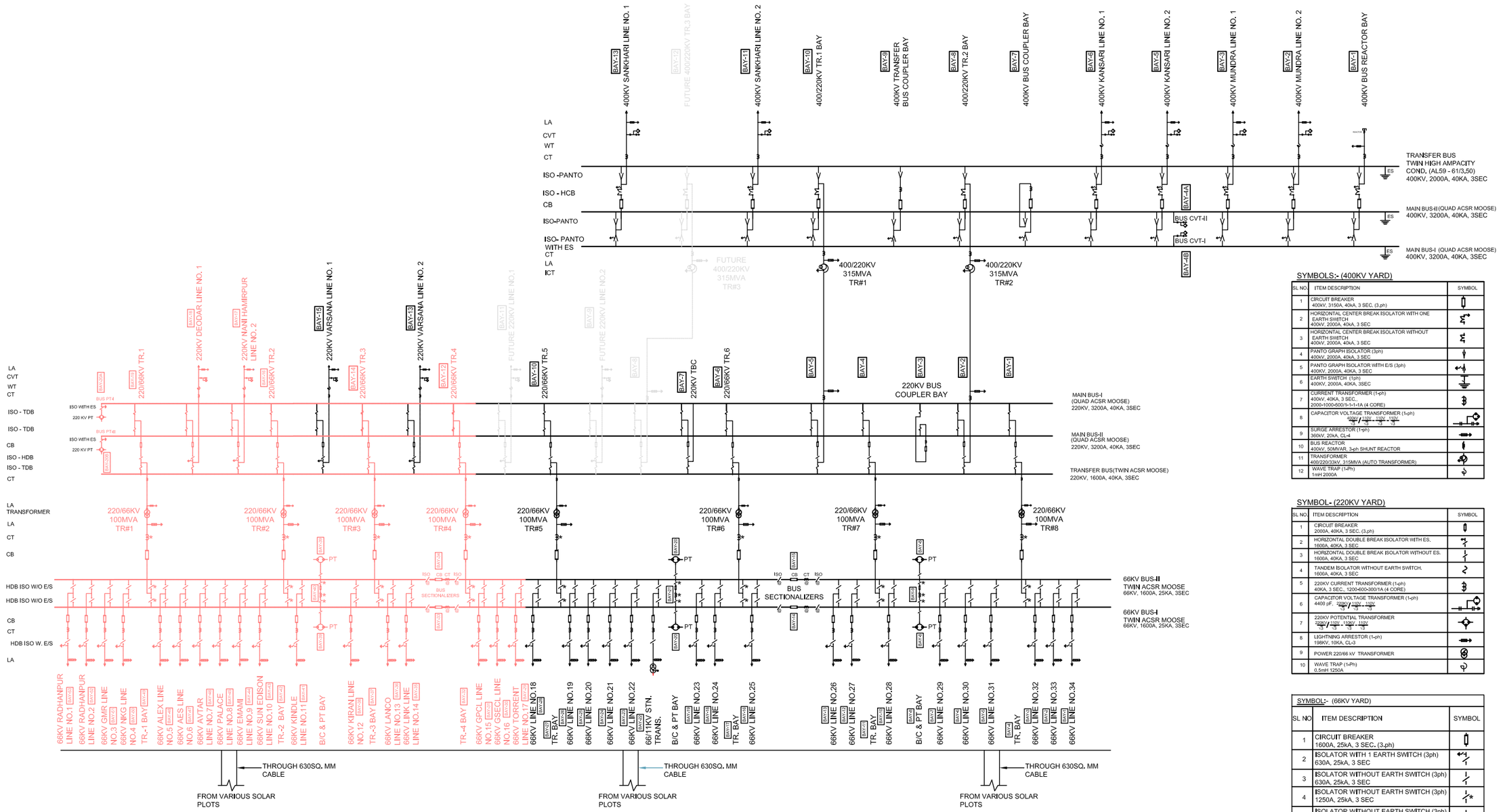
66 KV XCX300/630sqmm XLPE CABLE LAYING TRENCH DETAILS (UNDERGROUND CABLE)

		DRAWN:	CHECKED:	APPD:	SIZE: A3
REV:	DESCRIPTION	SIGN'D:	DATE:	DRG.NO:	SHEET: 1OF1 REV:

ANNEXURE-A

GETCO APPROVED CABLE LAYING AGENCIES FOR 66KV CABLES

	Name of cable laying agencies
1	M/s Rajesh Power Services Pvt. Ltd., Ahmedabad
2	M/s Supreme Services, Ahmedabad
3	M/s Vasudev Power Pvr. Ltd., Surat
4	M/s Siddharth Industries, Vadodara
5	M/s Parth Electrical & Engg. Pvt. Ltd., Vadodara
6	M/s Torrent Power Ltd., Ahmedabad
7	M/s HEC Infra Projects Pvt. Ltd., Ahmedabad
8	M/s GPI Projects Pvt. Ltd., Ahmedabad
9	M/s Shiralee Electricals, Ahmedabad
10	M/s Om Power Transmisison Pvt. Ltd., Ahmedabad
11	M/s Shri Sai Construction, Navsari
12	M/s Maktel Power ltd., Vadodara
13	M/s KEI Industries Ltd. New Delhi



SYMBOLS:- (400KV YARD)

SL NO.	ITEM DESCRIPTION	SYMBOL
1	CIRCUIT BREAKER 400KV, 3150A, 40kA, 3 SEC, (3,ph)	
2	HORIZONTAL CENTER BREAK ISOLATOR WITH ONE EARTH SWITCH 400kV, 2000A, 40kA, 3 SEC	
3	HORIZONTAL CENTER BREAK ISOLATOR WITHOUT EARTH SWITCH 400kV, 2000A, 40kA, 3 SEC	
4	PANTO GRAPH ISOLATOR (3ph) 400kV, 2000A, 40kA, 3 SEC	
5	PANTO GRAPH ISOLATOR WITH E/S (3ph) 400kV, 2000A, 40kA, 3 SEC	
6	EARTH SWITCH (1ph) 400kV, 2000A, 40kA, 3SEC	
7	CURRENT TRANSFORMER (1-ph) 400kV, 40kA, 3 SEC, 2000-1000-600/1-1-1A (4 CORE)	
8	CAPACITOR VOLTAGE TRANSFORMER (1-ph) 400kV / 110V - 110V - 110V	
9	SURGE ARRESTOR (1-ph) 360kV, 20kA, CL-4	
10	BUS REACTOR 400kV, 50MVAR, 3-ph SHUNT REACTOR	
11	TRANSFORMER 400/220/33kV, 315MVA (AUTO TRANSFORMER)	
12	WAVE TRAP (1-Ph) 1mH 2000A	

SYMBOL- (220KV YARD)

SL NO.	ITEM DESCRIPTION	SYMBOL
1	CIRCUIT BREAKER 2000A, 40KA, 3 SEC. (3,ph)	
2	HORIZONTAL DOUBLE BREAK ISOLATOR WITH ES. 1600A, 40KA, 3 SEC.	
3	HORIZONTAL DOUBLE BREAK ISOLATOR WITHOUT ES. 1600A, 40KA, 3 SEC.	
4	TANDEM ISOLATOR WITHOUT EARTH SWITCH. 1600A, 40KA, 3 SEC.	
5	220KV CURRENT TRANSFORMER (1-ph) 40KA, 3 SEC., 1200-600-300/1A (4 CORE)	
6	CAPACITOR VOLTAGE TRANSFORMER (1-ph) 4400 pF, 220kV / 110V - 110V	
7	220KV POTENTIAL TRANSFORMER 220kV / 110V - 110kV / 110V	
8	LIGHTNING ARRESTOR (1-ph) 198KV, 10KA, CL-3	
9	POWER 220/66 kV TRANSFORMER	
10	WAVE TRAP (1-Ph) 0.5mH 1250A	

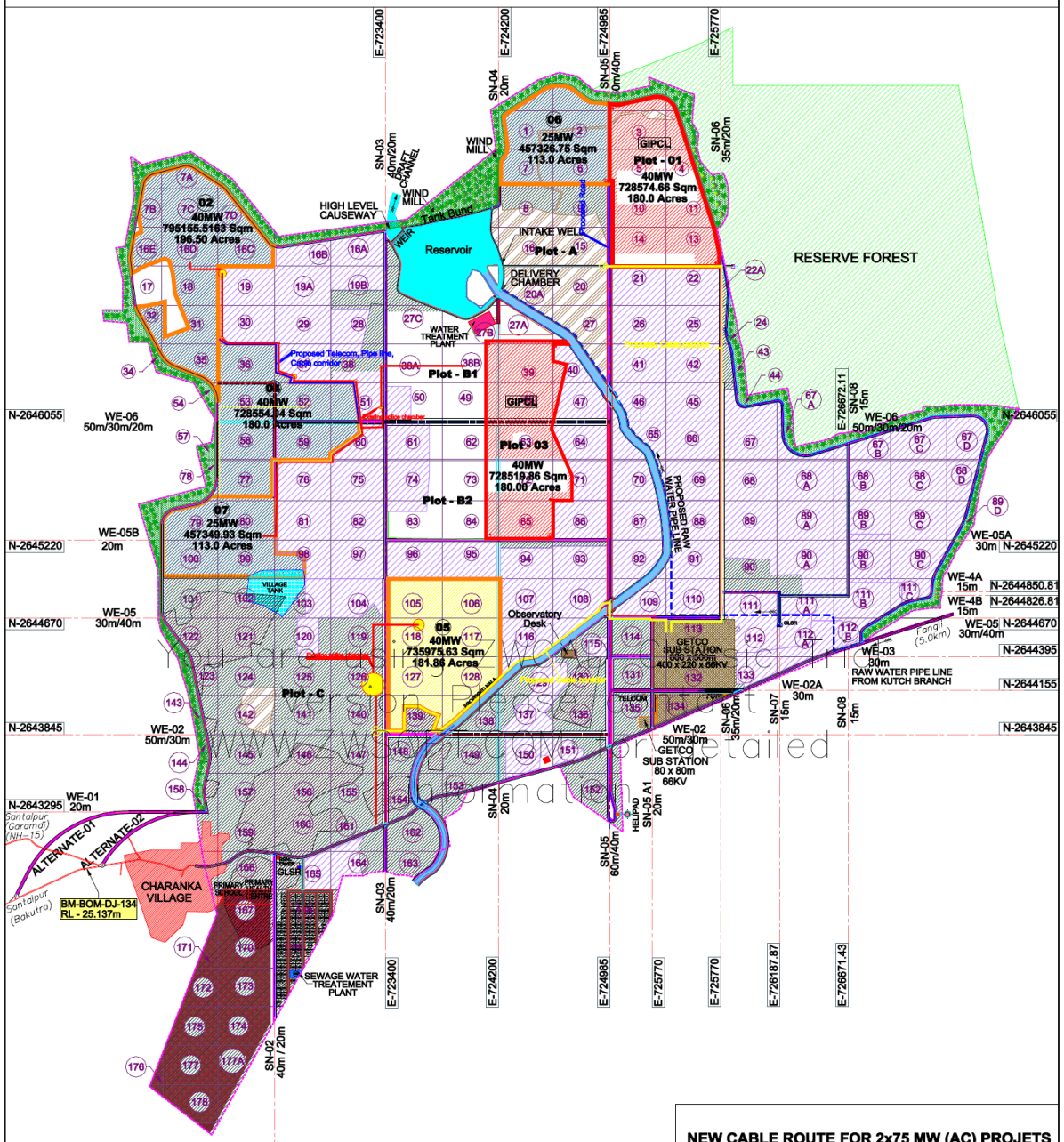
SYMBOL:- (66KV YARD)

SL NO.	ITEM DESCRIPTION	SYMBOL
1	CIRCUIT BREAKER 1600A, 25kA, 3 SEC, (3,ph)	
2	ISOLATOR WITH 1 EARTH SWITCH (3ph) 630A, 25kA, 3 SEC	
3	ISOLATOR WITHOUT EARTH SWITCH (3ph) 630A, 25kA, 3 SEC	
4	ISOLATOR WITHOUT EARTH SWITCH (3ph) 1250A, 25kA, 3 SEC	
5	ISOLATOR WITHOUT EARTH SWITCH (3ph) 1600A, 25kA, 3 SEC	
6	66KV CURRENT TRANSFORMER (1-ph) 31.5KA, 3 SEC., 1600-1200/1-1-1	
7	66KV CURRENT TRANSFORMER (1-ph) 31.5KA, 3 SEC., 1200-600/1-1-1	
8	66KV CURRENT TRANSFORMER (1-ph) 31.5KA, 3 SEC., 600-300/1-1-1	
9	66KV POTENTIAL TRANSFORMER 66KV / 110V - 110V	
10	LIGHTNING ARRESTOR (1-ph) 60kV, 10KA, CL-3	

GUJARAT ENERGY TRANSMISSION CORPN.LTD.

S.P.VIDYUT BHAVAN, RACE COURSE,
VADODARA - 390 007

MASTER PLAN OF CHARANKA SOLAR POWER PROJECT



Yearly maintenance work is carried out
Version Please contact
www.windtechnologies.com for detailed
information

NEW CABLE ROUTE FOR 2x75 MW (AC) PROJETS

Site Number	Capacity MW (AC)	Area Allotted Sq. Mtrs.	Length of Cable KM. (1 Phase)
A	75	7,60,809.00	3.780
B1		5,34,185.00	3.780
B2	75	4,04,686.00	2.930
C		8,96,783.38	2.930
Total	150	25,96,463.38	13.420

LEGEND	
PROJECT BOUNDARY	
PLOT NUMBER	93
INVESTORS DEVELOPMENT LAND	
PROPOSED SECI DEVELOPERS LAND	
SUBSTATION	
REMAINING LAND	
DROPPED OUT LAND	
PANCHAYAT LAND	
RESERVE FOREST	

CLIENT: GUJARAT POWER CORPORATION LTD.

GUJARAT SOLAR PARK

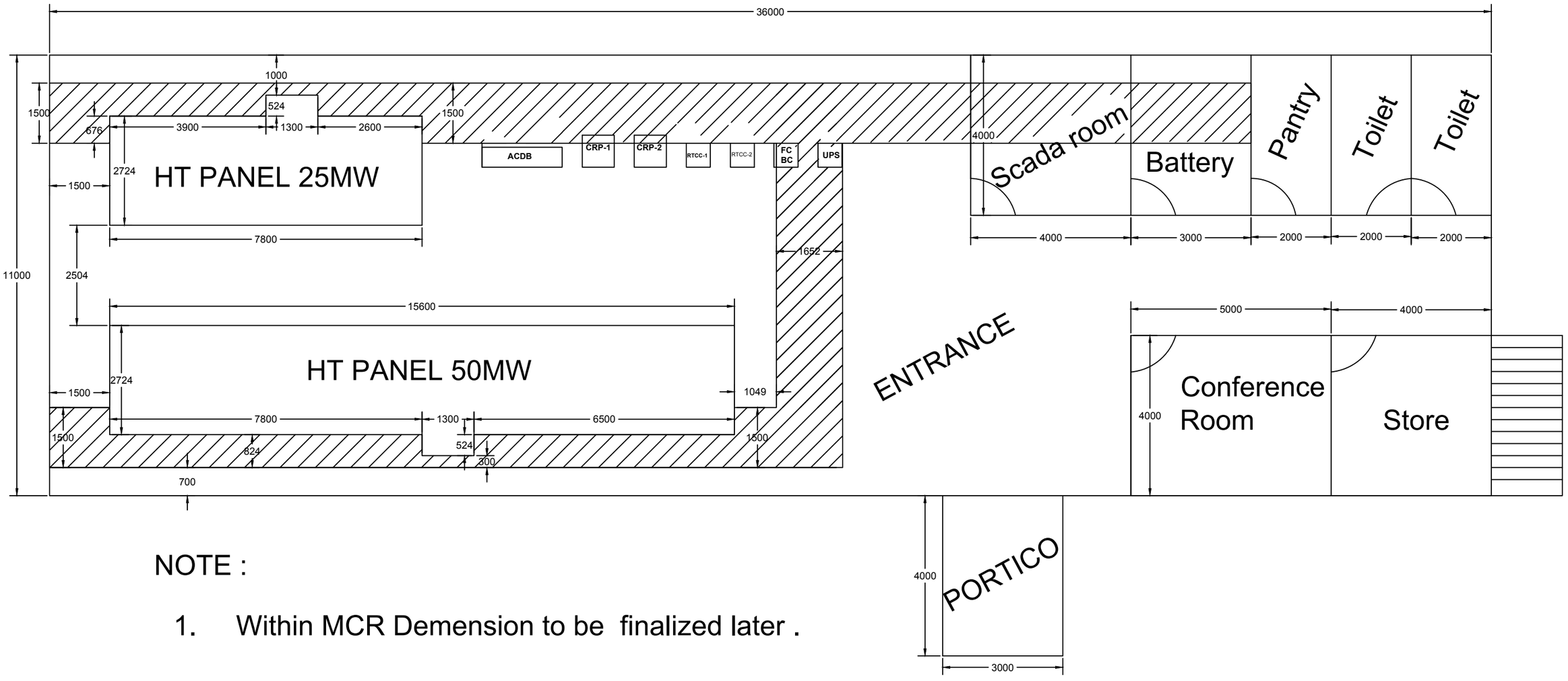
PROJECT TITLE: GUJARAT SOLAR PARK- CHARANKA

DRAWING TITLE: CABLE ROUTE DRAWING

Date	Drw.	Dsg.	Chk.	App.	Scale.	Drawing Status.
22.12.2017	NK	.	.	NR	NTS	FOR APPROVAL

Project No.	Drawing No.	Sheet No.	Rev.
GERMI-01	GERMI-GIPCL-CABLE-01	01 of 01	0

PRELIMINARY MCR LAYOUT



NOTE :

1. Within MCR Demension to be finalized later .

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