



OWNER:

THE TATA POWER COMPANY LIMITED

TITLE OF WORK TO BE AWARDED:

**ERECTION, TESTING AND COMMISSIONING PACKAGE FOR ELECTRICAL WORKS
FOR SHIRAWTA PSP**

ENQUIRY REFERENCE NO.: CC27FK026

NOTICE INVITING EXPRESSION OF INTEREST (EOI) FOR

ERECTION, TESTING AND COMMISSIONING PACKAGE FOR ELECTRICAL WORKS FOR SHIRAWTA PSP

Enquiry reference no.: CC27FK026
Title of Work: Erection, Testing and Commissioning Package for Electrical works for Shirawta PSP
Type of Bidding: E-tendering (through Ariba online portal) / Two Part (Technical and Price bids under separate envelopes)
Contact Details: All communication including EOI submission shall be addressed to following officer/s: Mr. Faizan Khatri Email: faizan.khatri@tatapower.com Copy of all communications shall be marked to (Cc): Mr. P Ramrayka / Mr. Ravi Shingare Email: p.ramrayka@tatapower.com / ravi.shingare@tatapower.com

The Tata Power Company Limited ("Owner") invites Expression of Interest (EOI) from interested parties for the Two-Part e-Tendering Process of following Relevant Work Package:

Table 1

Package Description	Tender Fee	Bid Security	Estimated Package Value
Erection, Testing and Commissioning Package for Electrical works for Shirawta PSP	INR 2000/- (INR Two Thousand Only) <i>To be submitted along with EOI. (Non-refundable tender participation fee)</i>	INR 2,00,000/- (INR Two Lakhs only). <i>Bid Security to be submitted as a Guarantee/ DD/ NEFT at the BID stage (and not with EOI)</i>	Rs. 1.5 Cr. (Indian Rupee One Crore & Fifty Lakhs)

1. INTRODUCTION:

The Tata Power Company Limited (TPC) is among the largest private sector Power Utility companies in India with presence in Generation, Transmission and Distribution of Power through conventional and renewable sources.

The tendering/procurement activities for this Package are being managed from Tata Power's following office:

Smart Center of Procurement Excellence (SCOPE),
Corporate Contracts,

The Tata Power Company Limited,
3rd Floor, Sahar Receiving Station, Near Hotel Leela,
Sahar Airport Road, Andheri East, Mumbai – 400 059.
Maharashtra, India.

2. SCOPE OF WORK:

Erection, Testing and Commissioning Package for Electrical works for Shirawta PSP.

Detailed Scope of Work shall be as per the below Technical Specifications (Ref No.: TCE.13376D-EL-4028-4004).

3. TENDER FEE & TIMELINES:

- a) Interested parties meeting the "Bidder Pre-Qualification Requirements" specified under point no. 4 in this document can request tender document and participate in the bidding process by submitting the Expression of Interest (EOI) Letter along with the Tender Fee Payment Details to the contact details mentioned below not later than deadline specified below. Request for extension of EOI submission date will be not entertained.
- b) **Interested bidders should submit the Expression of Interest by filling complete details in the Microsoft Forms available at:**

<https://forms.cloud.microsoft/r/N2x00Y73U8>

EOI / requests without complete information and communication as above within deadline shall be liable to be rejected and will not be considered further.

- c) Tender Fee, as indicated in the Table1 above may be paid through **NEFT/RTGS** as per details for payment of Tender Fee given in Table2 below:

Table 2

Details for payment of Tender Fee:	
Bank details for submitting Tender fees through bank transfer / NEFT:	Beneficiary Name: The Tata Power Company Limited Bank Name: HDFC Bank A/c no: 00600110000763 IFS Code: HDFC0000060 A/c type: CC Branch Name & Address: HDFC Bank, Maneckji Wadia Building, Nanik Motwani Marg, Fort, Mumbai 400023
Deadline for tender fee payment and submission of EOI:	23rd September 2026

d) Expression of Interest letter to be submitted along with tender fee payment details should include the following details:

- A covering letter duly stamped and signed by an authorized signatory clearly indicating the Tender Reference number and your EOI to participate in the tendering process.
- Tender fee payment details / reference no (ensure that tender fee is received by us within specified deadline)
- Bidder to indicate authorized person name, contact number and e-mail id (mandatory) of the person to whom RFQ / tender and all other communications to be addressed for this tender.

e) Detailed Bid Document (also referred as RFQ) shall be issued through Tata Power e-tender portal (Ariba System) only to the parties submitting a valid EOI as per terms mentioned in this document.

4. BIDDER PRE-QUALIFICATION REQUIREMENTS:

Interested parties to note that Bidder shall be required to fulfill the following bidder pre-qualification requirement / criteria to qualify for the subject work. Bidder will be required to submit relevant supporting documents to demonstrate their qualification during the bid submission stage against Tender document / RFQ and bidders not found meeting the pre-qualification requirements given below will be disqualified from the tender.

4.1 TECHNICAL REQUIREMENT:

1. Bidder should have successfully executed and commissioned at least three similar Contracts each of value not less than Rs. 1 Crore during the last seven (7) years. **(Bidder to submit PO copies/work completion certificate)**
2. Bidder shall have executed works involving erection, testing and commissioning of 22 kV switchgear, transformers, protection systems, power/control cables, 22KV DP structures, lighting system, earthing system and downstream 415 V distribution system in power plants, hydro projects, PSPs, substations, process industries or similar installations. **(Bidder to submit Work Completion Report /Certificate)**
3. Bidder shall have experience in the supply, installation, testing and commissioning of metering systems/scheme conforming to the standards, specifications and technical requirements approved by Maharashtra State Electricity Distribution Co. Ltd. (MSEDCL). **(Bidder to submit Work Completion Report /Certificate)**

4. Bidder shall hold a valid Electrical Contractor License issued by the appropriate statutory authority of the respective state and such license shall remain valid throughout the contract period. **(Bidder to submit valid Electrical Contractor's License)**
5. Bidder shall submit satisfactory performance certificates (at least 2 nos.) from end users for completed projects confirming successful commissioning and operation of the electrical system. **(Bidder to submit Work Completion Report / Certificate of similar scope)**

It may be noted that the above requirements are minimum qualification criteria. However, Tata Power reserves its right to further assess the capabilities of the parties and reserves its rights to further shortlist, accept or reject any party without assigning any reason.

FINANCIAL REQUIREMENT:

Bidder / Tenderer should have minimum Average Annual Turn-over of Rs. 3 Crore (Indian Rupees Three Crore) during the last three financial years **(Attach CA Certified P&L statement with UDIN Number)**

It may be noted that the above requirements are minimum qualification criteria. However, Tata Power reserves its right to further assess the capabilities of the parties and reserves its rights to further shortlist, accept or reject any party without assigning any reason. The tender may be split in more than one parties at the discretion of Owner. Consortiums are not permitted and bidder shall have to meet the PQR in individual entity basis only.

5. BID SECURITY / EMD:

Interested parties to note that Bidder will be required to furnish a Bid Security along with their Bid, in the format prescribed in Bid Document **in the form of Bank Guarantee or through RTGS or Demand Draft**, for an amount as defined in the covering page of this notice document. Bids not accompanied by an acceptable Bid Security shall be rejected by the Owner as being non-responsive and returned to the bidder without being opened.

Interested parties to note that Bid Security is not required with the EOI and it is required to be submitted with the Bid only during Bid Submission stage once RFQ is released to the interested parties that have submitted a valid EOI.

6. BIDDING PROCESS:

Detailed Bid Document (also referred as RFQ) shall be issued through Tata Power e-tender portal (Ariba System) only to the parties that submitted a valid EOI as per terms mentioned in this document.

Bidder to note that commercials for subject tender may be conducted through e-auction. Detailed bidding and auction process shall be detailed in the RFQ / tender document.

THE TATA POWER COMPANY LTD				Price Schedule - I			
CC27FK026 - Erection, Testing and Commissioning Package for Electrical works for Shirawta PSP				SUPPLY		ETC SERVICES	
Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
1	Installation, testing and commissioning of following MV Switchgear panel (including loading/unloading at site) as per specification & direction of Engineer-In charge						
1.1	MV Switchgear: 22 kV 3 phase, 50Hz, Floor mounted, Free standing, compartmentalised, draw-out type VCB panel (1 no. incomer + 2 nos. Outgoing feeder + 1No. Spare feeder+ Bus PT, refer SLD)	No.	1	NA	NA		
1.2	MV ICOG Panel: 22 kV 3 phase, 50Hz, Floor mounted, Free standing, compartmentalised draw-out type VCB panel (1 No. ICOG, refer SLD)	No.	1	NA	NA		
2	Supply, Installation, testing and commissioning of following LV panel (including loading/unloading at site) as per specification & direction of Engineer In-charge						
2.1	415V, 3 phase, 50Hz, TPN, Floor mounted, Free standing, Compartmentalised, fixed type, 415V Substation Distribution board, refer SLD (Indoor Type)	No.	1				
3	Supply, Installation, testing and commissioning, FAT (Incl logistics of MSEDCL representatives) of following Indoor Tariff metering panel & Audit metering panel (including loading/unloading at site) as per specification & direction of Engineer-In charge						
3.1	<u>Tariff metering panel at SS-1</u> a) Two meters: Secure Make Apex 150 3P4W, Self-Powered + Aux Power Accuracy Class: 0.2s PT: 22kV/V3 /110V/V3 CT: ***/1A, (Configurable 1-10A), RS-232, RS-485, Ethernet Configurable Pulse I/O: 4 Fixed Pulse O/P: 7 b) PQR (Power quality recorder) as per MSEDCL requirements c) Base Computer software: (M-cubed software with 5 year license) d) Meter Reading Instrument (MRI) Make-SANDS e) Meter to PC (Serial Communication Cable) f) USB to Serial Communication Cable Make : MOXA g) Modem Skyline E90, NbloT Modem Fall back to 2G	No.	1				

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
3.2	<u>Audit metering panel at SS-1</u> a) Four meters: Secure Make Apex 150 3P4W, Self-Powered + Aux Power Accuracy Class: 0.2s PT: 22kV/V3 /110V/V3 CT: ***/1A, (Configurable 1-10A), RS-232, RS-485, Ethernet Configurable Pulse I/O: 4 Fixed Pulse O/P: 7 b) PQR (Power quality recorder) as per MSEDCL requirements c) 8 Port Industrial LAN switch unmanaged d) Data Concentrator Unit (DCU)-Kalkitech Make	No.	1				
3.3	<u>DCU Sync & Configuration Services</u> a) Integration of new meter with Kalkitech DCU (By MSETCL team) Coordination with MSETCL & Kalkitech team for data integration at SLDC. b) Supervision of Installation and Commissioning of APEX meters.	No.	1				
4	Supply, installation, testing and commissioning, FAT (incl logistics of MSEDCL representatives) of following 22 kV MV Indoor CTPT panel as per specification & direction of Engineer-In charge						
4.1	22 kV Indoor metal clad CT PT Panel (Refer SLD) (To be complied MSEDCL requirement for metering)	Nos.	3				
5	Supply, installation, testing and commissioning of 22 kV Switchyard as per specification & direction of Engineer-Incharge						
5.1	22 kV, Double pole, 200x100mm RSJ structure with all supporting insulators, AB Switch with handle & locks, Lightning arrestor, LA copper rod, DO Fuse, Stay wire, required jumpers, bimetallic clamps, civil foundations, etc (Type -1)	Nos.	4				
5.2	22 kV, Double pole, 200x100mm RSJ structure with all supporting insulators, AB Switch with handle & locks, Lightning arrestor, LA copper rod, DO Fuse, Stay wire, required jumpers, bimetallic clamps, civil foundations, etc (Type -2)	No.	1				
5.3	22 kV, Double pole, 200x100mm RSJ structure with all supporting insulators, Lightning arrestor, LA copper rod, Stay wire, required jumpers, bimetallic clamps, civil foundations, etc (Type -3)	No.	1				
6	Installation, testing and commissioning of 22 kV Auxiliary transformer as per specification & direction of Engineer-Incharge						

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
6.1	Outdoor Transformer: 50 kVA, 22 kV/0.433 kV, ONAN, Z = *4%, OCTC with +5% instep of 2.5%, including civil foundations.	No	1	NA	NA		
7	Supply, installation, testing and commissioning of Battery, charger & DB as per specification & direction of Engineer-Incharge						
7.1	1 x 100% 3phase, 415 V input & 110 V DC output, Float charger + Float cum Boost charger (FC+FCBC) suitable for 200Ah batteries (> 50 Amps) (It includes inward & outgoing cables of Batteries) with all accessories as required	No	1				
7.2	200Ah (1 x 100%) VRLA batteries with Battery racks and accessories as required (It includes cables for Batteries)	Lot	1				
7.3	110 V, DC Floor mounted Distribution board for the charger/battery, refer SLD.	No	1				
8	Installation, testing and commissioning of Single/Multicore, 22kV (E) grade stranded & compacted aluminium conductor, extruded semi conducting screen over conductor, XLPE insulated, semi-conducting followed by copper tape screened, extruded PVC Type ST – 2 inner sheathed, aluminium/GS wire armoured, overall FRLS PVC outer sheathed, conforming to IS 7098 (Part II) – Laid in overhead trays /trench/hume pipe/tunnel. (Unit rate quoted for cable laying shall include supply & Installation of cable by 3mm nylon cord, Aluminium Cable identification plate at specified)						
8.1	3C X 300 Sq.mm	m	300	NA	NA		
9	Supply, installation, testing and commissioning of MV Power cable Terminations, (Unit rate quoted for cable termination at one end shall include supply of all accessories like glands, lugs, etc as listed below, and dressing, connecting all the cores of the cables, making the requisite holes on the gland plate of the switchgear / any other panel / equipment, fixing glands, terminating the cables in the cable boxes, earthing of cable armour & glands, crimping of cable lugs on each, supply and fixing of core identifying ferrules on each, neatly clamping the cables inside switchgear / panel cable alleys, wiring troughs and connecting to terminals as per the wiring diagrams and schedules).						

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
9.1	22 kV (E) Grade cable termination including termination kit - indoor type						
9.1.1	3C X 300 Sq.mm	Nos.	9				
9.2	22 kV (E) Grade cable termination including termination kit - Outdoor type						
9.2.1	3C X 300 Sq.mm	Nos.	11				
9.3	22 kV (E) Grade cable joining including Jointing kit for the cables included in the scope						
9.3.1	3C X 300 Sq.mm	No.	1				
10	Supply, installation, testing and commissioning of 1.1 kV grade single/multi-core, stranded Copper/ Aluminium conductor, extruded XLPE insulated, with extruded PVC inner sheath (Type ST-2), armoured and overall sheath with extruded Flame Retardant Low Smoke (FRLS) PVC compound (Type ST-2). These cables shall conform to IS-7098-Part-I – Laid in overhead trays / trench / hume pipe / tunnel. (Unit rate quoted for cable laying shall include supply & installation of cable by 3mm nylon cord, Aluminium Cable identification plate at specified interval)						
10.1	1.1 kV Grade Power cable						
10.1.1	3C x 2.5 Sq.mm (Cu)	m	120				
10.1.2	4C x 4 Sq.mm (Cu)	m	60				
10.1.3	4C x 10 Sq.mm (Al)	m	20				
10.1.4	4C x 16 Sq.mm (Al)	m	30				
10.1.5	3.5C x 25 Sq.mm (Al)	m	50				
10.2	1.1 kV Grade Control cable (Copper)						
10.2.1	5C x 4 Sq.mm	m	90				
10.2.2	7C x 4 Sq.mm	m	90				

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
11	Supply, installation, testing and commissioning of LV Power, Control & signal cable Terminations,						
	(Unit rate quoted for cable termination at one end shall include supply of all accessories like glands, lugs, etc as listed below, and dressing, connecting all the cores of the cables, making the requisite holes on the gland plate of the switchgear / any other panel / equipment, fixing glands, terminating the cables in the cable boxes, earthing of cable armour & glands, crimping of cable lugs on each, supply and fixing of core identifying ferrules on each, neatly clamping the cables inside switchgear / panel cable alleys, wiring troughs and connecting to terminals as per the wiring diagrams and schedules).						
	11.1 1.1 kV Grade cable termination – Power cable						
	11.1.1 3C x 2.5 Sq.mm (Cu)	Nos.	12				
	11.1.2 4C x 4 Sq.mm (Cu)	Nos.	20				
	11.1.3 4C x 10 Sq.mm (Al)	Nos.	2				
	11.1.4 4C x 16 Sq.mm (Al)	Nos.	6				
	11.1.5 3.5C x 25 Sq.mm (Al)	Nos.	2				
	11.2 1.1 kV Grade cable termination – Control cable (Cu)						
	11.2.1 5C x 4 Sq.mm	Nos.	16				
	11.2.2 7C x 4 Sq.mm	Nos.	16				
12	Supply, installation, testing and commissioning of Heavy-duty GI Cable trays with associated accessories such as coupler plates, tees, elbows, nuts, bolts, clamps, washers, etc., for the HT/LT power, control & signal cables as per specification & direction of Engineer-Incharge						
	12.1 Ladder Trays						
	12.1.1 150 mm width	m	80				
	12.1.2 300 mm width	m	10				
	12.1.3 450 mm width	m	45				
	12.1.3 600 mm width	m	10				
	12.2 Perforated Trays						
	12.2.1 50 mm width	m	5				
	12.2.2 100 mm width	m	5				
	12.2.3 150 mm width	m	35				
	12.2.4 300 mm width	m	5				

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
13	Supply, installation, testing and commissioning of Fire Proof Sealing system as per specification & direction of Engineer-Incharge						
13.1	Fire Stop / Sealing system for Cables penetrations with minimum two-hour fire protection rating	sq.m	5				
13.2	Fire break coating for Cables & Cable trays with minimum two-hour fire protection rating	Lit	2				
14	Excavation & back filling compacting for directly buried cables including supply of necessary items as per specification & direction of Engineer-Incharge. (Unit rate quoted for cable laying shall include protective covers, cable tags, markers & sand and all materials & accessories required for cable laying).						
14.1	300/450 mm Width X 1000 mm Depth	m	150	NA	NA		
14.2	700 mm Width X 1000 mm Depth	m	10	NA	NA		
15	Supply, design, installation, testing and commissioning of Conduits as per specification & direction of Engineer-Incharge						
15.1	25 mm GI Conduit with all associated fittings like couplers, bends and tees as required	m	70				
15.2	25 mm heavy duty PVC Conduit with all associated fittings like couplers, bends and tees as required	m	10				
16	Supply, design, fabrication, installation, testing and commissioning of MS supports including welding, bolting, riveting, supply of necessary anchor bolts and grouting etc, for structures as required including supply of all MS hardware materials, including all labour and materials for installation of cable tray supports, cable carrier structures in trenches / tunnels, vertical raceways, supports for mounting junction boxes / LPBS stations, equipment / panel supports as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.	MT	1				

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
17	Supply, design, installation, testing and commissioning of Lighting fixtures (Industrial type) as per specification of this tender and directions of Engineer-in-Charge: (Unit rates quoted for installation shall include all materials required to mount the fixtures on Pole / RCC slab / Column / Wall / PEB Structures, Providing suspension of high bay fixtures, GS conduit for suspension of fixtures, hooks in the RCC slab if required, Conduit Box with Ball & Socket suspension, fixing accessories including Galvanized screws, bolts and nuts including all labour and materials cable/wire terminations, etc.) (Model nos. of light fixture shall be considered same model or equivalent model in other makes as per vendor list can be considered.)						
17.1	120 Watts, Industrial LED Street light fixture with extruded aluminium housing as heat sink, heat resistant toughened glass, control gear compartment. Degree of protection IP 66. CGL ref.: Crompton RAPTOR PRO_120W or equiv.	Nos.	3				
17.2	20 Watts, Industrial LED Street light fixture with extruded aluminium housing as heat sink, heat resistant toughened glass, control gear compartment. Degree of protection IP 66. CGL ref.: Crompton Wanderer _20W or equiv.	Nos.	8				
17.3	2 x 20 Watts, Industrial LED light fixture with polycarbonate housing aluminium gear tray and opal cover of polycarbonate suitable for surface mounting. Minimum degree of protection IP 66. CGL ref. Cat. No.: IPFC112LT8-20 or equiv.	Nos.	18				
17.4	18 Watts, Industrial LED light fixture with round panel with body made from die cast aluminium and CRCA covering, powder coated suitable for surface mounting. Minimum degree of protection IP 20. CGL ref. Cat. No.: LCDSPLN-R-18-CDL or equiv.	Nos.	2				
17.5	2X10 Watts, automatic, industrial LED light fixture with CRCA sheet steel housing and opal diffuser suitable for surface / suspended / wall mounted consisting of rechargeable NI-CD battery (MIN 4 HOURS BACK UP), battery charger, & change-over circuitry in one compact unit housing inside the luminaire (IP20)	Nos.	2				
18	Supply, design, installation, testing and commissioning of Lighting Poles as per specification & direction of Engineer-Incharge (Unit rates quoted shall include junction box, Pipe sleeve, excavation of soil, cable terminations, lugs and glands, cable between junction box and lighting fixtures, backfilling, foundations, 4m-earthing rod with 25x6GS flat for pole earthing including all labour and materials, etc)						

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
18.1	Swaged single arm curved street light pole – Height 11 m from FGL (total height 13m)	Nos.	3				
18.2	1.5-meter height Pipe support for wall mounted street light fixture	Nos.	8				
19	Supply, design, installation, testing and commissioning of the following items of Lighting system & accessories: (Unit rates quoted for installation shall include all materials required to mount the following item on RCC slab / Column / Wall/PEB Structures, fixing accessories including Galvanized screws, bolts and nuts including all labour and materials, as per specification of this tender and directions of Engineer-in-Charge)						
19.1	32A LDB (Incoming-32 A MCB 4pole, Outgoing: 16A, TPN,4P, RCBO+ASTRO TIMER-3 Nos., DP RCBO 16A- 3Nos., DP RCBO 10A- 6Nos.,						
19.2	1no. 10A Switch with 2nos. 5A socket with switchbox, cover plate	Nos.	3				
19.3	5/15A combined switch socket outlet	Nos.	3				
19.4	4 No of 5A SWITCH with suitable metal box and plain cover plate.	Nos.	4				
19.5	32A three phase outdoor type, welding receptacle with RCBO & necessary interlocks.	No.	1				
19.6	1.1 kV FR PVC, stranded 2.5 Sq.mm CU wire	m	200				
19.7	1.1 kV FR PVC, stranded 4 Sq.mm CU wire	m	140				
20	Supply, installation, testing and commissioning of following size earthing strip/rod along the buildings, cable trenches or cable trays including welding at joints, providing anti-corrosive paint or bitumen for welded portion, clamping and necessary hardware for connecting, etc., including all labour and materials, as per specification of this tender and directions of Engineer-in-Charge						
20.1	25 mm dia MS rod buried in ground at a depth of around 600 mm deep, formed as ring / grid arrangement including excavation & backfilling	m	250				
20.2	50 x 10 GS Flat – Sub grid	m	90				
20.3	8 SWG GS Conductor	m	35				
20.4	25 x 6 GS Flat	m	140				
20.5	50 x 10 GS Flat	m	100				
20.6	40 x 6 Copper Flat	m	10				
20.7	1500 mm x 1500 mm grid with gap 300mm, conductor 50x10GS flat, for below Disconnector candle at 600 mm depth	Nos.	5	NA	NA		
20.8	65mm DIA×4000mm Long Pipe earth electrodes (GS) treated earth pit	Nos.	8 of 12				

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
20.9	40mm DIA×4000mm Long solid earth electrodes (MS) Non-treated earth pit	Nos.	20				
20.10	Electronic Earth pit (treated earth pit)	No.	1				
20.11	Soil resistivity test & report (No. of test locations 3)	No,	1	NA	NA		
21	Supply, installation, testing and commissioning of following equipment for lightning protection system along the buildings, structures, etc including excavation & backfilling work, support insulators, clamps, welding at joints, providing anti-corrosive paint or bitumen for welded portion, clamping and necessary hardware for fixing/ connecting, etc., including all labour and materials, as per specification of this tender and directions of Engineer-in-Charge.						
21.1	Test Link box (FRP)	Nos.	6				
21.2	25 x 6 GS Flat	m	180				
21.3	25mm dia, 1m long Cu rod	Nos.	4				
21.4	40mm DIA × 4000mm Long solid earth electrodes (MS) Non-treated earth pit	Nos.	6				

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Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total	Unit Rate	Total
22	Supply, installation, testing and commissioning of following Safety Equipment as per specification & direction of Engineer-Incharge						
22.1	First Aid Box	Nos.	2				
22.2	Safety chart with stand	Nos.	2				
22.3	Caution board as per IS-2551 (200x150)	Nos.	10				
22.4	Sand Buckets with stand (Each with at least 3 sand buckets)	Nos.	2				
22.5	Fire extinguishers						
	a) CARBON DIOXIDE - 5 kg (As per IS 2878, TAC Guide Lines)	Nos.	2				
23	Supply and laying of 1000mm wide safety insulation mats for maintenance of electrical equipment in substation, including cutting to required shape as per IS						
	a) Suitable for 415 V system. (1 kV Grade)	m	6				
	a) Suitable for 22 kV system (24 kV Grade)	m	15				
24	Obtaining approval from local statutory authorities including Electrical Inspector, wherever applicable, as stated in Specification	No.	1				
25	Commissioning and Start-up spares as per specification	Lot	1				
26	Mandatory spares as per specification	Lot	1			NA	NA
Sub Total							
GST				_____ %		_____ %	
Grand Total							
Sub Total (Supply + ETC Services)							
Grand Total (Supply + ETC Services)							

(Authorised Signatory with company seal)

Name:

Date:

Designation:

Bidder Name:

Place:

THE TATA POWER COMPANY LTD				Price Schedule - II	
CC27FK026 - Erection, Testing and Commissioning Package for Electrical works for Shirawta PSP				Unloading	
Sr. No.	Brief Item Description	UoM	Qty	Unit Rate	Total
1	MV SWITCHGEARS				
1.1	SS-3: 22 kV switchgear panel	No	1		
1.2	SS-4 22 kV ICOG panel	No	1		
1.3	Spares	Lot	1		
2	TRANSFORMERS				
	<u>Auxiliary Transformer-1 (AT-1)</u>				
2.1	Auxiliary Transformer (AT) 50 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=4%, OCTC ±5% in steps of 2.5% Service Transformer at SS-1 Substation.	No	1		
2.2	Spares	Lot	1		
3	MV CABLES & ACCESSORIES				
3.1	22kV (E) grade, 3C x 300 sqmm stranded aluminium conductor, XLPE insulated with all the screens, PVC inner sheathed, GS wire armoured, overall FRLS PVC outer sheathed suitable for directly buried in soil and outdoor.	m	300		
3.2	Heat shrinkable type joint kit suitable for the 22kV (E) grade, 3C x 300 sq.mm stranded aluminium conductor cables and directly buried in soil and outdoor.	No	1		
Sub Total					
GST				_____ %	
Grand Total					

(Authorised Signatory with company seal)

Name:

Date:

Designation:

Bidder Name:

Place:

TATA POWER COMPANY LIMITED (TPCL)



**ENABLING INFRASTRUCTURE FOR SHIRAWTA PUMPED
STORAGE PROJECT (1800MW)**

**SPECIFICATION
FOR
ERECTION TESTING & COMMISSIONING PACKAGE
FOR ELECTRICAL**

SPECIFICATION No. TCE.13376D-EL-4028-4004



**TATA CONSULTING ENGINEERS
71, CUNNINGHAM ROAD
BANGALORE 560 051
INDIA**

APRIL 2026

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SPEC.NO. TCE.13376D-EL-4028-4004	Tata Power Company Limited (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: A1 SHEET 1 OF 1
	TITLE SCOPE OF ENQUIRY	
1.0 This enquiry concerns the design, manufacture, inspection and testing at manufacturer's work, packing and forwarding, delivery to site including transit insurance, loading & unloading from carriers / wagons, shifting of unloaded items to store, handling, erection, testing & commissioning of electrical equipment/systems required for Construction power supply arrangement & related works as specified. 2.0 The extent of supply and works under this contract shall include all items / services required for satisfactory operation of electrical system/equipment of Enabling Infrastructure for pumped storage projects in line with applicable standards and good engineering practices. 3.0 The Bidder shall visit the site and acquaint themselves thoroughly with the site conditions as required. 4.0 It is not the intent to specify completely herein all details of design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing continuous commercial operation in a manner acceptable to the Purchaser, who will interpret the meaning of drawings and specifications and shall have the power to reject any work which in his judgement is not in full accordance therewith. 5.0 The extent of supply and works under this contract includes all items indicated in the specification, notwithstanding the fact that such items may have been omitted from the drawings or schedules. Similarly, the extent of supply also includes all items mentioned in the drawings notwithstanding the fact that such items may have been omitted in the specifications and / or schedules. 6.0 All equipment shall be new and of make as specified in the specification. The bought-out equipment for which the makes are not specified shall be of reputed make and shall be subject to approval by the Purchaser after award of Contract. 7.0 Bidder shall furnish all the information called for and all filled in formats, Data Sheet - B and the various other schedules of specification. The Bidder shall furnish the schedule of drawing submission for all the equipment indicating the dates for submission for each of the drawing / document after award of contract. The list of minimum drawings / documents to be submitted after award of contract is covered in respective sections of each system / equipment. 8.0 For the equipment / system offered, all deviations from the specification shall be clearly listed in the "Schedule of Deviations". If no deviations are indicated, it will be presumed that the offer conforms to the specifications in all respects. 9.0 Bidder shall furnish the price for start-up and essential spares listed in Section – D10. In addition, the Bidder shall furnish a list of recommended spare parts with the unit price of each spare part, which, in his opinion, is necessary for the trouble-free operation of the equipment for a period of 5 years.		
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SPEC.NO. TCE.13376D-EL-4028-4004	Tata Power Company Limited (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: A2 SHEET 1 OF 1
	TITLE DEFINITION OF TERMS	
1.0 'Pumped Storage Project' or 'PSP' shall mean pumped storage plant equipment/system including all the facilities associated with the project. 2.0 'BIDDER' shall mean the firm / party who quotes against an enquiry. 3.0 'Specification' shall mean collectively all the terms and stipulations contained in those portions of the 'Contract' known as General Conditions, the Specifications and such Amendments, Revisions, Deletions or Additions, as may be made in the Agreement and all written Agreements made or to be made pertaining to the method and manner of performing the work or to the quantities and qualities of the materials to be furnished under this 'Contract'. 4.0 'Approved' and 'Approval' where used in the 'Specification' shall mean, respectively approved by / approval of the OWNER / PROJECT MANAGER. When the words 'Approved', 'Approval', 'Subject to Approval', 'Satisfactory', 'Equal To', 'Proper', 'Requested', 'As Directed', 'Where Directed', 'When Directed', 'Determined by', 'Accepted', 'Permitted' or words and phrases of like import are used; the approval, judgement, direction etc., is understood to be a function of the OWNER / PROJECT MANAGER 5.0 'Minor Modification' as applied to equipment erection contracts only, shall mean the modification work required to be done on the Equipment and works, which need a maximum of 48 man-hours per item of work. In the case of civil contracts, it shall be works, which need a maximum of 8 man-hours per item of work. 6.0 'Major Modification' as applied to equipment erection contracts only, shall mean the modification work required to be done on the equipment and works needing more than 48 man-hours per item of work, where such work is required to be done for no fault of the VENDOR / BIDDER. In the case of civil contracts, it shall be works needing more than 8 man-hours per item of work. Note: For all other definition of terms can be referred from General conditions of Contract (GCC)		
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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)		VOLUME II SECTION: B SHEET 1 OF 2
	TITLE PROJECT INFORMATION		
PROJECT CODE: 13376 D PROJECT TITLE: ENABLING INFRASTRUCTURE FOR SHIRAWTA PUMPED STORAGE PROJECT (1800MW)			
1.	OWNER/PURCHASER	:	TATA POWER COMPANY LIMITED REGD. OFF.: BOMBAY HOUSE, 24, HOMI MODY STREET, MUMBAI-400001, INDIA. TEL: 91 22 6665 8282
2.	ENGINEERING CONSULTANTS	:	TATA CONSULTING ENGINEERS #71, CUNNINGHAM ROAD BANGALORE - 560 051 PH: 080 – 6959 6000
3.	PROJECT TITLE	:	ENABLING INFRASTRUCTURE FOR SHIRAWTA PUMPED STORAGE PROJECT (1800MW)
4.	LOCATION	:	PUNE DISTRICT, MAHARASHTRA STATE, INDIA
5.	APPROACH ROAD	:	NH 48, 22 KM FROM LONAVALA TOWN (MUMBAI-PUNE EXPRESSWAY)
6.	NEAREST RAILWAY STATION	:	LONAVALA
7.	NEAREST AIRPORT	:	MUMBAI & PUNE
8.	NEAREST SEAPORT	:	MUMBAI
9.	ELEVATION ABOVE SEA LEVEL	:	972.0 m
10.	LONGITUDE	:	73° 27' 15.78" E
11.	LATITUDE	:	18° 50' 26.26" N
12.	AVERAGE MONTHLY RAINFALL	:	1000.0 MM
13.	AVERAGE TEMPERATURE	:	32 Deg. C. & 70% Humidity
14.	EXTREME LOWEST TEMPERATURE	:	0 Deg. C
15.	EXTREME HIGHEST TEMPERATURE	:	43.3 Deg. C
16.	MEAN LOWEST IN THE MONTH (JAN)	:	6.8 Deg. C
17.	MEAN HIGHEST IN THE MONTH (MAY)	:	40.7 Deg. C
18.	SEISMIC DATA	:	AS PER IS: 1893 - 2002
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SPEC.NO. TCE.13376D-EL- 4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: B SHEET 2 OF 2
	TITLE PROJECT INFORMATION	

19.	I)	ZONE	:	III
20.		LANGUAGES SPOKEN IN THE REGION:	:	MARATHI, HINDI, ENGLISH
21.		OFFICIAL LANGUAGE FOR THE BIDDER TO DEAL WITH:	:	ENGLISH
22.		GRID STATION	:	CTU POOLING STATION AT KALAMB
23.		DESIGN AMBIENT TEMPERATURE OF ELECTRICAL EQUIPMENT	:	50 deg C

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SPEC.NO. TCE.13376D-EL-4028-4004	Tata Power Company Limited (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: C SHEET 1 OF 11
	TITLE BROAD SCOPE, CODES & STANDARDS, TERMINAL POINTS & EXCLUSIONS	
1.0 <u>BROAD SCOPE</u> The broad scope of work shall comprise of design, manufacture, inspection and testing at manufacturer's works, packing and forwarding, delivery to site including transit insurance loading & unloading from carriers / wagons, shifting of unloaded items to store, handling, erection, testing & commissioning of the following equipment / systems of Enabling Infrastructure for pumped storage projects. 1.1 The following equipment / items shall include Supply and erection, testing & commissioning at Substation-1 (SS-1) and as required: a) 22KV Switchyard: 22kV switchyard with all equipment, fittings & accessories. This shall include but not limited to that isolators, earth switches, lightning arresters, ACSR conductors, insulators & hardware, clamps, connectors & spacers, marshalling / junction boxes, supporting structures, Double pole structure poles with DO fuse, Air break switch, etc. as required for completion of switchyard. b) Audit metering panel: Metering panels for construction power measurement compliance with MSEDCL / Local statutory. c) Tariff metering panel (Revenue metering): Metering panels for construction power measurement compliance with MSEDCL / Local statutory. a) 110V DC system: 110V, 1x100% FC+FCBC with 1x100% VRLA batteries, Battery racks, DB's to cater 22 kV Substation panels & as required. b) 415V LV Substation DB: DB for LT power distribution at SS-1 switchgear room. This shall include but not limited to that MCCB, Relays, Meters, etc. as required. c) Cable & Cable Carrier System: Cables & Cable carrier system with all equipment, fittings & accessories. This shall include but not limited to all cables such as LV power cables, control cables, instrumentation cables, etc, cable raceway system with necessary fire barriers, fire proof sealing and coating systems, cable supporting structures, cable racks, cable trays, conduits, cable glands, Lugs, Termination and Jointing Kits, cable laying and cable terminations etc as required for the package scope of supplied items. d) Earthing system: Earthing system covering complete above & below ground earthing for both system & safety earthing including soil resistivity test & report. e) Lightning Protection system: Lightning protection system shall be complete with all accessories & equipment for the substation building, switchyard, etc. f) Lighting system: LED based Illumination system complete with Lighting fixtures, Wires, JBs, Lighting Poles, lighting supports, light fixture installation accessories, Earthing wires, etc for the specified package. g) 22 kV MV indoor CTPT Panel: Indoor 22 kV Current transformer & Potential transformer panel for Audit metering & Revenue metering.		
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SPEC.NO. TCE.13376D-EL-4028-4004	Tata Power Company Limited (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: C SHEET 2 OF 11
	TITLE BROAD SCOPE, CODES & STANDARDS, TERMINAL POINTS & EXCLUSIONS	

h) Electrical system related Miscellaneous items like Rubber mats, Danger boards, first aid charts, first aid boxes, Sand buckets, Fire extinguisher, Electrical Hand gloves to operate HT and LT Equipment, etc.

i) All equipment mounting and foundation accessories like Structural Steel, Clamps, bolts etc. and hardware for all electrical equipment. Also, all minor civil works associated with electrical installation like foundations, embedment, chipping, punching, making holes, openings, pipe sleeves, sealing and water proofing, etc.

j) **Start-up / Commissioning Spares**, as required for the items covered in the scope of supply

k) **Essential / Mandatory Spares** for the items covered in the scope of supply

l) **Special tools and tackles** required for installation, operation and maintenance of the items covered in the scope of supply.

m) Recommended Spares for 3 Years.

n) Any other electrical equipment and accessories required to completeness of work.

o) The scope of work of the Contractor shall include getting statutory approval of the electrical installation from State electrical inspectorate, & any statutory bodies required to commission the project.

p) Construction power for execution of the scope as specified

1.2 The following items will be a free issue to Bidder. Bidders shall consider in his scope Installation, testing & Commissioning including Unloading of these Items under OEM supervision. However, OEM supervision will be arranged by Client under scope of supply of Free issue items.

Sl. No.	Description	Type	SS-1 / Near Tap off point
1.	SS-1: 22 kV switchgear panel	Indoor	1 Set
2.	SS-1: 22 kV ICOG panel	Indoor	1 No.
3.	50 kVA, ONAN, 22/0.433kV Auxiliary Transformer	Outdoor	1 No.
4.	22kV (E) grade, 3C x 300 sq.mm stranded aluminium conductor, XLPE cable	-	1 Lot

1.3 Bidders shall include in their scope the unloading of the following items and the shifting of the unloaded items to the designated store under OEM supervision.

Sl. No.	Description	Quantity
1.0	MV Switchgears	
1.1	SS-2: 22kV HT Meter Box	1 No.
1.2	SS-3: 22 kV switchgear panel	1 Set
1.3	SS-4 22 kV ICOG panel	1 No
1.4	Spares	1 Lot

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	TITLE BROAD SCOPE, CODES & STANDARDS, TERMINAL POINTS & EXCLUSIONS	

2.0	Transformers	
2.1	Auxiliary Transformer-1 (AT-1) 500 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=5%, OCTC ±5% in steps of 2.5% Service Transformer for Labour colony	1 No.
2.2	Auxiliary Transformer-2&3 (AT-2&3) 2000 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=7.15%, OCTC ±5% in steps of 2.5% Service Transformer at Powerhouse area	2 No.
2.3	Auxiliary Transformer-4 (AT-4) 1250 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=6%, OCTC ±5% in steps of 2.5% Service Transformer at Powerhouse area	1 No.
2.4	Auxiliary Transformer-5 (AT-5) 2000 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=7.15%, OCTC ±5% in steps of 2.5% Service Transformer at Upper reservoir	1 No.
2.5	Spares	1 Lot
3.0	MV CABLES & ACCESSORIES	
3.1	22kV (E) grade, 3C x 300 sqmm stranded aluminium conductor, XLPE insulated with all the screens, PVC inner sheathed, GS wire armoured, overall FRLS PVC outer sheathed suitable for directly buried in soil and outdoor.	6800 m
3.2	Heat shrinkable type joint kit suitable for the 22kV (E) grade, 3C x 300 sq.mm stranded aluminium conductor cables and directly buried in soil and outdoor.	17 Nos.
4.0	FO CABLES & ACCESSORIES	
4.1	Fibre optic cable (Quantity considered 4 no. 48 Core FO cable per circuit)	25000 m
4.2	Fiber termination Rack	2 Nos.
4.3	HDPE pipes for FO cable (dia 40 mm)	25000 m
4.4	No. of FO joint boxes for 48F cable	24 Nos.
4.5	No. of termination kits (48F)	10 Nos.
4.6	Patch Cord for 48F Optic Fiber Cable	50 Nos.

1.4 Obtaining of the Electrical Inspectorate's Approval

1.4.1 The scope of work of the Bidder shall include getting statutory approval of the electrical installation from State electrical inspectorate & any statutory bodies required to commission the project.

1.4.2 The Bidder shall obtain and pay for all permits, licenses, and statutory approvals

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	from local authorities for completion of work. Original copies of these approvals shall be delivered to the Owner or his authorized representative and will become property of the Owner. It must be understood and agreed that such factors have properly been understood and considered while submitting the bid. No claim whatsoever will be entertained by the Owner neither any change in the time schedule of the Contract nor any financial adjustments arising thereof shall be permitted by the Owner.	
1.4.3	It will be the Bidder's responsibility to prepare the drawings / documents and obtain approval from local statutory authorities wherever applicable, for carrying out any work or for installation carried out which comes under the purview of such authorities.	
1.4.4	<u>Obtaining of the Electrical Inspectorate's Approval of Drawings for the Installation of Electrical Equipment / Switchgears:</u> The Bidder shall forward drawings for Site Plan, Substation / Switchgears Layout, Schematic layout, Drawings for overhead / underground line arrangement, General / physical arrangement of the equipment to be installed to the local Authority for their approval. In case of any comments / remarks received from the Local authority / Electrical inspectorate, same shall be incorporated in the respective drawings with the approval of Project Manager and corrected drawings shall be re-submitted with the item wise clarifications for the remarks pointed out.	
1.4.5	The Bidder shall arrange the visit of the MSEDCL inspector to the OEM works for FAT of the metering equipment and shall obtain dispatch clearance, including the scope of payment of all associated expenses, as applicable.	
1.4.6	The Bidder shall carry out installation and completion of the electrical works based on the drawings approved by local statutory authorities and obtains safety certificates before energizing the electrical equipment.	
1.5	Scope of Services shall include the following also, • Unloading & storage at designated storage space, Transportation from storage space to work site including lifting & shifting equipment. • Submission of progress report • Participation in Project Review / Technical Coordination meetings. • All necessary co-ordination with other Bidders on site for erection, testing and commissioning of equipment and accessories. • Carrying out necessary tests on equipment as required by the Owner. • Conducting performance test at shop and site. • Final check-up, testing and commissioning in presence of Owner's representative. • Obtaining Owner's approval and written acceptance of satisfactory performance. • Handing over of installation for commercial operations.	
1.6	Bidder shall furnish the mark-up properly with all information for preparation of	
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	TITLE BROAD SCOPE, CODES & STANDARDS, TERMINAL POINTS & EXCLUSIONS	
'As Built Drawings' by the owner's consultant. 1.7 All equipment and components shall be new and supplied by approved manufacturers. Equipment & Components requiring specialized maintenance or operation shall be avoided as far as possible. All equipment shall be complete with all necessary weather and anticorrosion protection including tropicalization to prevent damage/deterioration due to climate. 1.8 A document indicating service support details, against each item installed, shall be given during handover. This document shall contain contact person, designation, address, phone, fax and email for contacting after warranty completion period. (During item wise warranty period, the Project Manager shall contact only one responsible person from Bidders side for any defect related issues). 1.9 Makes of equipment / components shall be as per list of approved makes indicated in the specification. Deviation to this will not be acceptable. For equipment / components where make is not specified, CONTRACTOR shall obtain specific approval from owner / consultation prior to ordering. 1.10 It is not the intent to completely specify herein all details of design and construction of the equipment or materials to be supplied or of services to be rendered. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the BIDDER's guarantees in a manner acceptable to the OWNER. 2.0 <u>CODES AND STANDARDS</u> 2.1 All equipment, system and works covered under this specification shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. All equipment and systems shall conform to the standards / codes specified in Section – C, Section D and Data sheet – A. In case the Bidder offers equipment / systems conforming to any standards other than those specified in component specifications, the same shall be established to be equivalent or superior to the codes and standards as specified and the Bidder shall furnish copies of standards translated in English while submitting his proposal. 2.2 Notwithstanding the recommendations and stipulations of the Codes and Standards mentioned above, the requirement of this specification shall be deemed minimum and shall be complied fully. 2.3 In the event of conflict between requirements of any two clauses of the Contract document or requirements of the codes/standards, specified, the more stringent requirement shall be complied by Bidder. 2.4 All codes and standards referred to in the specification shall be understood to be the latest version as on the date of offer made by the Bidder unless otherwise		
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indicated. 2.5 The Bidder shall ensure that instruments and gauges to be used for testing and inspection of critical parameters as identified in the specification have valid calibration and the accuracy can be traced to National standards. 3.0 <u>SYSTEM DESIGN</u> 3.1 The electrical system shall be designed to provide: • Safety to personnel and equipment during the operation and maintenance • Reliability of service • Minimum fire risk • Ease of maintenance and convenience of operation • Automatic protection of all electrical equipment through selective relaying system. • Electrical supply to equipment and machinery within the design operation limits. • Adequate provision for future extension and modifications. • Fail safe features. • Suitability for applicable environmental factors. • Maximum interchangeability of equipment. 3.2 The latest versions of the following statutory regulations shall be followed for the design of electrical systems. • Indian Electricity Act. • CEA Regulation. • CBIP • CEIG requirement. • National Electrical Code & National Building Code (NBC) • Local Electricity board • The factory Act. • Central pollution control board (CPCB) • Additional standards refer in respective section of each equipment's Data sheet-A. 3.3 The design of systems and equipment shall ensure satisfactory operation under variations of voltage $\pm 10\%$, frequency (+) 5% to (-) 5%, combined voltage and		
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frequency 10% for A.C., -15% to +10% for DC as may be met under operating conditions, including those due to starting loads and short circuit and other fault conditions. 3.4 The design ambient temperature for all electrical equipment shall be 50°C for both indoor and outdoor equipment and relative humidity of 95% shall be considered. 4.0 <u>INSPECTION OF EQUIPMENT SUPPLIED BY CONTRACTOR</u> 4.1 The inspection of equipment listed in supply items shall be carried out in the presence of OWNER. 4.2 OWNER shall have the right to either inspect the material at manufacturer's work or waive off the inspection for dispatch and inspect at site. Even after this inspection, the party shall be responsible for the performance of the equipment at site after installation. 4.3 Acceptance and routine tests for all supply equipment/component parts shall be carried out as per the relevant standards for the respective equipment before dispatch to ensure compliance with the relevant specifications & agreed quality assurance/testing plan. These test reports and manufacturer's type test reports shall be submitted to Owner before dispatch of the equipment. Any other type tests/special tests to be conducted shall be as per the QAP and as indicated elsewhere in this tender document. 4.4 Certified copies of reports of all type tests carried out on similar type and rating of equipment (offered under this contract) within last five years from the date of submission of Bid shall be submitted to the OWNER for review and approval. In case the type test reports are not found to meet the specification requirements, the bidder shall conduct all such tests under this contract free of cost to the OWNER and submit the reports for approval. 4.5 Copies of the test certificates for all items bought shall be submitted for the OWNER's approval before dispatch. 4.6 Equipment shall not be dispatched unless the test certificates are duly approved by the OWNER/ ENGINEER. 4.7 Prices quoted shall include the cost of all routine tests / specific test specified in the specification. 5.0 <u>TESTING AND COMMISSIONING</u> 5.1 The BIDDER, at no extra cost, shall provide all instruments and accessories, tools and tackles required for testing and commissioning of the items specified for the required duration of test. 5.2 BIDDER shall ensure use of calibrated test equipment having valid calibrated		
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test certificates traceable to national standard. 5.3 All equipment and material supplied, installation and commissioning shall meet the requirements of IS / IEC Standard, and regulations as per local approving authorities. 5.4 On starting, intermediate stage, completion of installation work, the BIDDER shall arrange for inspection and obtain approval from the concerned statutory authorities as required. 5.5 The work shall be considered commissioned only after all equipment/items are put into service as per OWNER's satisfaction and design parameters. 5.6 All test equipment shall have valid calibration certificates and shall be made available at the time of inspection. 5.7 Commissioning Checklist for various equipment shall be furnished to Owner for Approval before commissioning. It is the responsibility of BIDDER to arrange for required test equipment for such purposes. 5.8 All commissioning tests shall be carried out in the presence of Owner's representative and approval for it shall be obtained before commissioning the installations. 5.9 Owner may ask for such additional tests on site, as in their opinion are necessary to determine that the work complies with the specifications or IS / IEC code of Installation (as agreed) or manufacturer's instruction. BIDDER shall be responsible and bear the cost of such additional tests. 5.10 Typical type test certificate for all equipment of equivalent ratings and type test certificate shall be submitted for scrutiny/approval to Owner. 5.11 The BIDDER shall bear all the cost of all tests & rejected material. The BIDDER without any time/ cost implications shall replace the rejected material. 6.0 <u>DRAWINGS / DOCUMENTS SUBMISSION</u> 6.1 List of drawings & documents to be submitted along with bid, refer Section-D12. 6.2 List of drawings & documents to be developed & furnished by the vendor / contractor / bidder after award of contract, refer Section-D12. 7.0 <u>TERMINAL POINTS</u> a) Tap-of at existing 22 kV Overhead line of Headworks line-2 (from Khopoli) near Shirawta dam wall b) Outgoing terminals of 22KV double pole structures at SS-1		
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8.0	<u>EXCLUSIONS</u> a) Scope of supply for the items mentioned in Clause 1.2 & 1.3 b) 22 kV Cables / FO Cables for Interconnection of SS-3 / SS-4 c) Overhead transmission line for interconnection of SS-2 d) SS-2 at Labour colony e) SS-3 at Powerhouse / LR f) SS-4 at Upper Reservoir g) Civil works (Building & RCC cable trench)	
9.0	<u>PROPOSED CONNECTION ARRANGEMENT FOR CONSTRUCTION POWER SUPPLY</u> PSP construction activities will be held in Proposed PSP plant, Lower & Upper intake area. The power supply to the proposed PSP construction activities will be fed from 22 kV system of existing KHOPOLI HPP through headworks line. The tap-off connection arrangement from Headwork lines and necessary metering arrangement will be near Shirawta dam wall which will be closure to the project area (SS-1). Further, distribution of power from SS-1 to SS-2 / SS-3 / SS-4 of substation near construction area will be arranged by others. The metering, power distribution / connection arrangement & scope demarcation, etc will be as shown in the SLD, refer TCE.13376D-EL-4002-AU-40005. 110 V DC power supply system shall be provided for the purpose of control supply to 22 kV MV switchboard / ICOG / metering panels located in SS-1 substation. The location of the panels refers in the attached Substation layouts (Dwg.No.:TCE.13376D-EL-4001-GA-40008) The proposed SS-1 location refers in the attached Substation location drawing (Dwg.No.: TCE.13376D-EL-4001-GA-40009)	
10.0	<u>CABLING SYSTEM</u> Cabling for MV/LV distribution / interconnection, Auxiliary power supply, control supply, CT/PT wiring, signal wiring, metering etc for the panels/switchgears shall be executed by the bidder as shown in the SLDs/cable schedule at the proposed locations. The cabling / cables shall be laid on overhead cable trays / on trenches / buried cabling / through hume pipes, etc as per proposed method of routing shown in the cable routing layouts.	
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Owner will issue cable tray layouts / cable schedule for construction / execution of the proposed work. However, bidder shall assess the site condition and plan for execution in consultation with site in-charge. 11.0 <u>EARTHING & LIGHTNING SYSTEM</u> Safety earthing / neutral earthing shall be done by the bidder for the equipment / items as per the drawings for the proposed work. Earthing will cover buried earthing system, embedded on concrete slab, equipment earthing, switchyard earthing, etc. as per earthing layout. It will also cover the Lightning protection system for substation buildings, switchyard, outdoor equipment, etc. as per the drawing. Owner will issue earthing/ lightning layouts for construction / execution of the proposed work. However, bidder shall assess the site condition and plan for execution in consultation with site in-charge. 12.0 <u>LIGHTING SYSTEM</u> Indoor / Outdoor lighting shall be executed by bidder as per the drawings for the proposed work. The Indoor lighting shall be executed by direct wall/ceiling mounting / Recess mounting and conduit wiring as per lighting layout. The outdoor lighting shall be executed by street lighting pole / wall mounted lighting pole / suitable supports. The cabling / cables shall be laid on buried cable routing / on trenches / through hume pipes, etc as per proposed method of routing shown in the layouts. Owner will issue lighting layouts for construction / execution of the proposed work. However, bidder shall assess the site condition and plan for execution in consultation with site in-charge. 13.0 <u>MISCELLANEOUS</u> 13.1 LOTO provision shall be equipped for all incomers & feeders of all equipment supplied by the bidder, such as Panels / DBs, FCBC, etc. 13.2 Equipment / items provided in outdoor shall be of minimum IP66 with weather proof type. 13.3 List of commissioning and start-up spares shall be furnished during detailed engineering and after commissioning, the balance spares shall be handed over to client. 13.4 List of Recommended spares with unit rates shall be furnished by the bidder and		
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the same will be decided by client during execution. 13.5 Caution name Plates: The caution name plates shall be in three languages – Local, Hindi & English. 14.0 <u>CONSTRUCTION POWER SUPPLY</u> 14.1 Contractor shall make his own arrangement for execution of the proposed construction power supply distribution. 14.2 Contractor shall supply and install firefighting equipment as per the regulations of the local electrical inspectorate / statutory bodies for the temporary electrical installation. 14.3 On award of contract, the Contractor shall furnish the electrical scheme, for Owner approval for distribution of their construction power supply.		
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	TITLE 22kV SWITCHYARD	
1.0 SCOPE 1.1. This specification covers the design, detailed engineering, construction / manufacture / supply, inspection & testing at Vendor's and/or his Sub-Vendor's works, packing, transportation, loading and unloading, delivery at site, storage at site, handling at site, erection, start-up & Commissioning and performance testing of all equipment/systems of 22kV switchyard. 1.2. A 22 kV switchyard shall be provided for distribution of power for PSP plant construction as well as PSP plant commissioning requirement. The switchyard scheme SLD enclosed for reference. 1.3. The switchyard will consist of double pole structure arrangement with LA, AB switch, Isolators, DO fuse etc. for each incoming / outgoing lines. Preliminary arrangement of switchyard refer attached SLD & substation/switchyard layouts. 1.4. The switchyards shall be supplied and installed with all equipment/systems and accessories to make the switchyards complete in all respects. The switchyard shall include all the equipment/systems indicated below but not limited to the following. 1.4.1. 22kV switchyard equipment (AB switch, isolators, DO fuse, earth switches, transformers, lightning arresters, busbars, ACSR conductors, insulators & hardware, clamps, connectors & spacers, marshalling / junction boxes, etc.) 1.4.2. Necessary steel structure with all supporting insulators, AB switch, DO fuse, isolator with earth switch, handle & locks, Lightning arrestor, stay wire, jumpers, bimetallic clamps and as required. 1.4.3. Earthing and direct stroke lightning protection system for switchyard in BIDDER's scope. 1.4.4. All power, control & instrumentation cables, cable carrier system, etc shall also be in BIDDER's scope. 1.5. It is the scope of the BIDDER to closely co-ordinate with the grid authorities for all the specification requirements and interfaces pertaining to protection, metering, communication and data transfer, cabling and any other requirements.		
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1.6. Determination of all relay settings shall be carried out in consultation with OEM of relay / panel manufacturer and obtaining approval of relay settings, co-ordinating with remote end protection and communication systems, etc. with the respective grid authorities is deemed to be included in the BIDDER's scope. 1.7. It is not the intent to completely specify herein all details of design and construction of the equipment/systems. However, all equipment/systems shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing continuous operation up to the BIDDER's guarantees in a manner acceptable to the PURCHASER who will interpret the meaning of drawings and specifications and shall have the power to reject any work or material which in his judgement are not in full accordance with the requirements. All the major equipment shall be installed tested and commissioned under supervision of representative of original manufacturer of respective equipment. 1.8. Although most of the systems are covered here, any other equipment/system required for successful completion of the works shall form part of this contract and shall be deemed to be included in the BIDDER's scope of works. 1.9. All equipment shall be suitable for smooth, efficient and trouble free operation for the site conditions and power supply variations as mentioned in General Project Information. All switchyard equipment shall comply with the specification requirement indicated in this section and associated Data Sheets. 2.0 CODES AND STANDARD 2.1. The design, manufacture, testing and performance of equipment shall comply with all currently applicable standards, codes of practice, regulations and safety codes in the locality where the equipment will be supplied. Nothing in this specification shall be construed to relieve the VENDOR of his responsibility. In case of conflict between these standards and this specification, more stringent of the two requirements shall govern. Some of the currently applicable standards are indicated in Data Sheet A 2.2. The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant/ Owner in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of		
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the code/ standard. Consultant/ Owner may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed 2.3. The VENDOR shall ensure that instruments and gauges to be used for testing and inspection shall have valid calibration and the accuracy can be traced to National and International Standards as applicable. 3.0 DESIGN CRITERIA 3.1. a) The switchyard shall be suitable for outdoor application having saline atmosphere and shall have tropical and fungicidal treatment. b) All structural steel and steel components in the switchyard equipment shall be hot dip galvanized. c) The 22 kV switchyard shall be designed for a short circuit current of 21 kA for 1 seconds. The dynamic rating of switchyard shall be 52.5 kA. d) The conductor size of tubular bus / stranded conductors shall also be sized considering short circuit conditions, corona / voltage gradient and effect of solar radiation. e) The final temperature of the conductor when carrying full load current shall not exceed 75°C considering maximum design ambient temperature. f) Complete switchyard shall be designed to withstand seismic acceleration as per relevant IS. g) The minimum clearances to be followed for the 22 kV switchyard shall be as mentioned in datasheet-A. h) The switchyard shall be provided with access ways and adequate space for maintenance of equipment. 3.2. SWITCHYARD LAYOUT REQUIREMENTS 3.2.1. Switchyard arrangement shall be planned as per available existing plant area & switchyard. 3.2.2. The BIDDER shall adopt bolted type connectors for ACSR bus conductors, fixed type of terminal connectors for isolator terminals, flexible type of terminal connectors for circuit breakers, current transformers and reactors and flexible jumper connectors for connecting lightning arresters and voltage transformers. Every bus shall have a flexible at one end of the bus and at suitable intervals of the bus to allow thermal expansion.		
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3.2.3. The BIDDER shall consider suitable bay width, phase spacing, clearances, etc., depending on the actual dimensions of the equipment keeping in view the design criteria / requirements and without sacrificing any maintenance space / conveniences. 3.2.4. The ACSR conductor shall be properly sized for normal current capacity and short circuit rating. 3.2.5. The switchyard shall be provided with access ways near the current transformers and circuit breakers and isolators/earth switches. 3.2.6. The cable trenches for the equipment shall be run as close to their foundations as possible even preferably touching. All the cable trenches shall be covered with RCC slab. 3.2.7. The switchyard shall be enclosed in fence around for safety and to prohibit unauthorised persons from entering. Lockable gates for personnel entry and equipment will be provided at convenient locations. The fence provided around switchyard shall be of 2000 mm height and at a minimum distance such that section clearance is available from any live part. The fence shall be suitably earthed as per relevant standards. However, switchyard fence & gates will be in the scope of Owner. 3.2.8. The switchyard equipment shall be suitable for outdoor installation and shall have tropical and fungicidal treatment. 3.2.9. The soak pit and burnt oil pit for the transformers, if applicable shall be sized as per norms indicated in CBIP Manual for Fire Protection of Power Transformers. The soak pit and burnt oil pit will be in the scope of Owner. 3.2.10. Earth mat of suitable size with closely spaced earth conductor shall be provided below the operating handle of individual switchyard equipment. 4.0 CONSTRUCTIONAL FEATURES 4.1. The double pole structure shall be of minimum 200x100mm RSJ structure with all supporting insulators, Isolator with handle & locks, Lightning arrestor, stay wire, required jumpers, bimetalic clamps. 4.2. Isolators: a) The isolator shall be horizontal double break type.		
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b) Isolators shall be suitable to operate manually. The earth switches shall be manually operated with proper interlock so that it shall not operate in case respective isolator is ON and other requisite conditions are not met. c) Base channels and other structural steel members such as operating pipes, phase coupling rods, operating mechanism boxes, bolts, pins, etc. shall be hot dip galvanised. All castings except current carrying parts shall be made of malleable cast iron or cast steel. Manual operating handles shall be galvanised steel. d) The isolator or earthing switch shall be provided with high current carrying contacts on the hinge and jaw ends and all contact surfaces shall be of silver faced copper. e) A mechanical position indicating device shall be provided for each disconnecter / earthing switch. f) The design of the auxiliary switches for the isolators shall be such that signalling of the closed position shall not take place unless the contact system has reached such a position that the rated current and the rated short time current can be carried safely and signalling of the open position shall not take place unless the contact system has reached a position of at least 80 percent of the clearance distance of the isolating distance. g) Adequate NO/NC contacts shall be provided for isolator & earth switch for remote indication & interlocks. 4.3. Lightning Arrestor a) 20kV, 10kA nominal discharge current, class-3, pressure relief class-A, metal oxide, gap less lightning arrester for 22kV switchyard shall be provided. b) Arrester shall be suitable for installation in effectively earthed system. c) Grading resistors and/or grading capacitors and grading rings shall be provided for uniform voltage distribution between the units making up the arrester, as dictated by the voltage class of the arrester. d) The arrester shall be mounted on an insulating base. e) 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. 4.4. 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 colour. 4.5. The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed. Insulators shall have compression type glaze with a good lustre and of uniform brown colour. The glaze shall be unaffected by sudden		
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changes in temperature and by atmospheric pollution of ozone, acids, alkali, dust etc.

4.6. Insulators shall be designed to avoid excessive concentration of electrical stresses in any section or across leakage surfaces.

4.7. Except where otherwise specified non magnetic bolts shall be used. Bolts shall be of sufficient strength to withstand without bending, the stresses introduced in them, when they are stressed to their rated strength. The bolts shall be readily removable after the fittings have been so stressed. Locking and split pins shall be of hard drawn brass, bronze or stainless steel. All castings shall be free from blow holes, cracks and other casting defects.

4.8. All current carrying parts shall be designed and manufactured to have minimum contact resistance.

4.9. Fittings intended to connect two dissimilar metals, shall be designed to avoid harmful bimetallic corrosion under service conditions. Minimum breaking strength of insulator hardware shall not be less than that of insulator connecting string. Where parallel insulators are used, base plates at the top and bottom shall be of sufficient strength.

4.10. **Clamps and Connectors**

The clamps and conductors shall be made of materials listed below. Clamps and connectors shall be wedge type only.

For connecting ACSR conductors	Aluminium alloy coating
For connecting equipment terminals made of copper or brass to ACSR conductors	Bimetallic connectors of aluminium alloy casting, with copper alloy liner.
For connecting GI shield wire	Malleable iron casting
Bolts, nuts, plain washers and spring washers for above	Hot dip galvanized mild steel of ultimate strength
For copper to copper, copper to brass or : brass to brass conductors	Copper alloy
Bolts and nuts for above	Rolled brass rods
Spring washers for above	Phosphor bronze

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All castings shall be free from blow holes, surface blisters, cracks and cavities. 4.11. Outdoor mounted, powder coated marshalling boxes shall be provided in the switchyard as required. 4.12. 110V DC power supply shall be provided for control, protection, interlock and annunciation requirements of the switchyard. 4.13. EARTHING & LIGHTNING PROTECTION 4.13.1. Earthing & Lightning protection system shall be provided for switchyard area. Earthing system shall consist of earth grids, earth pits, and electrodes buried in soil in the switchyard area, embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons. The earth pits shall be provided with disconnecting facility for monitoring of earth resistance. 4.13.2. Earthing system will be designed considering suitable corrosion allowance based on earthing conductor material and type of soil, for a service life of at least fifty (50) years for fault current 21 kA for 1 second. The minimum rate of corrosion of earthing conductor shall be considered as 0.12mm per year while determining the conductor size. 4.13.3. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal if average resistance of soil is more than 20ohm meter. 4.13.4. 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. 4.13.5. The soil resistivity data will have to be determined by the BIDDER. The earthing system design and installation shall generally comply with IEEE-80, IE Rules and IS-3043. 4.13.6. Powerhouse earthing system shall be interconnected to Switchyard earthing system to with minimum 2 Nos of earth conductors.		
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4.13.7. The size of conductors for lightning protection system shall be decided based on mechanical strength and as per IS/IEC 62305. 5.0 ESSENTIAL / MANDATORY AND RECOMMENDED SPARES Spare parts required for start-up, site testing & commissioning of the offered equipment shall be included in the scope of work & provided as required. List of recommended spares for Five (5) years of operation shall be furnished along with the bid. 6.0 TESTING AND INSPECTION 6.1. TESTS AT MANUFACTURER'S WORKS Routine tests for Switchyard equipment shall be carried out on completely assembled equipment as per relevant standards. Certified copies of reports of all type tests carried out on similar type and rating of equipment (offered under this contract) within last five years from the date of submission of Bid shall be submitted to the OWNER for review and approval. In case the type test reports are not found to be meeting the specification requirements, the BIDDER shall conduct all such tests under this contract free of cost to the OWNER and submit the reports for approval. Copies of the test certificates for all bought out items and calibration certificates shall be submitted for the OWNER's approval before dispatch of the switchyard equipment. 6.2. SITE / COMMISSIONING TESTS Site tests shall include all tests to be carried out at site on various equipment. They shall include but not be limited to calibration tests, configuration tests and commissioning tests. The BIDDER shall be responsible for all site / commissioning tests. All necessary testing equipment required for testing and commissioning shall be arranged by the BIDDER. The BIDDER shall maintain all tests, calibration records in owner approved formats, and these shall be countersigned by authorized quality control personnel of the BIDDER supervising these works. 7.0 ERECTION AND INSTALLATION 7.1. BIDDER shall supply all the instruction manuals necessary to perform erection, testing & commissioning, operation and maintenance activities. All the major		
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equipment shall be installed, tested and commissioned under supervision of representative of original manufacturer of respective equipment. Notes and details attached with this specification to be followed for all installation works. 7.2. The instructions shall include full details and procedure for installation of the equipment and all necessary adjustments during service and operation, together with part lists to enable spare part or replacements to be ordered. ISSUE P0		

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The 11kV Switchyard shall comply with the particulars indicated below.

Sl. No.	DESCRIPTION	UNITS	CLIENT'S SPECIFICATION
1.0	SWITCHYARD		
1.1.	Nominal voltage	kV	22
1.2.	Highest System voltage	kV	24
1.3.	Frequency	Hz	50
1.4.	Short circuit current	kA (rms)	21 kA for 1 sec.
1.5.	Making current	kA (Peak)	52.5 kA for 1 sec
1.6.	Impulse withstand voltage	kV (Peak)	125
1.7.	One minute power frequency withstand voltage	kV (rms)	50
1.8.	Switching impulse withstand	kV (Peak)	-
1.9.	Reference ambient temperature	°C	50
1.10.	Creepage distance	mm	31 mm/kV based on highest system voltage
1.11.	Minimum Clearances		
	(i) Phase to phase (min)	mm	610
	(ii) Phase to earth (min)	mm	460
	(iii) Sectional clearance	mm	2600
	(iv) Ground clearance	mm	2750
1.12.	Switchyard design		• Impulse withstand voltage: 125 kV (Peak) • Switching impulse withstand: 50 kV (rms)

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APPLICABLE STANDARDS		
1.0	SPECIFICATION FOR WROUGHT ALUMINIUM AND ALUMINIUM ALLOY BARS, RODS, TUBES AND SELECTIONS FOR ELECTRICAL PURPOSES	IS 5082 IEC
2.0	CIRCUIT BREAKERS	IS 13118 IS/IEC 62271-100
3.0	INSULATORS	IS 2544 IEC 273
4.0	LARGE HOLLOW PORCELAINS	IS 5621 IEC 233
5.0	ELECTRICAL POWER CONNECTORS	IS 5561 IEC
6.0	HOT DIP GALVANIZING	IS 2629 IEC
		IS 2633
7.0	GUIDE FOR TESTING OF CIRCUIT BREAKERS FOR OUT-OF-PHASE SWITCHING	IS 9135 IEC
8.0	SF6 GAS	IS IEC 376
9.0	ISOLATORS	IS 9921 IEC 129
		IEC 694
10.0	CURRENT TRANSFORMERS	IS 2705 IEC
11.0	BUSHINGS	IS 2099 IEC 137
12.0	VOLTAGE TRANSFORMER	IS 3156 IEC
13.0	COUPLING CAPACITORS AND CAPACITOR DIVIDERS	IS 9348 IEC 358
14.0	CAPACITOR VOLTAGE TRANSFORMER	IS 3156, PART -IV IEC 186
15.0	ELECTRICAL RELAYS FOR POWER SYSTEM PROTECTION	IS 3231 IEC
16.0	SPECIFICATION FOR STATIC PROTECTIVE RELAYS	IS 8686 IEC
17.0	LIGHTNING ARRESTER	IS 3070 IEC 99
18.0	SUSPENSION INSULATORS	IS 731 IEC
19.0	INSULATOR FITTINGS	IS 2486 IEC
20.0	HIGH VOLTAGE FUSE	IS 9385 IEC 60282-2
21.0	LOW VOLTAGE FUSE	IS 9224 IS/IEC 60947-3
22.0	BOARDS BLANKS FOR SLEY BOTTOM, RACE, CAP AND BOX BACK OF COTTON LOOMS	IS 9794 IEC
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23.0	CIRCUIT BREAKERS		IS/IEC 62271-100
24.0	METAL ENCLOSED SWITCHGEAR	IEC 62271-200	
25.0	CURRENT TRANSFORMERS	IS 2705	IEC 61869-2
26.0	VOLTAGE TRANSFORMERS	IS	IEC 61869-3
27.0	ARRANGEMENT FOR SWITCHGEAR BUSBARS, MAIN CONNECTIONS AND AUXILIARY WIRING	IS 5578 / IS 11353	
28.0	BUSBAR SUPPORT INSULATORS	IS 2544	IEC 60273
29.0	DEGREE OF PROTECTION	IS/IEC 60529	
30.0	ELECTRICAL RELAYS FOR POWER SYSTEM PROTECTION	IS 3231	IEC 60255
31.0	ELECTRICAL INDICATING INSTRUMENTS	IS 1248	IEC 60051
32.0	HIGH VOLTAGE FUSES	IS 9385	IEC 60282
33.0	A.C. ELECTRICITY METERS	IS 1595	IEC 60359
34.0	ALUMINIUM BUSBARS	IS 5082	IEC 60105
35.0	CODE OF PRACTICE FOR PHOSPHATING IRON AND STEEL	IS 6005	IEC 255
36.0	A.C DISCONNECTORS AND EARTH SWITCHES	IS/IEC 62271-102	
37.0	LOW VOLTAGE FUSES	IS/IEC 60947-3	

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DATA TO BE FURNISHED ALONG WITH THE BID

Sl. No.	DESCRIPTION	UNITS	TO BE FILLED BY BIDDER
1.0	22kV SWITCHYARD		
1.1	Nominal voltage	kV	
1.2	Highest System voltage	kV	
1.3	Frequency	Hz	
1.4	Short circuit current	kA (rms)	
1.5	Making current	kA (Peak)	
1.6	Impulse withstand voltage	kV (Peak)	
1.7	One minute power frequency withstand voltage	kV (rms)	
1.8	Switching impulse withstand	kV (Peak)	
1.9	Reference ambient temperature	°C	
1.10	Creepage distance	mm	
1.11	Minimum Clearances		
	(i) Phase to phase (min)	mm	
	(ii) Phase to earth (min)	mm	
	(iii) Sectional clearance	mm	
	(iv) Ground clearance	mm	
1.12	Corona extinction voltage	kV (rms)	
2.0	ISOLATORS		
2.1	Application		
2.2	Quantity		
	a) With earth switch	Nos	
	b) Without earth switch	Nos	
2.3	Type		
2.4	Execution of poles		
2.5	Rated current	A	

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Sl. No.	DESCRIPTION	UNITS	TO BE FILLED BY BIDDER
2.6	Short circuit withstand current and duration	kA (rms) Sec	
2.7	Making current	kA (Peak)	
2.8	a) Breaking capacity of line charging current	A	
	b) Breaking capacity of magnetising current	A	
2.9	Short circuit making current of earthing switch	kA (Peak)	
2.10	Material of main contact		
2.11	Whether contacts are to be silver faced		
2.12	Operating mechanism		
2.13	Operating device (motor / manual)		
2.13.1	Main disconnecter		
2.13.2	Earth switch		
2.14	Emergency operation		
2.14.1	Main disconnecter		
2.14.2	Earth switch		
2.15	Support insulators		
2.15.1	Type of insulator (Pedestal / Solid / Polycone etc.)		
2.15.2	Nominal creepage distance	mm	
2.16	Minimum strength		
2.16.1	Torsional	Nm	
2.16.2	Minimum cantilever strength	kgs	
2.17	Miscellaneous		
2.17.1	No. of NO & NC aux. Contacts for purchaser's use (main and earth switch)	Nos	
2.17.2	Pole discrepancy circuit required	Yes / No	

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Sl. No.	DESCRIPTION	UNITS	TO BE FILLED BY BIDDER
2.17.3	Purchaser's earthing conductor (material & size)	mm x mm	
2.17.4	Mounting structure included in vendor's scope of supply	Yes / No	
2.17.5	Phase to phase spacing of poles	mm	
2.17.6	Height of connection/bus above ground level	mm	
2.18	Clamps and connectors		
2.18.1	By purchaser/vendor		
2.18.2	Take off (Horz, Vert, etc)		
2.18.3	Conductor size and material		
2.19	Auxiliary supply		
2.19.1	Electrical		
2.19.2	Type of interlock		
2.20	Environment : salty / dusty / normal corrosive / polluted		
2.21	Wind pressure	kg/Sq.m	
2.22	Coefficient of seismic acceleration		
2.23	Altitude above M.S.L.	Mtr	
2.24	List of type tests to be carried out		
2.25	Spares		
2.25.1	Support insulator column		
2.25.2	Operating rod insulator		
2.25.3	Drive motor		
2.25.4	Motor contactor of each type		
2.25.5	Fuses of each rating		
2.25.6	Spring		
3.0	LIGHTNING ARRESTORS		

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Sl. No.	DESCRIPTION	UNITS	TO BE FILLED BY BIDDER
3.1	Quantity		
3.2	Installation		
3.3	System voltage		
	Nominal	kV	
	Highest	kV	
3.4	System Earthing		
3.5	Type of arrester		
3.6	Short circuit current at arrester location	kA	
3.7	Maximum duration of earth fault	Sec	
3.8	Co-efficient of earthing		
3.9	Temperature limits		
3.10	Seismic requirement		
3.11	Wind velocity		
3.12	Variation in frequency		
3.13	Rated values		
3.13.1	Rated arrester voltage / maximum continuous operating voltage	kV	
3.13.2	Discharge class		
3.13.3	Maximum residual voltage at nominal discharge current		
3.13.4	Pressure relief class (short circuit capability)		
3.13.5	Long duration current impulse withstand		
	a) Discharge class		
	b) Peak current & virtual duration of peak	A/μs	
	c) High current impulse	kA (Peak)	
3.14	Gapless arrester		

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Sl. No.	DESCRIPTION	UNITS	TO BE FILLED BY BIDDER
3.14.1	Continuous operating voltage	kV	
3.14.2	Residual voltage corresponding to		
	a) Steep current impulse	kV (Peak)	
	b) Switching current impulse	kV (Peak)	
3.15	Arrestor Housing		
3.15.1	Material of housing		
3.15.2	Withstand Test Voltages		
3.15.3	a) One minute power frequency dry & wet (rms)	kV	
	b) 1.2 / 50 micro second Impulse withstand voltage(Peak)	kV (Peak)	
3.15.4	Minimum total creepage distance of whole insulator– mm	mm	
3.15.5	Suitable for live washing	Yes/ No	
3.15.6	Level of pollution		
3.16	Additional requirements		
3.16.1	Minimum cantilever strength of arrestor assembly	kgs	
3.16.2	Maximum radio interference voltage	μV	
3.16.3	Type of mounting		
3.16.4	Whether insulating base required		
3.16.5	Accessories required		
	a) Discharge counter		
	b) Grading ring		
	c) Clamps and connectors		
	d) Leakage current meter		
	e) Earth lead disconnecter		
3.16.6	Purchaser conductor size		

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Sl. No.	DESCRIPTION	UNITS	TO BE FILLED BY BIDDER
	a) Line side		
	b) Earth side		
3.16.7	Visual discharge voltage		
3.16.8	Pressure relief valve	Yes / No	
4.0	INSULATOR		
4.1	Bus post insulator		
4.1.1	Type		
4.1.2	Cantilever strength	kgs	
4.1.3	Power frequency Puncture voltage		
4.2	Disc insulator		
4.2.1	Voltage class		
4.2.2	Type / No		
4.2.3	Creepage distance	mm	
4.2.4	Minimum protected creepage distance	mm	
4.2.5	Electromechanical strength		
4.2.6	Power frequency Puncture voltage		

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	TITLE LV SWITCHGEAR	

1.0 SCOPE

- 1.1. This specification covers the design, material, construction features, manufacture, inspection, and testing at VENDOR's/SUB-VENDOR's works, delivery to site including transit insurance and supervision of erection, testing & commissioning of metal enclosed Low Voltage switchgear for voltage not exceeding 1000 V AC.

2.0 CODES AND STANDARDS

- 2.1. The design, material, construction, manufacture, inspection, testing and performance of equipment shall comply with all currently applicable standards, codes of practice, regulations and safety codes in the locality where the equipment will be supplied & installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.
- 2.2. The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant/ Owner in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of the code/ standard. Consultant/ Owner may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed
- 2.3. In case of conflict between the applicable standards and this specification, the more stringent of the two shall govern.

3.0 LV Switchgear Panels

- 3.1. Below mentioned switchgear is covered under is specification. Additional details refer data sheet-A and attached SLD:

a) 415V Substation Distribution board -1 No.

The preliminary details such as continuous current rating of the bus bar, feeders, minimum protection relays, and meters, etc to be provided as shown

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in the Single line diagram. The Contractor shall review the rating of equipment required for the system offered, the protection relays and meters for effective protection and monitoring of the equipment being supplied and add additional relays/meters and suitable rated equipment as required.

- 3.2. The complete switchgear shall be procured from the same source to ensure interchangeability of components.
- 3.3. The switchboards shall derive power from the designated service transformers or from emergency DG set or from switchgear panels.
 - 3.3.1. The switches, breakers, contactors, and other power devices shall consider a margin of about 20% over the name plate current rating of the respective load.
 - 3.3.2. MCCBs with OV/UV/EF release shall be provided for feeders rated between 63 A & above and less than 400A. MCCB/MCB shall be provided for the feeders rated below 63A as per panel short circuit rating.
 - 3.3.3. -
 - 3.3.4. 24V* Interposing relays shall be provided for control from remote / SCADA.

4.0 CONSTRUCTIONAL FEATURES

- 4.1. The switchgear shall be indoor, metal enclosed, floor mounted of uniform height not more than 2450 mm, made up of the requisite vertical sections.

The frames shall be sheet steel enclosed and shall be dust, weather and vermin proof providing a degree of protection of - IP 52 up-to & equal to 1600A and IP42 above 1600A for indoor use and IP 55 for outdoor use. Sheet steel used shall be cold rolled and at least 2.5 mm thick and properly braced to prevent wobbling.

The degree of protection provided by enclosures against external mechanical impacts shall be IK08 minimum. Panels shall be supplied with base channel (Minimum ISMC 75/ 100) which will be an integral part of the panel.

Adjacent switchgear cubicles shall be provided with side sheets on either side to ensure complete isolation. The switchgear shall be easily extendable on both sides by the addition of vertical sections.

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Proper gasketing shall be provided all around the perimeter of adjacent panels, panel and base frame, removable covers and doors. Gaskets shall be EPDM type.

- 4.2. From internal isolation point of view, the switchgear shall be designated in the following form of separation:

Form 3 : Separation of busbars from the functional units

Separation of all functional units from one another

Form 3a : Terminals not separated from bus bars

Form 3b : Terminals separated from bus bars

Please refer Data sheet - A for the specified form of separation.

- 4.3. Fixed Type Withdrawable Chassis:

In this type of construction all power connections to the equipment mounted on the withdrawable chassis shall be of the bolted type. All control circuit connections to equipment mounted on the withdrawable chassis shall be carried out through conventional terminal blocks mounted in the respective chassis. It shall be possible to draw-out the chassis after unbolting/unscrewing all the power and control circuit connections to the equipment mounted on the withdrawable chassis.

- 4.4. Switchgear / MCCs shall be divided into distinct vertical sections of:

- Completely enclosed busbar compartment running horizontally
- Individual feeder modules in multitier arrangement. Module height shall be minimum 200mm
- Enclosed vertical busbars serving all modules in vertical section.
- Vertical cable alley covering entire height and minimum 250mm wide.
- A horizontal separate enclosure for all auxiliary power and control bus, if required.
- No equipment requiring operation shall be located less than 250mm from bottom level of the panel (ground level) and maximum operating height not more than 1800mm.

- 4.5. Each vertical section shall be equipped with space heater with thermostat.

- 4.6. Cable alley shall be provided with suitable hinged doors.

- 4.7. All doors shall be with concealed type hinges and captive screws.

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4.8. Main and Auxiliary Buses:

- a) Switchgear/MCC bus bars shall be of uniform cross section throughout the length and made of high conductivity, Aluminium /aluminium alloy of E91 grade.
- b) Busbars shall be sleeved, and with proper clearances, adequately supported to withstand stresses developed due to short circuits. Material used for sleeving shall be capable of withstanding maximum temperatures specified in technical requirements table. Supports shall be of glass reinforced phynolic material or cast resin. Busbar joints shall be shrouded with moulded epoxy shrouds. The busbar rating of the 415V switchgear shall be rated 1.25 times the incomer breaker rating and for tapoff busbars, the current rating shall be at least equal to total of corresponding connected breaker(s) rating.
- c) Switchgear / MCC shall be designed such that all component equipment and busbars operate satisfactorily without exceeding their respective maximum permissible temperature limits.
- d) Busbars shall be adequately supported on insulators. These shall withstand dynamic stresses due to short circuit currents specified.
- e) Size of the vertical busbars in each vertical section shall be such that it shall carry minimum 80% of the sum of the connected load to that vertical bus.
- f) In case of busduct termination at the incomer, flange arrangement as per requirement of busduct Vendor shall be considered.

4.9. PAINTING

- a) Panel shall be complete with all fabrication work like drilling, punching, shearing and welding etc. before proceeding to pre-painting processes.
- b) Pre-treatment of all sheet steelwork, including degreasing, acid pickling, de-rusting, phosphating, passivation including repeated rinsing in between each process shall be carried out as per applicable standard.
- c) After Pre-treatment, the panel shall be provided with protective coating including compatible primer with the shade as indicated in Data Sheet A1 for exterior and interior with minimum thickness of 80 microns DFT.
- d) After coating, Curing shall be carried out as per the required process. Any post painting fabrication activity like drilling, cutting, welding may liable for rejection of complete panel.

4.10. CONTROL SUPPLY

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4.10.1. Changeover operation for Incomers / buscouplers shall be derived from 110 V AC line PT supply.

4.10.2. DP MCB shall be provided for all control circuits where the fault level is less than fault withstand capacity of MCB. Else the control supply shall be tapped through a control transformer of adequate capacity supplied with MCCB/ MPCB / SFU of adequate short time rating. Independent DP MCBs shall be provided for each circuit such that tripping due to fault in one circuit should not affect other functions adversely. The insulation class for control transformer shall be Class B.

4.10.3. Where control transformer has been provided, a separate control bus shall be run maintaining adequate clearance of atleast 300mm from the power bus with provision of tapping at each vertical column section. The control bus should be preferably a bus bar with Heat shrinkable sleeve.

4.11. -

5.0 -

6.0 PROTECTION COORDINATION

It shall be the responsibility of the Vendor to fully coordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers/fuses/motor starters, to provide satisfactory discrimination. Protective releases shall be EMC compliant. The release shall be protected against non-linear loads and shall not cause nuisance tripping due to harmonics. All protective components esp. ACBs and MCCBs installed in PCC and at Incomer of downstream Panels shall be with Utilization Category "B" (i.e. offering time discrimination with downstream devices)

7.0 MOULDED CASE CIRCUIT BREAKERS (MCCB)

a) MCCBs in AC circuits shall be of triple/four pole construction arranged for simultaneous three/four pole manual closing and opening. Power closing device for remote operation shall be provided, if necessary. Operating mechanism shall be quick-make, quick-break and trip-free type. All MCCBs shall be provided with rotary operating handle with door interlock feature.

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- b) The instantaneous short circuit release shall be so chosen by the VENDOR as to operate at a current in excess of the peak motor inrush current and a range of settings shall be provided for the PURCHASER'S selection.
- c) All MCCB's shall be with $I_{cu}=I_{cs}=100\%$.
- d) All the MCCBs shall be of current limiting type and shall provide a cut off in, < 10 ms for prospective currents during faults.
- e) The MCCB's shall be provided with thermal magnetic or microprocessor based overload, short circuit and earth fault releases as required & specified. For four pole MCCB the microprocessor-based earth fault release shall be inbuilt. For TPN MCCB the microprocessor-based earth fault release shall be inbuilt with a separate neutral CT input or the earth fault protection shall be provided by CBCT, ELR and shunt trip coil. For thermal magnetic release the earth fault protection shall be provided by CBCT, ELR and shunt trip coil.

8.0 -

9.0 Meters

All the meters shall be digital type including Ammeter & Voltmeter. All digital meters shall indicate true RMS. Digital Multifunction meter shall display all electrical parameters like (but not limited to) following metering features : Current, Voltage, Frequency, Energy (kWh), MD (kW/kVA), PF, kVAh, kVA_r, kVARh, V THD, I THD, etc. Multi-function meters shall be provided with communication facility i.e MODBUS RTU (TCP/IP; Ethernet) for SCADA interconnection.

All analog values to be provided on SCADA or HMI in control room.

10.0 MODULE DETAILS

10.1. INCOMERS

- (a) The incomer modules of 415V switchgear shall be MCCB controlled. They shall be provided with following minimum requirements:
 - (i) Dedicated CTs for metering and protection
 - (ii) MCCB/MPCB/MCB for control supply
 - (iii) Breaker control switch
 - (iv) Local remote selector switch

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(v) 3 phase inverse time over current & 1 no. of E/F microprocessor-based release, (vi) Indicating lamps for on, off and fault (vii) Necessary circuitry and devices for auto trip, fault alarm, auto changeover of supplies and for control/ alarm of the breaker as required. (viii) IPRs for the SCADA / PLC control (b) The incomer modules shall be interlocked with their upstream breakers such that they can be closed only when upstream breaker is closed and trips automatically when upstream breaker is tripped. (c) All hardware required for meeting the functional requirements stated above, whether specifically listed out in the specification or not, shall be included in the Contractor's scope of supply. 10.2. - 10.3. OUT GOING FEEDERS The modules shall be provided with the following: (a) Moulded case circuit breakers (MCCBs) or MPCB or MCB shall be provided when called for in Data Sheet-A1/SLD. (b) Breaker on, off and trip indicating lamps. (c) Emergency PB (d) Local remote selector switch(SS), Auto/manual SS, etc., (e) Necessary auxiliary contactors/relays for remote indications. 11.0 INTERNAL WIRING 11.1. All wiring shall be carried out with 1100V grade, single core, FRLS-PVC, flexible multi stranded copper conductor wires and shall be vermin and rodent proof. 11.2. The internal wiring shall be with 1.5sq.mm multi stranded copper conductor for control wiring and 4 sq.mm for CTs & 2.5 sq.mm for PTs and suitably sized for power wiring with a minimum of 2.5 Sq.mm copper. 11.3. Wire color shall be Red, Yellow, Blue for respective Phases/PT wires, Black		

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for neutral, Green / Yellow for earthing circuits, Grey for control wiring etc.

11.4. Power circuit wiring minimum 4.0 Sq. mm Red, Yellow & Blue colour for Ph and Black for Neutral wire.

11.5. All power wiring for rating up to and including 63A shall be carried out with multi stranded copper wires duly crimped with ring type lugs. Power connections for rating above 63A shall be done with bus bars (machine bend for proper profile) insulated with black heat shrinkable sleeves.

11.6. Terminal blocks shall be of stud type, 1100 volts grade, 10 amps. rated complete with insulated barriers. Terminal blocks for CTs and VTs shall be provided with test links and isolating facilities and CT terminals shall have short circuiting and earthing facility. Terminals shall be suitable to take up two numbers of 2.5 sq. mm. copper wires. All terminals of different control voltages shall be separate from each other. Suitable barriers shall be provided between two terminals connected to different voltage supplies. 20% spare terminals to be provided for each terminal strip for each panel.

12.0 CABLE TERMINATION

Glands shall be of heavy duty brass castings, machine finished and complete with check nut, washers, neoprene double compression ring etc. The lugs shall be tinned copper/aluminium depending on cable conductor and of solder-less crimping type.

13.0 ARC RESISTANCE

- The switchgear assembly shall be certified as Arc Resistant. The minimum arcing duration used for testing shall be 500ms as specified in the applicable standard.
- Rear venting flaps in the panel shall be provided for added air flow under normal operating conditions but automatically close during an arc event to prevent pressure and gasses from escaping.
- The panel top shall be provided with roof flaps for pressure relief created by an internal arcing event.

14.0 -

15.0 EARTHING

15.1. An earthing bus shall be provided at the bottom and extended throughout the

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length of the switchgear. It shall be bolted / welded to the frame work of each unit and each breaker earthing bar.

15.2. All non-current carrying metal work of the switchgear shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible earthing braid.

15.3. Positive earthing of the circuit breaker frame shall be maintained both in service and test position.

16.0 MAINTENANCE REQUIREMENTS

16.1. Easy access shall be provided for all components in the switchgear for maintenance

16.2. As far as possible the switchgear shall be so designed that no special tools are necessary for installation and maintenance. However, if special tools are required, the Bidder shall include price of one complete set in his bid.

17.0 TESTS

17.1. Routine tests shall be carried out on completely assembled equipment as per relevant standards.

17.2. Functional tests shall be carried out to demonstrate the specified control and interlocks.

17.3. Copies of the test certificates for all brought out items shall be submitted for the PURCHASER'S approval.

17.4. Oscillographic test records for closing and tripping timings of the breakers shall also be furnished.

17.5. The contractor shall furnish copies of all valid type test reports as per the relevant standards. Type tests shall be carried out free of cost to prove the design if not tested in the previous five years.

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SL. No.	DESCRIPTION	UNITS	CLIENT'S SPECIFICATION
1.0	Switchboard & Bus bars		
1.1.	Rated voltage, phases & frequency	V/P/Hz	415V, 3-PH, 50Hz, 4 wire
1.2.	System neutral earthing		Effectively earthed
1.3.	One minute power frequency voltage withstand		
1.3.1.	Power circuits	V	2500
1.3.2.	Control circuits	V	1500
1.3.3.	Auxiliary circuits	V	2000
1.4.	Reference ambient air temperature	°C	50
1.5.	Material of bus bars		Aluminium/Aluminium Alloy
1.6.	Maximum temperature of bus bars contacts, droppers at site reference ambient of 50°C	°C	85°C for non silver plated joints 105°C for silver plated joints
1.7.	Short circuit withstand		
1.7.1.	Short time current (1 sec.)	rms	50kA
1.7.2.	Momentary current	Peak	105 kA
1.8.	Switchboard / MCC Construction		
1.8.1.	Form of separation		Form – 3b
1.8.2.	Fully draw out / Fixed		Fixed type
1.8.3.	Double front / single front		Double Front / Single front (However, final arrangement will be confirmed during details engg. as per layout requirement)
1.8.4.	Cable entry (Power & Control)		Bottom
1.8.5.	Modular construction		Yes
1.9.	Degree of protection		IP 52 ≤ 1600 A IP 42 >1600A IP 55 for outdoor use

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	TITLE LV SWITCHGEAR DATA SHEET – A	

SL. No.	DESCRIPTION	UNITS	CLIENT'S SPECIFICATION
1.10.	Thickness of sheet steel		Frame / Door / Cover
1.10.1.	Cold rolled	mm	2.5 / 2.0 / 2.0
1.10.2.	Hot rolled	mm	2.5 / 2.0 / 2.0
1.11.	Clearances in air for live parts		
1.11.1.	Phase to Phase	mm	25.4
1.11.2.	Phase to Earth	mm	19.4
1.12.	Paint shade		RAL 7032
2.0	Contactors & O/L relay		
2.1.	Utilization category for contactors		AC3 for non-reversible & AC4 for reversible
2.2.	Contactor rated duty		Uninterrupted
2.3.	Reset feature for thermal O/L Relay		Hand
2.4.	Starter type		Not Applicable
3.0	-		
4.0	Moulded case circuit Breakers (MCCB)		
4.1.	Voltage, frequency & no. of phases		415V,50Hz & 3ph
4.2.	Rated operating duty		Category B
4.3.	Rated short-time withstand current and time		50 kA for 1 sec
4.4.	Rated current at site reference ambient temperature		As per SLD
4.5.	On/off operation : a) Manual b) Remote power operated (Motorised)		a) Yes b) No
4.6.	Releases required		a) Thermal Magnetic Based (for 63A & below rating) b) Microprocessor based release (for above 63A and less than 400A)

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SL. No.	DESCRIPTION	UNITS	CLIENT'S SPECIFICATION
4.7.	Protection		MCCB with Overload and short circuit protection
4.8.	Operating Handle		To be provided for MCCB & MPCBs on doors
5.0	CTs and VTs		
5.1.	Short time withstand current and duration for CT		50kA for 1 sec
5.1.1.	Breaker controlled		Based on breaker short circuit current rating and duration
5.1.2.	Switch fuse controlled		To match with fuse withstand
5.2.	Overvoltage withstand capacity for VT	p.u.	1.2 continuous and 1.9 for 30 seconds
5.3.	Type		Cast Resin
5.4.	Insulation class		Class B or better
5.5.	Accuracy class		Accuracy for Metering shall be 0.5 and for Protection 5P20
6.0	Meters		
6.1.	Type		Digital multifunctional meters with communication facility
6.2.	Class of accuracy		1.0 for other meters, 0.5 for energy meters & TVM
7.0	Earthing bus	mm mm x	25x6 Copper Flat (min)

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APPLICABLE STANDARDS

1.0	LOW VOLTAGE SWITCHGEAR AND CONTROL GEAR ASSEMBLIES-GENERAL RULES	IS/IEC:61439-1
2.0	LOW VOLTAGE - AC CIRCUIT BREAKERS	IS/IEC 60947-2
3.0	AUTOMATIC POWER FACTOR CORRECTION PANELS FOR VOLTAGES UP TO AND INCLUDING 1000V	IS: 16636
4.0	AIR BREAK SWITCHES	IS:60947-3
5.0	CURRENT TRANSFORMERS	IS:2705, 16227 (P-2)
6.0	VOLTAGE TRANSFORMERS	IS:61869
7.0	LOW VOLTAGE SWITCHGEAR AND CONTROL GEAR - GENERAL RULES	IS/IEC:60947-1
8.0	CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF SWITCHGEAR	IS:10118
9.0	CODE OF PRACTICE FOR PHOSPHATING IRON AND STEEL	IS: 6005
10.0	GUIDE FOR TESTING UNDER CONDITIONS OF ARCING DUE TO INTERNAL FAULT	IEC 61641
11.0	TESTING GUIDE	ANSI/IEEE C.37.20.7

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	TITLE LV SWITCHGEAR DATA SHEET – B	

DATA TO BE FURNISHED ALONG WITH THE BID.

SL. No.	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
1.0	GENERAL PARTICULARS		
1.1.	Manufacturer's Name		
1.2.	Manufacturer's type designation		
1.3.	Applicable Standard		
1.4.	Degree of Protection of the enclosure		
1.5.	Overall dimensions of each switchgear cubicle (Length x Depth x Height)	mm	
1.6.	Minimum space required in front and rear	mm	
1.7.	Cubicle weight with circuit breaker	kg	
1.8.	Dynamic Loading	kg	
1.9.	One minute power frequency withstand voltage	kV rms	
1.10.	1.2/50μS impulse withstand voltage	kV peak	
2.0	BUS BARS		
2.1.	Material		
2.2.	Bare/Insulated		
2.3.	Number and size of 1 phase	mm x mm	
2.4.	Minimum Clearance		
	(a) Phase to phase	mm	
	(b) Phase to earth	mm	
2.5.	Busbar Arrangement		
	(a) Horizontal or vertical		
	(b) Phase segregation provided	Yes / No	
	(c) Voltage class of support		

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SL. No.	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
	insulators		
2.6.	Current rating under reference ambient condition		
	(a) Continuous		
	(b) One second		
	(c) Dynamic		
3.0	CIRCUIT BREAKERS		
3.1.	Manufacturer's type designation		
3.2.	Applicable standard		
3.3.	Duty cycle for the breaking capacity		
3.4.	Total interrupting time measured from trip coil energisation	Cycle	
3.5.	Total making time measured from closing coil energisation	Cycle	
3.6.	Main Contacts		
	(a) Type		
	(b) Material		
	(c) Thickness of Silver plating		
3.7.	Arcing Contacts		
	(a) Type		
	(b) Material		
	(c) Thickness of Silver plating		
3.8.	Closing coil consumption at rated voltage	Watts	
3.9.	Trip coil consumption at rated voltage	Watts	
3.10.	Number of auxiliary contacts		
3.11.	Spring charging motor		

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SL. No.	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
	(a) Rating	Watts	
	(b) Type	AC/DC	
	(c) Voltage	V	
	(d) Class of insulation		
4.0	CURRENT TRANSFORMERS		
4.1.	Type (bar/wound)		
4.2.	Applicable Standard		
4.3.	Class of insulation		
4.4.	Short time withstand capability		
	(a) Short time current 1 sec.	kA rms	
	(b) Dynamic rating	kA Peak	
5.0	VOLTAGE TRANSFORMERS		
5.1.	Type		
5.2.	Applicable Standard		
5.3.	Type of insulation		
5.4.	Ratio		
5.5.	Connections		
5.6.	Rated output burden (1-phase)	VA	
5.7.	Accuracy class		
5.8.	H.V. Fuse Rating/Rupturing Duty	A / kA	
5.9.	Rated Voltage Factor		
	(a) Continuous		
	(b) Short time		
6.0	RELAYS (TYPE & MAKE)		
6.1.	Inverse time over current relay		

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SL. No.	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
6.2.	Instantaneous over current relay		
6.3.	Thermal overload relay		
6.4.	Locked Rotor Protection Relay		
6.5.	Earth Fault Relay		
6.6.	Voltage operated, neutral - displacement relay		
6.7.	Under voltage relay		
6.8.	Earth leakage relay (with core balance CTs)		
6.9.	Differential Relay		
6.10.	Auxiliary relays		
6.11.	Relays drawout type	Yes/No	
7.0	SPARES		
	List of recommended spares for normal maintenance for a period of 5 years furnished	Yes/No	
8.0	TESTS		
	Type tests certificates furnished with the bid	Yes/No	
9.0	DRAWINGS		
	List of drawings submitted along with bid		
10.0	Technical literature for the following are submitted with the bid		
	(a) Switchgear	Yes/No	
	(b) Circuit Breakers	Yes/No	
	(c) CTs & VTs	Yes/No	
	(d) Relays	Yes/No	

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	TITLE METERING PANEL	
1.0 <u>SCOPE</u> 1.1 This Specification covers the requirements of sizing, design, engineering, material selection, constructional features, manufacture, inspection and testing at the VENDOR'S or his SUB-VENDOR'S Works, delivery to Site including transit insurance, installation, testing & commissioning and performance testing of meter panels and the associated equipment mounted thereon. 1.2 The following list of items/systems are covered under the specification. Additional details refer data sheet-A / SLD. 1.2.1 Tariff metering panel at Metering Room in SS-1. a) Secure Make Apex 150 3P4W, Self-Powered + Aux Power Accuracy Class: 0.2s PT: 22kV/$\sqrt{3}$ /110V/$\sqrt{3}$ CT: ***/1A, (Configurable 1- 10A), RS-232, RS-485, Ethernet Configurable Pulse I/O: 4 Fixed Pulse O/P: 7 b) PQR (Power quality recorder) as per MSEDCL requirements c) Base Computer software: (M-cubed software with 5 year license) d) Meter Reading Instrument (MRI) Make-SANDS e) Meter to PC (Serial Communication Cable) f) USB to Serial Communication Cable Make : MOXA g) Modem Skyline E90, NbloT Modem Fall back to 2G 1.2.2 Audit metering panel at Metering Room in SS-1. a) Secure Make Apex 150 3P4W, Self-Powered + Aux Power Accuracy Class: 0.2s PT: 22kV/$\sqrt{3}$ /110V/$\sqrt{3}$ CT: ***/1A, (Configurable 1- 10A), RS-232, RS-485, Ethernet Configurable Pulse I/O: 4 Fixed Pulse O/P: 7 b) PQR (Power quality recorder) as per MSEDCL requirements c) 8 Port Industrial LAN switch unmanaged d) Data Concentrator Unit (DCU)-Kalkitech Make 1.2.3 DCU Sync & Configuration Services a) Integration of new meter with Kalkitech DCU (By MSETCL team) Coordination with MSETCL & Kalkitech team for data integration at SLDC. b) Supervision of Installation and Commissioning of APEX meters.		
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1.3 The following technical specifications and procedures form an integral part of this specification for compliance with STU / TPCL metering requirements.

ANNEXURES -1	TECHNICAL SPECIFICATION FOR STU METERS
ANNEXURES -2	TECHNICAL SPECIFICATION FOR TPCL METER
ANNEXURES -3	TECHNICAL SPECIFICATION FOR SUMMATOR
ANNEXURES -4	STANDARD OPERATING PROCEDURE FOR INTEGRATION OF THIRD-PARTY IEM/DCU IN AMR SYSTEM

1.4 **Refer attached SLD for the minimum requirement of metering schemes. However, it shall comply MSEDCL, Local State Electricity Board & project requirement.**

2.0 CODES AND STANDARDS

2.1 The design, manufacture, testing and performance of equipment shall comply with all currently applicable standards, codes of practice, regulations and safety codes in the locality where the equipment will be supplied. Nothing in this specification shall be construed to relieve the VENDOR of his responsibility. In case of conflict between these standards and this specification, more stringent of the two requirements shall govern. Some of the currently applicable standards are indicated in Data Sheet A

2.2 The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant/ Owner in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of the code/ standard. Consultant/ Owner may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.

2.3 The VENDOR shall ensure that instruments and gauges to be used for testing and inspection shall have valid calibration and the accuracy can be traced to National and International Standards as applicable.

3.0 EXTENT OF WORK

The extent of work covered in this specification is as follows:

3.1 Design, fabrication, assembly and finishing of the complete panels.

3.2 Procurement, mounting and wiring of all equipment specified. Mounting and

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wiring of the Purchaser's equipment shall also be done wherever specified. 3.3 All internal wiring to equipment and terminal blocks. 3.4 All intra panel wiring i.e., between panels aligned together. 3.5 Testing of panels and associated equipment and furnishing of test certificates/reports. 4.0 <u>PANELS</u> 4.1 Simplex panel type shall consist of a vertical front panel with equipment flush mounted thereon and having wiring access from the rear. Doors shall have handles with built-in locking facility. 4.2 Doors shall have provision for safe keeping of drawings in the form of compartment on the inner side of the panel door. 4.3 Panel doors shall be provided with neoprene gaskets. All panel openings shall be properly sealed with blanking plates, plugs etc., as appropriate. 4.4 Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment. Equipment mounted inside the panel shall be so located that MCBs, terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible. 4.5 Indicating instruments and meters shall be at a suitable height so that the lettering on the dials can be easily read. Control switches / push buttons and relay resetting knobs shall be conveniently located for ease of operation. The complete layout shall give an aesthetically neat and uniform appearance. 4.6 A minimum clear space of 125 mm shall be maintained between any two rows of auxiliary relays to avoid congestion in panels. 4.7 The panels shall be fixed on the embedded foundation channels with intervening layers of anti-vibration strips made of shock absorbing material. 4.8 All wiring shall be carried out with 1100 V grade, single core, multistrand copper conductor wires with Low halogen FRLS / HFFR insulation and shall be vermin, rodent proof. The minimum size of the stranded copper conductor used for panel wiring shall be as follows: a) All circuits except CT & PT circuits: 1.5 sq.mm per lead. b) CT & PT Circuits: 4 sq.mm per lead. The minimum number of strands per conductor shall be seven. Extra flexible wires shall be used for wiring of devices mounted on moving parts such as		
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swinging panels and doors. Colour coded wires & cross feruling should be available in panel wiring. 4.9 Panel wiring shall be securely supported, neatly installed by lacing and tying, readily accessible and connected to equipment terminals and terminal blocks. Flame retardant, plastic wiring channels / troughs with clip on plastic covers shall be used for this purpose. 4.10 Longitudinal troughs extending throughout the full length of the panels shall be provided for intra panel wiring, for AC and DC supplies, PT circuits, annunciator circuits and other common services. Interconnections to adjacent panels shall be brought to a separate set of terminal blocks located near the slots or holes meant for taking the interconnecting wires. Arrangements shall permit easy interconnections to adjacent panels at site and wires looped and bunched properly inside the panels for this purpose shall be provided by the Vendor. 4.11 Wire terminations shall be made with solder less crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules, marked to correspond with the panel wiring diagram shall be fitted at both ends of each wire. Round lugs shall be provided for metering circuits. 4.12 Terminal blocks shall be 1100V grade, 10 amps rated with insulated barriers and identification strips. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams. 4.13 Moulding materials shall be self-extinguishing or resistant to flame propagation, substantially non-hygroscopic and shall not carbonise when tested for tracking. The insulation between any terminal & framework or between adjacent terminals shall withstand a test of 2 kV rms for one minute. The mouldings shall be mechanically robust to withstand handling while making terminations. 4.14 Protective covers of transparent plastic for placing over the live parts of the terminal blocks shall be provided. 4.15 Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. Also, CT secondary leads shall be provided with short circuiting and earthing facilities but PT with earthing facility. 4.16 Unless otherwise specified, all the terminal blocks except the terminal blocks for CTs & AC/DC power supply shall be suitable for connecting minimum two 2.5 sq.mm copper conductors of the Purchaser cables at each connecting point. The terminal blocks for CTs shall be suitable for connecting minimum of 4.0 sq.mm copper conductors and for AC/DC power supply it shall be upto 10 sq.mm. 4.17 A minimum of 20% spare terminals shall be provided in each panel and these spare terminals shall be uniformly distributed on all rows of terminal blocks.		
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4.18	All spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks.	
4.19	The terminals for external connections shall be arranged for consecutive connections of different cores of a multicore cable. The terminal block wiring shall be done in such a way that the jumper connections and external cable connections are made on different sides of the terminal block. The sides on which Jumper connections and external cable connections are made shall be consistent and unambiguous throughout.	
4.20	The external cable connections will be terminated on the terminal blocks provided in the panel. All necessary cable terminating accessories such as gland plates, supporting clamps and brackets, fire retardant wiring troughs and gutters, etc., for the external cables shall be included in the Vendor's scope of supply.	
5.0	<u>TARIFF / AUDIT METER</u>	
5.1	Meters shall support for DSM (Deviation Settlement Mechanism) for Billing.	
5.2	For monitoring the transmission of power, a metering system using digital meters shall be provided. All measurements such as voltage, current, power, energy etc., used for monitoring, shall be provided as per drawings. All the energy meters used for measurements shall have minimum accuracy of 0.2S and shall be connected to the data acquisition system for automatic meter readings. The special energy meters (SEMs)/Audit meters, as marked in the drawing and in accordance with the Metering regulations of the CEA, are used for commercial purpose. It shall have the following features: a) Meters shall be static type and have anti-tampering features. b) Meters shall be capable of four quadrant measurement of kWh, kVARh, kVAh. c) Meters shall have downloading facilities of metered data through meter reading instrument (MRI). d) Meters shall be immune to external influences like magnetic induction, vibration, electrostatic discharge, switching transients, surge voltages, oblique suspension and harmonics etc., e) Meters shall have necessary ports for communication to plant SCADA system. f) Communication Cables for the transfer of all SEM data to plant computers in control room shall be provided. g) Meters shall meet all the requirement of latest regulations at the time of commissioning. h) Meters shall be provided with MODBUS RTU (TCP/IP; Ethernet) for remote connectivity.	
5.3	In addition to the above, it shall comply with following minimum requirement:	
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• Accuracy class of 0.2S as per IEC 62053 standard • Working voltage of 63.5V • Composite meter capable of measuring Active and Reactive Energy in all 4 quadrants, • Direct measurement as per CT/PT secondary quantities • Filters harmonics and measure energy at fundamental frequencies. • Operates on self-power from connected PT supply (110V Ph to Ph/ 63.51 V Ph-N) • Secondary current rating of 1A • VA burden not more than 10 on any of the phases • Working range (-5 to 60 deg C) • Works on Real Time Clock (RTC) hence data is time stamped with accuracy of 60 sec/month • Time adjustment facility (in steps of 1 min in a week) • No calibration required due to absence of moving parts. (Calibration possible only at Manufacturers' works) • Extended temperature LCD for display • Rechargeable Ni-Cd battery with a push button on front panel to operate during power failure • High security of data storage • Offline data collection possible for 6-7 hrs during power off condition • Surface mounted, light in weight (<2.5kg) • Mounting can be done on a flat surface, one hole on top and two holes at the bottom. • Supplied DSM meter shall be suitable and shall follow the local Guidelines of Electrical board.		
5.4	Main meter, check meters, PQR, etc shall be provided as shown in the SLD. Necessary ports at all meters with connections shall be provided inline with MSEDCL requirement.	
5.5	All electronic hardware shall conform to the requirements of applicable standards and suitable for the specified environmental conditions at site enumerated in Section-B. No air-conditioning will be made available in the environs where this equipment are to be located. In case any equipment requires controlled atmospheric conditions, Bidders shall specifically indicate the same in the Bids	
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without taking recourse to catalogues etc. 5.6 The printed circuit cards shall be designed for trouble-free service throughout the life of the plant when subjected to normal operation, handling & maintenance under atmospheric conditions specified in the Section-B/respective sections. 5.7 Spare space shall be provided in the control panels / cubicle for installing at least 20% of installed control modules at site to meet future requirement. 6.0 <u>INDICATING LAMPS</u> 6.1 Indicating lamps shall be Multi-chip LED type suitable for panel mounting with rear terminal connections. The indicating lamps shall be with Low Voltage Glow Protection. 6.2 Lamp and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if any, required for replacing the lamps and lenses shall also be included in the scope of supply. 7.0 <u>SPACE HEATERS</u> 7.1 Strip type space heaters of adequate capacity shall be provided inside each panel to prevent moisture condensation on the wiring and panel mounted equipment when the panel is not in operation. Space heaters shall be rated for 240V, 1 Phase, 50 Hz supply. Heaters inside the panels shall not be mounted close to the wiring or any panel mounted equipment. Also accidental contact with heaters by operators shall not be possible. Heaters shall be complete with miniature circuit breakers. 7.2 A thermostat shall be provided in the heater control circuit to cut-off the heater at 45°C. 8.0 <u>INTERIOR LIGHTING AND RECEPTACLES</u> 8.1 Each panel shall be provided with a lighting fixture rated for 240V, 1 phase, 50Hz supply for the interior illumination of the panel during maintenance. Switching of the fitting shall be controlled by the respective panel door switch. 8.2 Each panel shall be provided with a 240V, 1 phase, 50 Hz, 5/15 Amps, 5 Pin receptacle with switch. The receptacle with switch shall be mounted inside the panel at a convenient location. 9.0 <u>POWER AND CONTROL SUPPLIES</u> 9.1 The Purchaser shall provide duplicate auxiliary power supply feeders. The Vendor shall provide auto/manual-changeover facility so that in case of failure of one power source, other shall cut in.		
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9.2	Indicating lamps of LED type to indicate the healthiness of main incoming power supply feeders shall be provided on the front of the panel. Facility shall be provided for remote annunciation in case of supply failure.	
9.3	Each panel shall be provided with necessary arrangement for receiving, distributing, isolating and protection of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with MCBs. Supply monitoring arrangement shall be provided. Selection of the main and sub-circuit fuse/MCB ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by fuses/MCBs.	
9.4	If auxiliary voltages other than those specified in Data Sheet A are required, then necessary arrangement shall be made by the Vendor within the panel to obtain the desired voltages by providing step-down transformers and/or inverter / converter, etc.	
9.5	If miniature circuit breakers (MCBs) are used in VT secondary circuits, they shall have requisite (minimum 2 NO and 2 NC) auxiliary contacts for blocking trip circuits of voltage dependent protection and annunciation. MCB used in control circuit shall have similar arrangement and auxiliary contact to be used in annunciation. In case of short circuit, the speed of operation of MCB shall be less than 5 milli seconds.	
10.0	<u>LABEL</u>	
10.1	All front mounted equipment as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved.	
10.2	Labels shall be made of non-rusting metal or 3-ply lamacoid. Labels shall have white letters on black or dark blue background. The lettering size shall be 6 mm for panel designation and minimum 3 mm for device labels. The label inscriptions shall be subject to the Purchaser's approval.	
11.0	<u>EARTHING</u>	
11.1	All panels shall be equipped with an earth bus securely fixed along the inside base of panels.	
11.2	Provision shall be made on the earth bus bars of the end panels for connecting the Purchaser's earthing grid at two points. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of the Vendor. Bi-metallic washers shall be provided when the material of Purchaser's Earth flat is different from the material of the panel earth flat.	
11.3	All metallic cases of relays, instruments and other panel mounted equipment shall be connected to the earth bus by independent copper wires of size not less than 2.5 sq.mm. The colour code of earthing wires shall be as per applicable	
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standard. Earthing wires shall be connected on terminals with suitable clamp connectors and soldering shall not be permitted. 11.4 Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided. 11.5 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups. 11.6 Separate earthing points shall be provided in the panel for cable screens of static equipment. Insulation between the two earths prior to connection of the two earths to the Purchaser's earthing grid, shall withstand a test voltage of 1500V for 1 minute (or have resistance of not less than one (1) Mega-ohm at 500V). Connection between the screen terminals and the screen earth-point shall be by jumper wires. Connection of this earth point to the station earth shall be carried out. 12.0 <u>SEALING ARRANGEMENT</u> 12.1 Arrangements shall be provided for proper sealing of the meter cover so that access to the working parts shall not be possible without breaking the seal. All the sealing requirements for meters including body seal, security seal, optical port seal, meter terminal cover seal etc shall be as per the requirements of applicable standards and DISCOM. 12.2 The sample of sealing arrangement to be provided by the VENDOR should be got approved from DISCOM. 13.0 <u>TESTS</u> 13.1 All modules and sub-assemblies shall be energised and tested individually as well as in assembled form at the factory. 13.2 Routine tests shall be carried out on all associated components / equipment as per relevant standards. 13.3 Type tests reports shall be furnished for similar panels and if the same is not available then type tests shall be carried out without time and cost implication. 13.4 The equipment shall be demonstrated for proper operation including performance of meters, alarms and indicators. 13.5 Certified copies of all type and routine test certificates shall be submitted for the Purchaser's approval before despatching the control/relay panel.		
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14.0 PAINTING

Epoxy Painting or electrostatic powder coating shall be carried out as per the applicable standards. The colour of the paint / powder coating shall be as specified in Data sheet A1. Paint thickness shall be subject to Purchaser's approval.

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DATA SHEET – A1

SL. NO.	ITEM	TECHNICAL PARTICULARS
1.0	<u>GENERAL PARTICULARS</u>	
1.1	Panel designation	Tariff metering panel & Audit metering panel
1.2	Type of panel	Simplex type
1.3	Cold rolled sheet steel thickness a. Front and rear b. Sides, top and bottom	3 mm 2 mm
1.4	Painting a. Powder Coating/Epoxy painted b. Color Shade to IS 5.	Powder Coating RAL 7032
1.5	Cable Entry - Top / Bottom	Bottom
1.6	Earth bus material and size, inside the panel.	Copper 35 x 6 mm
1.7	Degree of protection	IP 54 for indoor IP 55 for Outdoor
1.8	Auxiliary voltages to panels a. AC b. DC	230 VAC 110 VDC
1.9	Tests a. H.V. Test (2 kV for 1 minute) b. Megger Test c. Verification of wiring as per approved schematics d. Electrical control, interlock and sequential operation tests.	Yes
1.10	Meter	
1.10.1	Type	ABT based digital billing meter & support for DSM
1.10.2	Model	APEX 150
1.11	All switches, push button, indicating lamps, meters, annunciators mounted on front of the panel ?	Yes, as required.
1.12	Alarm supply failure scheme operation	On a separate DC voltage / AC auxiliary supply
1.13	Lockable switches to be provided	Yes

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DATA SHEET – A2

SL. NO.	DESCRIPTION	REFERENCE STANDARDS
1.0	Low voltage switchgear and control gear –General rules	IS /IEC 60947-1 IEC 60947-1
2.0	Panel wiring	IS 5578 & 11353
3.0	Low voltage switchgear and control gear assemblies-General rules	IS/IEC 61439-1 IEC 61439-1
4.0	Miniature circuit breakers	IS 8828 IEC 60898-1
5.0	HRC cartridge fuse	IS 13703(P2), IS/IEC 60269 IEC 60269
6.0	D Type Fuses	IS 8187 IEC 60269
7.0	Control switches / push buttons	IS 6875 (P1 & P2)
8.0	Current transformers	IS 2705, 16227 (P-2) IEC 61869-2
9.0	Voltage transformers	IS 16227 (P-3) IEC 61869-3
10.0	Relays	IS/IEC 60255 IEC 60255
11.0	Indicating instruments	IS 1248 IEC 60051
12.0	A. C. Electricity meters	IS 722
13.0	Degree of Protection	IS/IEC 60529 IEC 60529
14.0	Code of practice for phosphating iron and steel	IS 6005
15.0	Environmental test for electronic and electrical equipment	IS:9000
16.0	Environmental requirements for semiconductor devices and integrated circuits	IS 6553
17.0	Conformal coating on electronics cards and PCBs	IPC-CC-830C ISA S71.04 IEC 60721-3-3
18.0	Metal clad base material for printed circuits for use in electronic and telecommunication equipment	IS 5921
19.0	Terminals for electronic equipment	IS 4007

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SL. NO.	DESCRIPTION	REFERENCE STANDARDS
20.0	Control transformer for switchgear and control gear for voltage not exceeding 1100V AC	IS 12021
21.0	Transformers and conductors (Power, Audio, Pulse & Switching) for electronic equipment	IS 6297
22.0	Guide for color coding of electrical mimic diagrams	IS 11954

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DATA SHEET - B

SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
1.0	PANELS		
1.1.	Panel Designations		
1.2.	Make and country of manufacture		
1.3.	Weight of each panel section	kg	
1.4.	Dimensions of each panel section (Width x Depth x Height)	mm	
1.5.	Clearance required around panel	mm	
1.6.	General arrangement drawing attached of		
1.7.	Individual panel section Overall arrangement of complete panels showing floor space		Yes/No Yes/No
1.8.	Changeover facility for power supply provided	Auto / Manual	
2.0	AUXILIARY / INTERFACE RELAY		
2.1.	Make		
2.2.	Type designations		
2.3.	Contacts, Hand Reset / Self reset		
2.4.	No. of pairs of contacts		
	a) Make contacts b) Break contacts		
2.5.	Burden of Relay	VA	
2.6.	Contact Rating:		

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SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
	a) Continuous current b) Voltages c) Making Current & duration d) Breaking current : i) Resistive ii) Inductive, 0.3 P.F iii) Inductive, L/R = 10msec / 40 msec	A V V/SEC A A,AC/DC A,AC/DC	
3.0	TIMERS		
3.1.	Make		
3.2.	Type designation		
3.3.	Range of time delay		
	a) On energisation b) On de-generation	msec msec	
3.4.	Accuracy class as per IS		
3.5.	Contact Rating :		
	a) Continuous current b) Voltages c) Making Current & duration d) Breaking current : i Resistive ii Inductive,0.3P.F iii Inductive, ,L/R=10msec/40msec	A V V/SEC A A,AC/DC A,AC/DC	
3.6.	No. of pairs of contacts		
	a) Make contact b) Break contact		
4.0	CONTROL SWITCH		
4.1.	Make & Front Dimensions		
4.2.	Type of switch (Stay put / Spring return / Spring return with sequence / discrepancy)		

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SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
4.3.	Contact Rating		
	a) Continuous current b) Voltages c) Making Current & duration d) Breaking current : i) Resistive ii) Inductive, 0.3 P.F iii) Inductive, L/R = 10msec / 40 msec	A V V/SEC A A,AC/DC A,AC/DC	
5.0	PUSH BUTTON		
5.1.	Make		
5.2.	Actuator type :		
5.3.	Momentary / Maintained Shrouded to prevent inadvertent operation		Yes/No Yes/No
5.4.	Whether integral engraved inscription plates provided		Yes/No
5.5.	Type and No. of NO / NC contacts		
5.6.	Contact Rating		
	a) Continuous current b) Voltages c) Making Current & duration d) Breaking current : i) Resistive ii) Inductive, 0.3 P.F iii) Inductive, L/R = 10msec / 40 msec.	A V V/SEC A A,AC/DC A,AC/DC	
5.7.	Elec. life expectancy based on 300 switching operation cycles/ hour		
6.0	INDICATING LAMPS		
6.1.	Type		
6.2.	Ratings		
6.3.	a) Voltage b) Wattage	V W	
6.4.	Series resistors are provided		

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SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
6.5.	Series resistors - Ohms - Watts		
6.6.	Life of lamp in burning hours	Nos.	
7.0	ANNUNCIATORS		
7.1.	Make		
	Dimensions of each window (L x W x H)	mm	
7.2.	No. of lamps per window	No.	
7.3.	Lamps - Volts - Watts	V W	
7.4.	Is the sequence of operation as per specification		Yes/No
7.5.	Initiating contact requirements		
	a) Making current b) Impulse duration	A msec	
8.0	INDICATING METERS		
8.1.	Make		
8.2.	Type of movement		
8.3.	Type designation		
8.4.	CT / VT Sec. current / Volt	A,V	
8.5.	Burden :		
	a) Current coil b) Voltage coil	VA VA	
8.6.	Details of shunt, if any		
8.7.	a) Rated current b) Rated voltage drop	A V	
8.8.	Accuracy class & standard		
8.9.	Total deflection angle	Deg	
8.10.	Total scale length	mm	
8.11.	Suitable for specified reference operating conditions		Yes/No

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SL. NO.	ITEM	UNIT	TECHNICAL PARTICULARS
9.0	ENERGY METERS		
9.1.	Make		
9.2.	Type of measurement (3 phase, 3 wire unbalanced power / 3 phase, 4 wire unbalanced power		
9.3.	Measuring range in primary watts		
9.3.1.	CT ratio	A/A	
9.3.2.	VT ratio	V/V	
9.4.	Accuracy and standard to which meter conforms:		
9.5.	Burden		
	a) Current coil b) Voltage coil	VA VA	
9.6.	No. of digits in the meter	Nos.	
9.7.	Impulse contact for remote summation or printing provided or connectivity with the plant computer provided		
9.7.1.	Details of impulse contacts a) Impulse frequency b) Duration c) Contact rating	Nos./sec msec W,V	
9.8.	Mounting details and testing facilities		
9.9.	Literature with connection diagram furnished		Yes/No

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	TITLE DC SYSTEM	
1.0 SCOPE 1.1. This specification covers the design, engineering, manufacture, inspection, testing at BIDDER's and/or his sub-vendor's works, packing, transportation, delivery to site, including transit insurance, erection, testing, start-up, commissioning and performance testing of all the equipment's and accessories required for the complete 110V DC system. 1.2. Following list of items shall be provided for the project a) 1x100% rated 110V Lead Acid VRLA battery with associated 1x100% (float + float cum boost charger) and DC switchboard. Refer SLD. 2.0 CODES AND STANDARDS 2.1. The design, manufacture, testing and performance of equipment shall comply with all currently applicable standards, codes of practice, regulations and safety codes in the locality where the equipment will be supplied. Nothing in this specification shall be construed to relieve the VENDOR of his responsibility. In case of conflict between these standards and this specification, more stringent of the two requirements shall govern. Some of the currently applicable standards are indicated in Data Sheet A 2.2. The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant/ Owner in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of the code/ standard. Consultant/ Owner may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed 2.3. The VENDOR shall ensure that instruments and gauges to be used for testing and inspection shall have valid calibration and the accuracy can be traced to National and International Standards as applicable. 3.0 DESIGN CRITERIA 3.1. Valve Regulated Lead Acid Battery		

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(a) The VRLA batteries shall be starved electrolyte type to allow recombining of generated oxygen internally. The battery shall be completely explosion resistant. The battery shall not require any topping and be maintenance free. (b) Battery Cell nominal voltage shall be 2.0 V per cell and Cell voltage required for float charging shall be taken as 2.25 Volts / cell as recommended by Battery – OEM. (c) The battery bank shall be sized for a discharge rate with end cell voltage per cell as 1.85V. (d) Battery for all systems shall be sized in accordance with IEEE 485-1997. (e) A design margin of 20% shall be considered. (f) Inter-cell and inter-tier connectors and terminal posts shall be of low (g) resistance and corrosion resistant alloy/copper (h) All inter cell, inter modules and inter stack connectors shall be covered with heat shrunk FR/FRLS sleeves. (i) The covers/shrouds for Battery terminal shall be of FRLS (anti-static type) (j) The cell containers shall conform to the safety requirements of UL 94 V0 or equivalent safety standard. The safety vent shall be self resealing pressure regulating with flame arrestor. In case the batteries are proposed to be housed in a sheet metal or polymeric enclosure, the same is deemed to be included in the scope of the bidder. (k) Container should have adequate Mechanical strength to prevent bulging, cracking etc. during the life span of battery when operating under expected temperature range and due to action of static and dynamic loads and the action of electrolyte. (l) In order to prevent thermal runaway an air flow distance of 10 mm shall be provided between the cells. 3.2. The DC Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The 110V DC systems should be unearthed. Battery sets shall be capable of operating at a peak ambient temperature of 50 Deg.C. The offered battery shall be compact and shall require no maintenance. All safety equipment required for installation shall be provided by the manufacturer. 3.3. The D.C. Battery shall be operated without an intentional ground. For indicating the incidence and degree of a ground fault on the D.C. control circuitry, the midpoint of the battery shall be earthed through an ammeter (center Zero) of high resistance.		

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	TITLE DC SYSTEM	
3.4. The battery located at Switchgear room shall be sized to cater the station loads. 3.4.1. Continuous Load (For 10 hours duration) (a) Indicating lamps on switchgears and control panels (b) Auxiliary relays (c) Panel DC loads 3.4.2. Emergency Load (For 2 hours duration) (a) Emergency lighting (b) PLC & Instrumentation Loads 3.4.3. Momentary Load (For duration up to 1 minute) (a) Tripping / closing loads of breakers 3.4.4. An aging factor of 1.25 (for VRLA Battery) shall be considered in sizing the battery as per IEEE 485. 3.5. The temperature correction factor as given in IS. For this purpose, electrolyte temperature shall be considered as 5°C above the ambient temperature. 3.6. The BIDDER shall furnish battery-sizing calculations during detailed engineering for PURCHASER's / ENGINEER's approval. 3.7. BATTERY CHARGER (a) Battery Charger system shall be static type composed of Switch Mode Power Supply (SMPS) modules and suitable for use with any selected type batteries (as specified in the datasheet). (b) The number of modules shall be paralleled with active current sharing to facilitate at least partial availability of the system in case of one or two rectifier module failure. The charger shall comprise of N+1 modules. N refers to number of SMPS modules. The current rating of each module shall be considered as output current of the SMPS module and shall not be less than 10 % of the rated capacity of the charger. (c) The rectifier transformers for float and boost chargers shall be indoor dry type, double wound with delta-delta/suitable vector connections. (d) It shall be provided with an adequately rated isolation transformer and filters on input to minimise harmonics and to keep ripple factor within acceptable limits.		

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(e) Battery Charger (110V) shall be suitable to operate at 415V AC, three phase, 50HZ supply. The chargers should be capable to deliver the full rated load at specified voltage at output terminals. This voltage is maintained for AC input variation of +10%, -15% and load variation from 0-100% full load. (f) The battery charger shall be suitable for operating under input voltage and frequency variations as given below: Voltage: 415 (-15% to + 10%) Frequency: $\pm 5\%$ (g) Float / Float cum boost charger shall be rated to cater to the following loads in float mode: - Trickle charging current of the battery. - Continuous load (10 hours) for 110V DC System. - Largest DC motor running current, as applicable 25 % spare capacity over above loads. - The float voltage output of the float charger shall be automatically adjusted depending upon the ambient temperature such that the batteries remain floating throughout the range of variation of temperature. (h) In boost mode, the charger shall be rated such that the battery can be fully charged from fully discharged condition within 8 hours for normal charging. (i) The rating of the float cum boost charger shall be based on the boost charger rating or the float charger rating whichever is higher and suitable to meet the battery requirements in float, boost and equalising charge mode (j) All components shall be rated for the electrical system characteristics, voltage and frequency variations as stated on the data sheets(s). (k) All components shall be rated for charging the battery set(s) in both float/boost modes plus full load requirements at continuous operation for the specified life of the system in the specified design conditions. All components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short-circuits and circuit switching operations, etc. Damage arising from component failure should be confined to the component concerned.		

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(l) Protection shall be provided against supply system switching transients, input surges and short circuits. The load limiter characteristic will be such that any sustained overload or short circuit in DC system will neither damage the charger nor will it cause blowing of any of the charger fuses. The charger will not trip on overload or external short circuit. After clearance of fault, the charger voltage will build up automatically when working in automatic mode. (m) If the equipment's supplies require forced air cooling, all fans shall be equipped with monitoring facilities to trigger an alarm in the event of fan failure. (n) The design of the charger unit shall be such that replacement of an SMPS module can easily be carried out and shall be hot swappable / hot pluggable. (o) The charger unit efficiency shall be greater than 90% and power factor shall be minimum 0.9 at all loads from 50-100%. (p) The maximum allowable RMS ripple voltage, with battery disconnected, shall be equal to or less than 0.5% rms of the nominal output voltage. (q) The SMPS Module's input current harmonics (THDi) shall not be more than 5%. (r) The SMPS module shall have Soft Start feature (upto 10 Seconds) (s) The controller shall have facility to change set points, prepare or examine an event or alarm log, etc. access to charger settings and configuration shall be password-protected. (t) It shall be possible to connect charger through RJ45 to DCS or SCADA system for selected analogue and digital data to be made available to a higher-level controller. Communication shall be by MODBUS TCP/IP. If there is any converter requirement to communicate in that protocol, this must be supplied by the vendor, and it is the responsibility of vendor to communicate the required parameters to DCS/SCADA. 3.8. FLOAT CHARGING MODE 3.8.1. The D.C. output voltage during float charging shall be stabilised within $\pm 1\%$ of the set DC bus voltage for AC input voltage variation of $\pm 10\%$, frequency variation of $\pm 5\%$ and DC load variation from 0 - 100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response with high frequency SMPS with intelligent control. The ripple content shall be within 1% of D.C. output nominal voltage with battery disconnected. Also in any mode of operation, the		

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maximum current harmonics in the charger input, both in float and boost mode operation shall not exceed 5% and input power factor shall be better than 0.85. 3.8.2. The setting of the output D.C. bus voltage shall be adjustable between $\pm 10\%$ of nominal rated voltage. 3.8.3. There shall be provision for manual control if auto mode fails. 3.8.4. The load (current) limiting feature of the float charger should be designed to take care of the loads connected. The chargers shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the Charger nor shall it cause blowing of any of the charger fuses. 3.8.5. Line surge suppressers shall be provided. 3.9. BOOST CHARGING MODE 3.9.1. For boost charging the discharged battery after a mains failure, the rectifier shall charge the battery at high rate limited to the maximum boost charging voltage. In auto control, the DC output current shall be stabilised within $\pm 2\%$ for AC input voltage & frequency variation of $\pm 10\%$ and $\pm 5\%$ respectively. There shall be provision for manual control if auto-mode fails. The boost charge voltage and current settings shall be adjustable between 70 to 100% of maximum boost charge voltage and between 50 to 100% of maximum boost charging current. It shall have a provision for initial charging. Preferably AH input to the battery shall be measurable to facilitate accurate first charging. 3.9.2. During boost charging following emergency measures shall be provided: (a) If the AC mains supply fails, an arrangement shall be made to automatically connect the battery directly across the load. (b) In case of Float cum boost charger and standby float charger scheme with one battery, If the standby float charger supplying D.C. load fails and tap cell diode arrangement provide, the load shall be fed from the point of connection at the tapping of the battery via adequately rated blocking diodes. Two blocking diodes in series shall be provided to take care of short circuit of any one diode. (c) Battery shall feed the load through dropper diode which is provided at the output of the charger to prevent the high voltage charge damaging the loads. Dropper diode shall be bypassed otherwise through adequately rated DC Contactor. 3.10. Line surge suppressers shall be provided.		

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3.11. The cable drops to be considered in DC system shall be 2% from the charger / battery to distribution board and 3% from board to any feeder in case of 110V DC system.

4.0 CONSTRUCTIONAL FEATURES

4.1. **Batteries**

(a) The battery offered shall be capable of high discharge performance and shall be suitable for indoor application.

(b) The batteries shall be complete with accessories and devices, including but not limited to the following:

- (i) Battery racks
- (ii) Porcelain insulators, rubber pads etc.
- (iii) Set of lead coated inter-cell, inter-tier and interbank connectors as required for the complete installation.
- (iv) Accessories for testing and maintenance:

1 No.	± 3 Volts DC Voltmeter with built in discharging resistor and suitable leads for measuring cell voltage
2 Nos.	PVC aprons
1 Set	Terminals for connecting cable as required. Spare connectors Spare nuts and bolts Suitable set of Insulated spanners
1 Set	Torque Wrench / Spanners
1 No.	Cell lifting straps

(c) -

(d) Battery racks shall be constructed from steel. Metallic stands shall be painted with acid resistant paint.

4.2. **Battery chargers**

a) Charger cubicles shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet Steel used shall be cold rolled and at least 2.0mm thick and properly braced to prevent wobbling. The components shall be housed in a well-ventilated sheet metal cubicle complete with input and output terminals.

b) In case of SMPS, Electronic equipment shall be of modular design consisting of plug in modules in standard metallic racks with metallic card

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guides. Card to card wiring shall be through motherboard. The modules shall be hot-swappable to reduce MTTR (Mean Time to Repair). c) Indications, controls and output voltage setting adjustments shall be on front panel. d) All printed circuit cards shall be plug-in type, interlocked to prevent insertion in a wrong slot. Each card shall have LED indication on its front plate to indicate normal condition and readily marked test pins. e) The layout of Charger components shall be such that their heat losses do not give rise to excessive temperature within the Charger panel surface. Location of the electronic modules will be such that temperature rise of the location, in no case, will exceed 10°C over ambient air temperature outside the Charger. 4.2.1. COMPONENTS/ACCESSORIES a) For SMPS based rectifier, each module shall be provided with MCB /MCCB at the input for isolation. b) Double wound, dry type, three phase suitably rated mains transformer with fuse/MCB protection and with one set of power factor correction capacitors to maintain a power factor of 0.85 (lag) at both float and boost operation mode. c) Suitable rated series inductor to reduce the ripple contain in the output DC. d) Suitable rated control transformers for electronic controller. e) Electronic controller comprising of power supply card, soft start cum current limit card, auto trickle mode card with facility for setting trickle charge current and monitoring battery current, error amplifier cards and pulse generating cards for achieving the DC output voltage stabilisation of +1% and also for achieving current limiting feature. The electronic controller shall be provided with boost current stabilisation and boost charge current limiter. The electronic controller shall have protection features with indications for under-voltage, over-voltage, earth fault, set output voltage and phase failure or voltage unbalance. f) Adequately sized necessary built-in accessories shall be provided such that on failure of the controller in auto mode the voltage can be effectively controlled manually. g) Filter circuit comprising of smoothing choke and condensers complete with HRC fuse with trip indication for filter condenser circuit. h) One (1) Auto / Manual selector switch for selecting the mode of operation of the controller. i) One (1) front panel mounted potentiometer for set point adjustment of output voltage in auto /manual mode. In case of float cum boost charger,		

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	TITLE DC SYSTEM	
the potentiometer for set point adjustment of output voltage for auto and manual operation shall be sized to take care of maximum boost voltage. j) One (1) set of MCCB / ACB for AC input with suitable ratings and with trip indication for each of the charger units k) One (1) AC contactor with suitably rated coil with three main contacts and 2 NO + 2 NC auxiliary contacts, suitably rated thermal overload relay and ON/OFF control switch. l) One (1) set of MCCB/ACB for the DC output and with trip indication. m) One no. make before break type selector switch for charging mode. n) DC contactor of suitable rating for disconnection of load during boost charging. o) One (1) battery under voltage relay to annunciate fully discharged condition of the battery. p) Two (2) nos. blocking diodes in series to block back feed from battery to float charger. q) One (1) cubicle space heater suitable for 240 V AC 50 Hz, single phase shall be provided. r) One (1) 240 V AC LED lamp for cubicle internal lighting shall be provided. s) Two (2) - ON/OFF switches with MCB for space heater and internal lighting shall be provided. t) Tap cell – blocking diode/dropper diode u) A separate wall mounted isolation switch shall be provided for emergency battery isolation. It shall carry the rated current in both direction of current flow. It shall be enclosed in sheet steel enclosure of at least 2mm having IP 54 degree of protection. The isolation switch box shall be wall mounted type located in battery room. v) Switch shall not trip on fault, only upstream battery charger MCCB/ACB shall be tripped. Switch ON/OFF status indicators shall be provided. Potential free contacts for remote indication of close/open status of the switch shall also be provided. 4.2.2. BATTERY CHARGER MONITORING SYSTEM i. Battery charger shall be provided with MMI unit to monitor & annunciate the charger parameters. ii. There shall be a LCD display (4X20) in which all the parameters like faults; AC/DC voltage can be seen. The micro controller shall have fault history (events with Date & Time) logging & retrieval facility. Controller shall have one RJ45 port facility to monitor all the parameters indicated below from remote location. Controller shall have facility to change the alarm set points at site (password protected) iii. Following annunciation shall be provided as minimum:		

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a) Mains AC failure (b) Charger over load (c) DC output breaker tripped (d) AC input breaker tripped (e) Battery fully discharged (f) Battery on boost (g) DC system earth fault (h) DC under voltage (i) DC Over voltage (j) Float/Boost charger rectifier fuse blown (k) Float/Boost charger filter condenser fuse blown. (l) Charger current limiter protection operated (m) Battery breaker tripped (n) Battery on boost (o) Boost charge changeover alarm (When battery reaches min voltage limit , alarm to change it to Boost mode) iv. Analog/digital meters shall be provided for each charger to read the following measurement parameters: (a) AC input voltage and current (b) Charger input current. (c) DC Output current of Float/Boost Charger (d) DC Output voltage of Float/Boost Charger (e) Load voltage and current (f) Battery voltage (g) Battery current (h) Charge/discharge currents of the battery v. Following LED status indications shall be provided: (a) AC Input R, Y, B ON (b) Float Charger ON (c) Boost Charger ON (d) Battery ON (e) Equalizing charge ON 4.2.3. POWER ELECTRONIC COMPONENTS a) The charger shall preferably be modular type based on high frequency switching mode power supply (SMPS) technique using IGBT devices. b) IGBT based SMPS shall be capable of providing continuous output at specified voltages. It shall have high power efficiency. c) If the assemblies are connected in parallel, care shall be taken to ensure that each one operates within its rating and shares the load uniformly.		

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	TITLE DC SYSTEM	
d) Necessary protection to be considered inbuilt to avoid complete shut-down of the equipment because of a fault on single unit. Suitable fuses shall be provided for such protection. e) Necessary spare capacity shall be built in the equipment to continuously supply full load even with one unit out of circuit. f) SMPS shall be natural air cooled. 4.3. D.C. distribution boards 4.3.1. DC switchboards shall be provided for the DC loads as mentioned in datasheets/SLD. 4.3.2. DCDB shall be a Separate floor mounted panel & On /off control at front door. 4.3.3. DC MCCB/MCB shall be considered for incomer & outgoing feeders. 4.3.4. Earth fault relay & Under voltage relay with timer 4.3.5. Indicating lamps for ON, OFF, earth fault, under voltage conditions 4.3.6. The continuous current rating of the bus bars, incomer for 110V DC switchboards shall be the maximum D.C. load (excluding the momentary load, as required) on the bus plus 20% margin rounded off to the next higher standard rating. 4.3.7. The short circuit current rating of the switchboard shall be arrived at considering the contribution from charger & battery with (>10%) margins. 4.3.8. Spare feeders - 20% of each type and rating with a minimum of two (2) nos. feeders. 4.3.9. Switchgear/DB - Should be provided with proper LOTO arrangement. 5.0 TESTS 5.1. All routine tests shall be conducted as per the relevant standards for battery, battery chargers and DCDBs. 5.2. Type Tests: Performed at Manufacturer's works or Valid type test reports on identical rating and type of cell issued by an authorised test house shall be furnished. 5.3. Acceptance Tests: Acceptance tests as per relevant standards shall be performed at vendor's works. Also, acceptance tests shall be performed at site after installation and commissioning of the battery including capacity test and test for voltage during discharge. 5.4. A loading resistor bank which can be automatically controlled using time and current signals along with the charger shall be supplied to facilitate discharging of voltages as part of routine maintenance tests.		

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	TITLE DC SYSTEM	
5.5. TESTS FOR BATTERY CHARGERS 5.5.1. The following routine tests shall be conducted at Vendor's works: (a) Visual checks for dimensions and general arrangement. (b) Wiring checks (c) Functional checks (d) Voltage regulation for rated input supply for loads from 0-100% (e) Load test to show the charger can deliver the rated duty without the current limiter device operating (f) Ripple measurement by oscilloscope at different loads (g) Demonstration of guaranteed efficiency and power factor (h) Insulation test (with 500V Megger) (i) High voltage test, excluding electronic controller, at 2kV AC for one min (j) Heat run test shall be conducted at full load for 24hours at the vendor works on charger (k) Checking of DC charger system monitoring and associated communication system (l) Checking of auxiliary devices, protective devices & control equipment 5.5.2. Certified copies of reports of all type tests carried out on similar type and rating of various equipment (offered under this contract) within last five years from the date of submission of Bid shall be furnished to the Purchaser for review and approval. In case the type test reports are not found to be meeting the specification requirements, the VENDOR shall conduct all such tests under this contract free of cost to the Purchaser and submit the reports for approval. • Heat run test on each type of battery charger 5.6. TESTS FOR DC DISTRIBUTION BOARD 5.6.1. All routine tests as per applicable standards shall be conducted on the board. 5.6.2. Valid Type test reports on identical switchgear issued by an authorised test house shall be furnished.		

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	TITLE DC SYSTEM DATA SHEET – A	

DATA SHEET-A1			
SL. NO	DESCRIPTION	UNIT	CLIENT'S SPECIFICATION
A.	BATTERY		
1.0	Application		110 V DC system for Switchgear & control systems
2.0	Type of Battery		VRLA maintenance free battery
2.1.	Number of battery banks required		110 V: 1 set (1 x 100%),
2.2.	Number of cells in each bank in series (Approximate)		To be finalised during detailed engineering
3.0	Ambient conditions	°C	50
4.0	D. C. System voltage	V	110 V DC system for Switchgear & control systems
5.0	Design margin to be considered		20%
6.0	Ampere hour capacity of battery at 27°C.		
6.1.	10hours rate to give final cell voltage of 1.85volts/cell for Lead acid battery.	Ah	200 Ah
7.0	Layout drawing No. (If any)		Not Applicable
8.0	Mounting Arrangement		To be finalised during detailed engineering
9.0	High discharge test required	Yes / No	No.
			If yes,
			Amps :
			Time :
			End cell voltage :
10.0	Charging method proposed		Float/Trickle
B.	BATTERY CHARGER		
1.0	General		Free standing floor mounting Float charger and Float-cum-boost charger
1.1.	Number required	Sets	1x100% of (FC+FCBC),

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	TITLE DC SYSTEM DATA SHEET – A	

DATA SHEET-A1			
SL. NO	DESCRITPTION	UNIT	CLIENT'S SPECIFICATION
1.2.	Proposed Charger Rating		≥ 50 Amps
1.3.	Charger Technology (SCR / modular SMPS)		SMPS modular
1.4.	DC System Voltage (Nominal)	V	110 V DC
1.5.	DC System Earthing		Unearthed
1.6.	Ambient Design Temperature	°C	50
2.0	DC Bus Load		
2.1.	Total continuous DC load	A	During detailed Engg.
2.2.	Short time loads (Additional to continuous loads)		During detailed Engg.
	(a) Testing of DC lights / Facia lamps	A sec	During detailed Engg.
	(b) Starting / Running current of Largest connected DC Motor	A / A sec	Spring charging motor of MV Switchgear breakers
2.3	DC system Fault level & duration	kA	15 kA for 1 sec
2.4	No. of cells	No.	As per system voltage
2.5	End cell voltage	V	1.85
2.6	Nominal Float voltage (V)	V	2.25 V/ cell
2.7	Boost voltage (Maximum) (V)	V	Bidder to furnish the detail along with offer
2.8	AH Capacity of Battery	AH	Bidder to furnish quoted AH capacity and battery sizing as per system requirement
3.0	AC system data		
3.1.	Supply		
	Volts	V	415
	Phase		3 Phase
	Hz	Hz	50
3.2.	Variation of parameters		

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	TITLE DC SYSTEM DATA SHEET – A	

DATA SHEET-A1			
SL. NO	DESCRIPTION	UNIT	CLIENT'S SPECIFICATION
	a) Variation in supply Voltage		±10%
	b) Variation in supply frequency		±5%
	c) Combined Variation		10%
3.3.	Type of earthing		Solidly earthed
4.0	Performance		
4.1.	DC voltage setting adjustment for float charger	%	±10% of nominal voltage
4.2.	Voltage stabilisation for constant voltage regulator	%	±1% of set D.C voltage, with AC input variation as in 3.2
4.3.	Maximum permissible variation in DC voltage (no load to full load)	%	±1%
4.4.	D.C. voltage setting adjustment for boost charging	%	70% to 100% of max. Boost charging voltage.
4.5.	D.C. current adjustment for boost charging	%	30% to 100% of max. boost charging current
4.6.	Current stabilisation for constant current regulator for boost charger	%	±2%
4.7.	Minimum permissible power factor at rated continuous load		0.85
4.8.	Permissible ripple content at rated continuous load	%	1% (maximum)
4.9.	Maximum permissible harmonics with or without battery	%	5%
5.0	Miscellaneous		
5.1.	Cable entry		Bottom
5.2.	Cable sizes		
	Battery	Sq.mm	Bidder to furnish
	DC output	Sq.mm	Bidder to furnish
	AC input	Sq.mm	During detailed engineering
5.3.	Potential free contacts	Yes / No	YES

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	TITLE DC SYSTEM DATA SHEET – A	

DATA SHEET-A1			
SL. NO	DESCRIPTION	UNIT	CLIENT'S SPECIFICATION
5.4.	Degree of protection of charger cubicle		IP 42
5.5.	Overall efficiency of charger		>80%
5.6.	Standard reference drawings enclosed		YES
C.	DC SWITCHGEAR / DCDB		Floor mounted panel
1.0	Switchgear and busbar rating		Bidder to furnish
1.1.	Rated voltage	V	110 V DC
1.2.	Maximum voltage at which all components shall operate satisfactorily	V	121 V for 110 V DC system
1.3.	Continuous current rating of bus bars under site reference ambient temperature		Bidder to furnish
1.4.	Reference ambient temperature	°C	50
1.5.	Maximum temperature of bus bars droppers and contacts at continuous current rating under site reference ambient temperature		90°C for non-silverplated joints 105°C for silver plated joints
1.6.	Short circuit current withstand for bus bars and droppers		
	(a) short time (1sec)	kA	15 kA
	(b) Dynamic rating	kA (Peak)	
2.0	Switchgear constructional requirements		
2.1.	Thickness of sheet steel		FRAME / DOORS / COVERS
	Cold rolled	mm	2.5 / 1.6 / 1.6
	Hot rolled	mm	- / 2.0 / 2.0
2.2.	Degree of protection		IP 52
2.3.	Colour finish shade as per IS		

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	TITLE DC SYSTEM DATA SHEET – A	

DATA SHEET-A1			
SL. NO	DESCRITPION	UNIT	CLIENT'S SPECIFICATION
	(a) Interior		Glossy White
	(b) Exterior		RAL 7032
2.4.	Earthing bus		50x10mm (GS)

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DATASHEET-A2 APPLICABLE STANDARDS <table> <tr> <td colspan="3">A. BATTERY</td></tr> <tr> <td>1.</td><td>GENERAL REQUIREMENT AND METHOD OF TESTS FOR VALVE REGULATED BATTERY</td><td>IEC: 60896-2</td></tr> <tr> <td>2.</td><td>WATER FOR STORAGE BATTERY</td><td>IS: 1069</td></tr> <tr> <td>3.</td><td>SYNTHETIC SEPARATOR FOR LEAD ACID BATTERIES</td><td>IS : 6071</td></tr> <tr> <td>4.</td><td>RECOMMENDED PRACTICE FOR SIZING LEAD ACID BATTERIES FOR STATIONARY APPLICATIONS</td><td>IEEE : 485</td></tr> <tr> <td>5.</td><td>STANDARD FOR SAFETY OF FLAMMABILITY OF PLASTIC MATERIALS FOR PARTS IN DEVICES AND APPLIANCES TESTING</td><td>UL: 94</td></tr> <tr> <td>6.</td><td>RUBBER AND PLASTIC CONTAINERS FOR LEAD ACID STORAGE BATTERY</td><td>IS: 1146</td></tr> <tr> <td>7.</td><td>STATIONARY VALVE REGULATED LEAD ACID BATTERIES</td><td>IS: 15549</td></tr> <tr> <td colspan="3">B. BATTERY CHARGER</td></tr> <tr> <td>1.</td><td>ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL EQUIPMENT</td><td>IS 9000</td></tr> <tr> <td>2.</td><td>ENVIRONMENTAL REQUIREMENTS FOR SEMICONDUCTOR DEVICES AND INTEGRATED CIRCUITS</td><td>IS 6553</td></tr> <tr> <td>3.</td><td>FACTORY BUILT ASSEMBLIES OF SWITCHGEAR AND CONTROLGEAR FOR VOLTAGES UPTO AND INCLUDING 1000V A.C. AND 1200VD.C.</td><td>IS 8623 IEC 61439 / IEC 60947</td></tr> <tr> <td>4.</td><td>DEGREE OF PROTECTION</td><td>IS 2147</td></tr> <tr> <td>5.</td><td>SEMI-CONDUCTORS CONVERTERS</td><td>IS 4540 IEC 60146</td></tr> <tr> <td>6.</td><td>SEMICONDUCTOR RECTIFIER EQUIPMENT SAFETY CODE</td><td>IS 6619</td></tr> <tr> <td>7.</td><td>LOW VOLTAGE SWITCHGEAR AND CONTROL GEAR ASSEMBLIES-GENERAL RULES</td><td>IS/IEC:61439-1</td></tr> </table>			A. BATTERY			1.	GENERAL REQUIREMENT AND METHOD OF TESTS FOR VALVE REGULATED BATTERY	IEC: 60896-2	2.	WATER FOR STORAGE BATTERY	IS: 1069	3.	SYNTHETIC SEPARATOR FOR LEAD ACID BATTERIES	IS : 6071	4.	RECOMMENDED PRACTICE FOR SIZING LEAD ACID BATTERIES FOR STATIONARY APPLICATIONS	IEEE : 485	5.	STANDARD FOR SAFETY OF FLAMMABILITY OF PLASTIC MATERIALS FOR PARTS IN DEVICES AND APPLIANCES TESTING	UL: 94	6.	RUBBER AND PLASTIC CONTAINERS FOR LEAD ACID STORAGE BATTERY	IS: 1146	7.	STATIONARY VALVE REGULATED LEAD ACID BATTERIES	IS: 15549	B. BATTERY CHARGER			1.	ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL EQUIPMENT	IS 9000	2.	ENVIRONMENTAL REQUIREMENTS FOR SEMICONDUCTOR DEVICES AND INTEGRATED CIRCUITS	IS 6553	3.	FACTORY BUILT ASSEMBLIES OF SWITCHGEAR AND CONTROLGEAR FOR VOLTAGES UPTO AND INCLUDING 1000V A.C. AND 1200VD.C.	IS 8623 IEC 61439 / IEC 60947	4.	DEGREE OF PROTECTION	IS 2147	5.	SEMI-CONDUCTORS CONVERTERS	IS 4540 IEC 60146	6.	SEMICONDUCTOR RECTIFIER EQUIPMENT SAFETY CODE	IS 6619	7.	LOW VOLTAGE SWITCHGEAR AND CONTROL GEAR ASSEMBLIES-GENERAL RULES	IS/IEC:61439-1
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	TITLE DC SYSTEM DATA SHEET – B	

DATA TO BE FURNISHED ALONG WITH THE BID.

SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
A.	BATTERY		
1.0	Manufacturer's Name		
2.0	Standards to which battery is manufactured		
3.0	Rated Capacity At 27°C		At 10 hour rate
4.0	Expected life of battery	Years	
5.0	Recommended charging rate		
5.1.	Float charging Voltage / Current	V / A	
5.2.	Trickle charging Voltage / Current	V / A	
5.3.	Rapid Boost charging Voltage / Current duration	V / A /Hr	
5.4.	Normal Boost charging voltage / Current / duration	V / A /Hr	
5.5.	Equalising charge		
	(a) Voltage / current	V / A	
	(b) Duration	Hrs	
	(c) Interval between successive equalising charges	Days	
	(d) Criteria to initiate the same		
6.0	Expected fault level at bus due to battery	kVA	
7.0	Internal resistance of each cell (fully charged)	Ohms	
8.0	Total resistance of battery including resistance of inter-cell connectors	Ohms	
9.0	AH efficiency at rated load	%	
10.0	Watt hour efficiency	%	
11.0	Type of containers		
11.1.	Type of cell		

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	TITLE DC SYSTEM DATA SHEET – B	

SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
11.2.	Overall dimensions		
11.3.	Each cell L x W x H	mm	
11.4.	Weight		
11.5.	Each cell	kg	
11.6.	Complete	kg	
11.7.	Whether explosion vents are offered	Yes / No	
12.0	Ventilation requirements		
13.0	Whether there would be any harmful effect on the life of battery if discharged as per load cycle specified above, after being maintained in float charging condition.	Yes / No	
14.0	List of spares / accessories enclosed	Yes / No	
B.	BATTERY CHARGER		
1.0	Manufacturer's Name		
2.0	Type		
3.0	Ratings		
4.0	Input voltage	V AC Phase	<u>FLOAT CH.</u> <u>BOOST CH.</u>
5.0	Output voltage	V DC	
	(a) Nominal		
	(b) Setting range		
6.0	Rated output	kW	
7.0	Type of AVR / controller		
7.1.	Voltage regulation with AVR, when supply voltage fluctuation is $\pm 10\%$, frequency fluctuation is -5% to +3% and load variation is 0% to 100%	%	
7.2.	Voltage regulation with manual controller.	%	

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	TITLE DC SYSTEM DATA SHEET – B	

SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
7.3.	Type of voltage / current control and adjustment provided for boost charger.		
8.0	Guaranteed efficiency		
8.1.	At 50% load	%	
8.2.	At rated load	%	
9.0	Power factor		
9.1.	At 50% load		
9.2.	At rated load		
10.0	Maximum permissible temperature rises over ambient.		
10.1.	Rectifier transformer	°C	
10.2.	Rectifier cells	°C	
10.3.	Smoothing reactor	°C	
11.0	Class of insulation		
11.1.	Rectifier transformer		
11.2.	Smoothing reactor		
12.0	Method of cooling		
12.1.	Rectifier cells		
12.2.	Transformer		
13.0	Ripple content at rated load		
13.1.	With battery	%	
13.2.	Without battery	%	
14.0	Rectifier and Blocking Diodes		
14.1.	Make and Type		
15.0	Silicon controlled Rectifiers (SCR)		
15.1.	Make and Type		
15.2.	RMS current rating	A	

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SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
15.3.	Peak inverse voltage continuous	V	
16.0	Fault indicating lamps and necessary circuit provided as required	YES/NO	
17.0	Potential free contacts for each fault provided	YES/NO	
18.0	Common alarm contact provided	YES/NO	
19.0	Overall dimensions of charger (LxWxH)	mm	
20.0	Degree of Protection		
21.0	Weight	kg	
22.0	List of spares/accessories enclosed	YES/NO	
C.	DC SWITCHGEAR		
1.0	GENERAL PARTICULARS		
1.1.	Manufacturers name		
1.2.	Modular construction.	Yes/No	
1.3.	Fully draw-out /semi-draw-out /fixed	FD/SD/F	
1.4.	Dimension of the switchgear L x W x D	mm L W D	
1.5.	Bus bar continuous rating	A DC	
1.6.	Short time rating (1sec)	kA DC	
1.7.	Degree of protection provided by the enclosure (as per IS:13947 or equivalent)		
1.8.	Earth bus bar size	mm	
2.0	MCCB / MCB		
2.1.	Make & Type		
2.2.	Service Voltage	V DC	
2.3.	No. of poles and breaks per pole		

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SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
2.4.	Rated operating duty		
2.5.	Rated current	A	
2.6.	De-rating factor for operation under site conditions		
2.7.	Rating breaking current at _____ V DC	kA DC	For L/R = _____ms.
2.8.	Rated short time current for (1 sec.)	kA DC	
2.9.	Rated making current	kA DC	
2.10.	Number of opening the circuit is capable of performing without inspection, replacement of contacts or other parts at 110% rated breaking current		
2.11.	Overload release settings		
2.12.	Short circuit release settings and time delay features provided	Yes/No	
2.13.	Under voltage release settings		
3.0	BUS BARS		
3.1.	Material of bus bars		
3.2.	Size	mm	
3.3.	Type of insulation		
3.4.	Whether bus bars have been taped	Yes/No	
3.5.	Maximum continuous current rating	A DC	
3.6.	Temperature rise over the specified ambient when carrying rated current.	°C	
3.7.	Maximum fault withstand current rating (peak)	kA DC	
3.8.	Maximum fault withstand current momentary rating (peak)	kA DC	
3.9.	Dielectric strength	Volts AD rms	

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SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
3.10.	One min. power frequency withstand voltage.	kV rms	
4.0	AIR BRAEAK SWITCHES		
4.1.	Make & Type		
4.2.	Rated Current	A	
4.3.	De-rating factor for use under site ambient conditions		
5.0	D.C. CONTACTORS		
5.1.	Make		
5.2.	Rated duty		
5.3.	Rated utilisation category		
5.4.	Limits of operation i) Supply voltage variation. ii) Dropout voltage	± % ± %	
6.0	FUSES		
6.1.	Make & Type		
6.2.	Rated current	A	
6.3.	Category of duty as per IS:9224		
6.4.	Rupturing capacity (prospective current)	kA	
6.5.	Maximum let through current for 1sec	kA	
7.0	UNDER VOLTAGE RELAY		
7.1.	Make & Type		
7.2.	Burden	VA	
7.3.	Setting range	V	
8.0	AUXILIARY RELAYS		
8.1.	Make & Type		
8.2.	Coil burden	VA	
8.3.	Operating time	Sec	

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SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
8.4.	Time delay range (for timer)	Sec	
8.5.	Resetting features		
8.6.	No. of contacts i) Normally open ii) Normally closed		
8.7.	Contact rating.	A	
8.8.	Whether operation indicator is provided	Yes/No	
9.0	CONTROL/SELECTOR SWITCH		
9.1.	Make & Type		
9.2.	Spring return or stay put		
9.3.	Type of handle		
10.0	VOLTMETER		
10.1.	Make & Type		
10.2.	Accuracy class		
11.0	AMMETER		
11.1.	Make & Type		
11.2.	Accuracy class		
12.0	WATT METER		
12.1.	Make & Type		
12.2.	Accuracy class		
13.0	INDICATING LAMPS		
13.1.	Make & Type		
14.0	PUSH BUTTONS		
14.1.	Make & Type		
15.0	SPACE HEATER		
15.1.	Make & Type		

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SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
16.0	WIRING & THERMAL BLOCKS		
16.1.	Minimum size of conductor for i) Power wiring ii) Control wiring	mm ² mm ²	

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	TITLE CABLES & CABLING SYSTEM	
1.0	CABLING SYSTEM	
2.0	SCOPE	
2.1.	This Specification covers the requirements of design, engineering, material selection, constructional features, manufacture, inspection and testing at the VENDOR'S or his SUB-VENDOR'S Works, delivery to Site including transit insurance, installation, testing & commissioning and performance testing of the cables, cable carrier system (Cable tray support angles, cable trays, conduits, etc.) for the construction power supply arrangement. The scope of work shall also include supply and installation of cable glands, cable lugs, cable termination kits, cable jointing kits, cable clamps, cable ties, cable identification tags, and cable route markers etc. for all cables supplied under this contract. All the LT Power, Control & Instrumentation cables required for the application shall be included in the scope.	
2.2.	All control, instrumentation cable sizes, no of cores, etc shall be as required for the application.	
2.3.	Quantities of items for cabling system refer BOQ / Schedule.	
2.4.	The quantities of free-issue MV cable items shall be as per the scope mentioned in Section C1. Refer to the BOQ/Schedule	
3.0	CODES AND STANDARDS	
	The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant / Owner in case of any revisions/reaffirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of the code/ standard. Consultant/ Owner may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.	
4.0	CABLE TYPES	
4.1.	-	
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	TITLE CABLES & CABLING SYSTEM	
4.2.	For 415V power supply services, space heating, PVC power cables with the following specifications shall be provided. 1100 Volt grade, single or multi core, stranded copper & aluminium conductor, XLPE insulated, cores laid up, inner sheathed with extruded PVC compound type ST2, armoured with galvanised steel wire or strip for multicore cables and aluminium wire or strip armoured for single core cables, outer sheathed with extruded FRLS PVC compound type ST2 complying with IS: 7098.	
4.3.	For control, protection, CT/PT connections and interlocks, metering, PVC control cables with the following specifications shall be provided. 1100 volt grade, multi core, stranded annealed high conductivity copper conductor (class 2 as per IS 8130), extruded PVC compound type C insulated, cores identified by numerals, cores laid up, inner sheathed with extruded PVC compound type ST1, armoured with galvanised steel wire/strip and outer sheathed with extruded FRLS PVC compound type ST1 cable complying with IS:1554.	
4.4.	-	
5.0	SPECIFIC REQUIREMENTS OF CABLES	
	The following aspects are applicable for all types of cables.	
5.1.	Core Identification shall meet the requirement of IS.	
5.2.	FRLS PVC compound for outer sheaths of all the cables shall meet the following performance requirements and cables shall pass these tests. (a) The critical oxygen index values shall be minimum 29 at room temperature and the temperature index value shall be minimum 230°C at oxygen index of 21 when tested as per ASTM-D-2863-77. (b) The maximum total acid gas generation as determined by titration shall be less than 20% by weight, when tested as per IEC 60754-1(1994). (c) The maximum smoke density rating shall not exceed 60% when tested as per ASTM-D-2843-77. (d) The cables shall pass the hydraulic stability and ultraviolet test as per DIN 53387. The values of tensile strength and elongation measured shall not be more than 60% of that measured before the test.	
5.3.	The finished cables shall pass the flammability test as per IEC-332-1 and IEE-383. In addition it shall also pass flammability test as per class F3 of Swedish Standard SS-424-1475.	
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5.4. The cables shall be suitable for continuous operation and satisfactory performance for the following power supply conditions. Variation in supply voltage ± 10% for MV cables. Variation in supply voltage (+) 10% & (-) 15% for LV cables. Variation in supply frequency ±5%. Combined voltage and frequency variation 10%.

5.5. There should not be any joint in the run of cable.

6.0 TESTS

The Contractor shall conduct the routine tests on each drum length, acceptance and type test on the cables as per applicable standards. Also special tests for critical oxygen index, temperature index values, acid gas generation, smoke generation, flammability test, effects of light and water test shall be conducted on specimen, from different batches.

7.0 CABLE CARRIER SYSTEM

7.1. Following cable carrier system shall be adopted in various areas as indicated below.

(i)	Switchgear & Control Room	:	Cable trenches with trays
(ii)	Switchyard	:	Cable trenches with trays / Buried
(iii)	Street lighting	:	Directly buried
(iv)	Transformer	:	Cable trenches with trays / Buried
(v)	Road /rail crossing	:	Hume & steel pipes

7.2. The cables shall be laid in built-up trenches, directly buried in ground, on cable trays, vertical raceways, clamped on structures / walls / ceiling, pulled through pipes and conduits, laid in tunnels / ducts , etc., as per the project drawings.

7.3. The Cable trench walls will be provided with insert plates for the installation of cable try support angles by the Contractor. The Contractor shall supply, install, test and commission the cable trays, cables and all cable installation material in these trenches.

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	TITLE CABLES & CABLING SYSTEM	
7.4. CABLE TRAYS (i) Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows, etc., shall be prefabricated from 2mm thick mild steel sheets, Cable tray covers shall be prefabricated from 1.7mm thick MS sheets. (ii) Depth of cable tray shall be 100 mm minimum. (iii) The spacing of rungs for ladder type of trays shall be not more than 250mm. (iv) Vertical raceways shall be formed by either structural members or slotted angles or by running the prefabricated trays vertically. (v) Prefabricated Cable trays, accessories and covers shall be hot dip galvanised. (vi) Perforated Cable trays shall have standard width of 150mm, 300mm, 450mm & 600mm and standard length of 2.5metre. (vii) Ladder type Cable trays shall have standard width of 150, 300, 450, 600 and 750 mm and standard length of 2.5meters. (viii) Perforated types cable tray to be used for control and C&I cables only. 7.5. CONDUITS & PIPES (i) The galvanised steel conduits shall be used for sizes up to 63.5mm. The conduits shall be manufactured by electric resistance welding process and shall be hot dip galvanised. The conduits and fittings shall comply with IS: 1653, 3837, 2667. (ii) Galvanised steel pipes shall be used for sizes from 80mm on wards. They shall be medium duty class-B type as per IS. The pipes shall be manufactured by electric resistance welding and hot dip galvanised. The pipes and fittings shall comply with IS. (iii) Flexible steel conduits shall be manufactured with electro galvanising process. Galvanising thickness shall be minimum 75microns. The flexible conduits and their fittings shall comply with IS: 3480, 4649. (iv) The hume pipes/RCC pipes shall comply with IS:458. 7.6. CABLE / CABLE TRAY SUPPORTS (i) Cable tray supports shall be fabricated from standard steel structures of different sizes. The sizes selected shall be adequate for the weight of cables/trays encountered. (ii) The steel members shall be cleaned thoroughly, and hot dip galvanised to minimum thickness of 75microns / painted.		
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7.7. CABLE CARRIER INSTALLATION PRACTICE (i) Minimum level difference between two tiers of horizontal cable trays in building, trenches shall be 275mm. In vertical race ways with multi-tiers the tiers shall be located at least with 400mm intervals. (ii) In trenches width of the cable tray shall be limited to 600mm. (iii) Separate cable trays/tiers shall be provided for different voltage grade cable viz., 33kV power, 22kV power, 11/6.6 kV power, 415V and 240V power, control cables and instrumentation & communication cables. (iv) Cable trays shall be supported at every 1500mm interval for horizontal and 1000 mm for vertical risers. (v) Cable trays shall be welded to the mounting / carrier structures. (vi) Vertical trays (raceways) and all outdoor cable trays shall be provided with removable 16 gauge galvanised MS sheet covers. (vii) Each continuous laid out length of cable tray shall be earthed at minimum two places by MS flats of minimum size 25mmx3mm, the distance between earthing points shall not exceed 10metres. 7.8. CABLE INSTALLATION 7.8.1. Cables to each circuit shall be laid in one continuous length. Cable jointing and splicing shall be avoided. For the Control cable jointing, weatherproof junction boxes mounted on suitable supports shall be provided. A rain canopy shall be provided protecting the weatherproof junction box. 7.8.2. a) If, equipment will be provided with undrilled gland plates for cables / conduit entry, the CONTRACTOR shall be responsible for punching, drilling of gland plates, painting and touching up. Holes shall be made by drilling and deburred for sharp edges. b) PURCHASER will normally provide embedded steel inserts in concrete floors / walls, angle embedment in trenches / tunnels. The CONTRACTOR shall secure supports by welding to the inserts available. c) However, in cases where no such embedded steel inserts are available, the CONTRACTOR shall have to secure supports from walls / floors by suitable anchoring by using anchor fasteners at no extra cost to the PURCHASER. d) The successful BIDDER shall determine the actual requirements of structural steel members based on the cable tray layout drawings which would be furnished by the ENGINEER / PURCHASER. The quantities indicated in BOQ are tentative and for guidance only		
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7.8.3. OUTDOOR CABLE INSTALLATION (a) Where cables cross roads and water, oil or sewage pipes, the cables shall be laid in hume or steel pipes. For road crossings, the pipe for the cable shall be buried at not less than 600mm. Hume pipes shall be preferred to steel pipes from the point of view of corrosion. (b) The cables shall be tied to tray rungs by means of 3mm dia. nylon cord at an interval of 5000mm and also at bends. (c) For good sealing arrangement at entry points, suitable pipe sleeves, adequate in number and of adequate sizes shall be provided in building walls / slabs for passage of cables into a building from cable trays / racks / cable trenches located outside the building. 7.8.4. CABLES IN TRAYS / ON RACKS (a) Different voltage grade cables shall be laid in separate trays. When trays are arranged in tiers, MV cables shall be laid in top trays and cables of subsequent voltage grades in lower tiers of trays. (b) The MV power cables shall be laid in trays/on racks as follows : (i) In single layer only without exception. (ii) 3 core cables to be laid in touching formation. (iii) Single core cables to be laid in trefoil groups. (c) 1100V grade power cables shall normally be laid in single layer in trays / on racks. (d) Control and instrumentation cables can be laid up to a maximum of two layers in each tray/rack, if routing is difficult, otherwise one layer. (e) Single core power cables for 3 phase AC circuits laid in trays/racks/ trenches in trefoil formation shall be held by trefoil clamps placed at an interval of 3m. The trefoil groups of cables shall be additionally tied by means of 3mm dia. nylon cord as follows: (i) At an interval of 1m when laid in cable trays/racks. (ii) At an interval of 750mm when laid in trenches without cable trays. (f) Control cables and small power cables on racks shall be run in ladder type cable trays supported on rack carrier arms. The cables shall be tied to tray rung by means of 3mm dia. nylon cord at an interval of 5000mm and also at bends.		
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7.8.5. BENDING RADII FOR CABLES The bending radii for various types of cables shall not be less than those values recommended by the cable manufacturer. 7.8.6. TERMINATIONS, CLAMPING AND MISCELLANEOUS DETAILS (a) Cable entry to motors, push button stations and other electrical devices shall be from the bottom as far as possible or from the sides. Top entry shall be avoided particularly for outdoor equipment. (b) Identification tags made from aluminium sheet shall be attached to each end of each cable by means of GI binding wire. Tags shall be additionally put at an interval of 30metres on long runs of cables and in pull boxes. (c) All cable terminations shall be done with solderless crimping type lug. Cable terminations shall be done with double compression type brass cable glands. (d) Saddle type clamps to suit number of cables to be clamped at a particular location shall be used for clamping cables running along walls, ceilings, structures, etc. at 750mm interval. (e) Required number of glands & lugs shall be supplied. Glands shall be double compression type and of brass. 7.8.7. MV cable termination and jointing kits shall be of heat shrinkable cold shrinkable 7.8.8. Cable Terminations: All MV termination kits shall be of heat shrinkable type and suitable for XLPE insulation. All 1100V termination for XLPE/PVC power cables and control cables shall be by crimping type tinned copper / aluminum lugs. Cable termination will be done with suitable double compression type brass cable glands. 7.8.9. Cable Joints: Cable joints shall be avoided to the extent possible. If joints are unavoidable due to circuit length, more than permissible maximum drum length, they shall be heat shrinkable type having a short circuit withstands capacity of 25 kA for 1 sec. for MV cables and 50kA for 1 sec. for 1100V grade cables. MV Cable termination / joints shall be suitable for the cable as mentioned below:		
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“22 kV cables shall be of earthed grade three core stranded aluminium conductor grade H4, class 2 as per IS 8130, screened by extruded semi conducting compound, cross linked polyethylene insulated, cores screened with non-magnetic metallic tape helically applied single layer of copper tape, laid up, inner sheathed with extruded PVC compound type ST2, armoured with galvanised steel round wire armoured and overall sheathed with extruded FRLS PVC type ST2.” 8.0 FIRE PROOF SEALING SYSTEM (FPS) (a) Fire proof sealing system shall consist of (i) Fire-stops/fire-seals for sealing of cable/cable tray and conduit/pipe penetrations, both horizontal and vertical through brick or RCC walls/floor, to prevent the spreads fire from one area which is separated from others by the resistant barriers. (ii) ‘Fire-breaks’ provided on long runs of cable racks/trays prevent the propagation of fire along the cable rack with a single fire-area or fire-zone. (b) The FPS system shall also include all the necessary accessories and equipment required for supporting, holding in position and installation of the fire-stop/fire-break. (c) The FPS system shall comply in all respects with the requirement of the codes and standards listed below. IEEE-634 ASTM-E-814 ANSI-IEE-383 IEC-331 IEC-332 (d) MV & LV cables shall be provided fire resistant paint as per applicable IS / NBC code. Fire paint shall be UL/ FM/ accredited lab approved with 2 hour rating. (e) Fire stop / seal The FPS system adopted for cables or cable trays penetrating through walls and floor openings (if any), or cables passing through embedded conduits/pipes/pipe-sleeves, constitutes a ‘fire stop/seal’, which is meant to prevent spreading of fire between areas separated by fire-resistant barriers. (f) Fire Break The fire proofing system, other than fire-stops, adopted to retard flame propagation along long runs of horizontal or vertical cable trays in the same fire zone or area, in an event of a fire, shall constitute a ‘fire-break’ and shall be provided by applying a suitable fire-resistant coating on cables and cable trays		
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for the required length, with or without a fire resistant panel, at the point of the fire break to obtain the fire-rating specified. (g) Performance Requirements (i) Requirement of fire stops The material, design and construction of the fire stops shall be such as to provide the fire-rating of 120 minutes for a fire on any side and meet all requirements listed in this specification and the relevant codes and standards. The material used in the fire stops shall be non-hygroscopic, compatible with the type of cables. The fire stops shall be suitable for retrofitting of cables through the penetration seal without disturbing the sealing of the cables already existing. (ii) Requirements of fire breaks Each fire break shall have a fire-rating of 120 minutes and shall be capable of withstanding for the duration specified a fire on any side of the fire break. (h) Application of fire proof sealing system (i) Fire stops Fire stops shall be provided for cable penetration openings listed below The passage of cables/cable trays / pipe sleeves/ embedded conduits through walls/floors. Vertical raceways which carry cables between successive floors, if any, through openings provided in the RCC floor slab, shall be sealed by fire stops at each floor level. Cable entry through openings in floor slabs below MV/LT switchgear, MCCs, various control and relay panels and other bottom entry panels, shall be effectively sealed by fire stops. (ii) Location of fire breaks Fire breaks shall be provided on both cable rack and trenches at all cable tray intersections and tee-off. On linear runs of cable trays between fire stops or fire breaks, fire breaks shall be provided at interval of 15metres on horizontal cable runs and 5m vertical cable runs. Bidder shall estimate the requirement of fire sealing system based on the equipment layout, cable layout drawing prepared by him. (i) Tests on Fire Breaks Fire breaks shall undergo the following tests as per ANSI-IEEE-383: (i) Ampacity test (ii) Flame test		
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9.0 TESTING AND COMMISSIONING OF CABLES 9.1. (a) Cables shall be checked for insulation resistance before and after jointing. (b) High voltage testing 9.2. All MV cables shall be subjected to DC or AC (preferably DC) high voltage test after terminating but before commissioning as per Table 4 in IS: 1255. 9.3. Routine test and acceptance tests shall be conducted on cables offered. 9.4. Type test certificates shall be furnished. 10.0 ELECTRICAL EQUIPMENT INSTALLATION All the equipment supplied under this contract shall be neatly installed / erected as per normal industrial practices. All the safety equipment like rubber mats in the switchgear rooms, danger boards, first aid box, name plate etc & any other as required for the system and to meet the statutory requirements shall be included in the scope. 11.0 EARTHING i. Metallic sheaths, screens and armour of all multicore cables shall be earthed at both equipment and switchgear end. ii. Sheath and armour of single core power cables shall be earthed at switchgear end only. If specifically indicated in project specification/drawings, for long lengths of cables, multiple earthing may have to be adopted to safeguard against the presence of standing voltages under normal as well as under fault conditions. iii. Earthing of CT and PT neutral lead shall be done at one end only, as indicated in respective control wiring drawings.		
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	TITLE CABLES & CABLING SYSTEM DATA SHEET – B	

DATA TO BE FURNISHED ALONG WITH THE BID.

SL.NO.	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
1.0	Cabling System		
1.1.	Cables		
1.1.1.	Manufacturers name		
1.1.2.	Whether cores identified by Numerals for cables with 5 core and above	Yes / No	
1.1.3.	Whether incremental running lengths are marked on cable	Yes / No	
1.1.4.	Whether the cables comply with specification requirement	Yes / No	
1.1.5.	Group derating factor for MV cables laid in air		
1.1.6.	Group derating factor for MV cables laid in sand filled cable trench		
1.1.7.	Group derating factor for LV Power cables laid in air		
1.1.8.	Group derating factor for LV Power cables laid in sand filled cable trench		
1.1.9.	Applicable standards		
1.2.	MV Cable termination and straight through joint kits		
1.2.1.	Nominal (Phase to phase) System Voltages	kV	
1.2.2.	A.C withstand voltage (Ph / Ground)	kV	
1.2.3.	Time duration	mins	
1.2.4.	Partial discharge at 2 Uo	pC	
1.2.5.	Impulse withstand, 1.2 / 50 μ s	kV	
1.2.6.	Load cycle test		
	(a) Each cycle – heating - duration	Hrs	
	Temperature	$^{\circ}$ C	

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	Cooling duration	Hrs	
	(b) Number of cycles		
	(c) Continuous phase to ground voltage withstand	kV	
1.2.7.	Thermal withstand short circuit current 1 sec.	kA	
1.2.8.	Dynamic short circuit withstand	kA/peak	
1.2.9.	Type test report for all the tests enclosed	Yes / No	
1.3.	Cable carrier system		
1.3.1.	Type of cable carrier system offered		
1.3.2.	All cable carrier steel components are hot dip galvanised	Yes / No	
1.4.	Fire proof sealing system offered		
1.5.	Type of glands		
1.6.	Type of lugs		

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	TITLE EARTHING & LIGHTNING PROTECTION SYSTEM	
1.0	SCOPE	
1.1.	This specification covers the requirements of supply, installation, testing and commissioning of earthing and lightning protection systems. The work shall be carried out in accordance with this specification, relevant project layout drawings, typical drawings and installation notes.	
1.2.	(a) Earthing system shall consist of earth grids including treated and non-treated pits, risers, clamps, accessories and electronic earthing and sub-earth mat embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons. (b) Complete earth mat, earthing grid & earthing system for the construction power supply arrangement shall be provided. (c) Lightning protection system for Transformer, switchgear buildings, DG set and switchyard as per project layout shall be provided.	
1.3.	Quantities of items for Earthing / Lightning system refer BOQ / Schedule.	
2.0	CODES AND STANDARDS	
2.1.	The earthing and lightning protection installation work shall conform to the latest applicable Regulations, all currently applicable standards, codes of practice and safety codes of the locality where the installation is to be carried out. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.	
2.2.	The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant/ Owner in case of any revisions/reaffirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of the code/ standard. Consultant/ Owner may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.	
2.3.	The CONTRACTOR shall ensure that measuring instruments and gauges to be used for testing and inspection shall have valid calibration and the accuracy can	
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be traced to National / International Standards as applicable.

3.0 DESIGN CRITERIA

3.1. FAULT CURRENT & DURATION

The earthing system shall be designed for maximum fault current of the system i.e 25 kA for 1 sec.

3.2. CONDUCTOR MATERIAL

The earthing system conductors and accessories proposed are as follows:

(a)	Conductors above ground level and in trenches	:	Galvanised Steel
(b)	Conductors buried in ground or embedded in concrete	:	Mild Steel
(c)	Electrodes	:	GI Pipe / Rod
(d)	Treater pit	:	GI Pipe
(e)	Lightning protection air termination and down conductors for buildings	:	Copper spike lightning rod, GS Flat
(f)	Shield wire	:	GS

Earthing and lightning protection system installation shall be in strict accordance with the latest editions of CEA Regulations, relevant Indian Standards and Codes of Practice, and Regulations existing in the locality where the system is installed.

a)	Code of practice for Earthing	IS 3043
b)	AC substation grounding	IEEE 80
c)	Generating Station Grounding	IEEE 665
d)	Measures relating to Safety and Electric Supply	CEA Regulation
e)	National Building Code	IS SP 7
f)	Protection against lightning	IS/IEC 62305
g)	National Electrical Code	IS SP 30
h)	Manual on Earthing of AC Power Systems	CBIP 339

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The Contractor shall undertake the soil resistivity measurements as per Wenner's 4 electrode method. The earth resistivity values measured shall be utilized for earthing grid design calculations and select suitable type of conductors. Minimum cross section of main earth conductor shall not be less than 50x10mm GS / MS flat. The earth electrode shall be not less than 25mm dia of GI.		
3.3.	SIZE OF CONDUCTORS	
(a)	Main Earthing Conductors	
	The earthing conductor sizes shall be calculated as per IS 3043 and shall comply with Indian Electricity rules and IEEE 80.	
(b)	Rod Electrodes	
	Galvanised Iron rod electrodes of suitable diameter and length shall be used as per the recommendation of IS 3043. For test pits electrodes shall be heavy duty type (Class – C) G I pipe of suitable diameter with perforations. Electrodes installed in the test pits shall have disconnecting facilities. The arrangement of test pits shall meet the requirement of IS 3043.	
(c)	Equipment Earthing Leads	
	The size of the earthing leads shall be decided based on the type of equipment and structure to be earthed and shall be provided generally as per IS 3043.	
(d)	Conductors for lightning protection system	
	The size of conductors for lightning protection system shall be decided based on mechanical strength and as per IS/IEC 62305.	
4.0	EARTHING SYSTEM	
4.1.	The earthing system design and installation shall generally comply with IS 3043, IEEE 80, IEEE 665 and Indian Electricity Rules.	
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(a) Metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, lightning protection system conductors and neutral points of various systems shall be connected to a single earthing system. Two earthing leads shall be used if rated voltage of equipment is above 250V. If the rated voltage is 250V or below, one earth lead shall be provided. Metallic structures adjacent to electrical equipment shall be earthed by one earthing lead. (b) Whether specifically shown in drawings or not, Steel/RCC columns, metallic stairs, hand-rails, etc. of the building housing electrical equipment shall be connected to the nearest earthing grid conductor by at least one earthing lead. Electrical continuity shall be ensured by bonding the different sections of hand rails and metallic stairs. (c) All cable trays in the buildings as well as inside the trenches shall be connected to earth grid at an interval of about 10m. (d) Two separate earthing leads shall be provided for each of the Transformer (indoor and outdoor) / Generator neutrals. Each of the earthing leads shall be directly connected to a separate treated earth pit which in turn, shall be connected to two different runs of the main earthing grid. The neutral earthing lead shall not touch the frame. (e) In all plants, system neutrals (transformers, generators, neutral grounding transformer / resistor and outdoor substation LAs) shall be earthed through treated earth pits only. (f) Earth connections using stranded copper/aluminium conductor shall be provided with lugs (crimped type) (g) Chemicals used for earthpit treatment shall not cause ground water pollution and shall not be corrosive. (h) Number and type of earthpits at Point of Supply shall be as per the requirement of Electric Utility Company (Electricity Board) & Local Electrical Inspectorate. (i) The grounding system shall be designed for a life expectancy of at least fifty years, for maximum fault current of the system. MS flats or rods shall generally be used as main ground mat. The touch and step potentials shall be maintained within acceptable limits as per relevant Institute of Electrical and Electronics Engineers or Indian Standards or International Electrotechnical Commission standards. (j) Special attention shall be made for grounding of high voltage Gas Insulated Switchgear equipment, computer networks and communication equipment as per the manufacturer's recommendations.		
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(k) Provision at appropriate locations shall be kept for measurement of grounding resistance at regular intervals. 4.3. EARTHING CONDUCTOR LAYOUT 4.3.1. Earthing conductors in outdoor areas shall be buried 600mm (min) below finished grade level unless stated otherwise. 4.3.2. The spacing between adjacent electrodes shall be minimum 2000mm, unless otherwise stated elsewhere. 4.3.3. Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location. 4.3.4. Earthing conductors embedded in the concrete floor of the building shall have at least 50mm concrete cover. 4.3.5. Earthing conductors along their run on columns, walls, etc. shall be fixed by suitable welding or cleating at intervals of 1000mm and 750mm respectively 4.3.6. Tap connections from the floor earthing grid to the equipment/structure to be earthed shall be terminated on the earthing terminals of the equipment, if the equipment is available at the time of laying the grid. Otherwise, "earth insert" with temporary wooden cover or "earth riser" or "earthing pads" shall be provided near the equipment foundation/pedestal for future connections to the equipment earthing terminals. 4.3.7. In outdoor areas, buried conductors shall be brought 500 mm above ground level for making tap connections to equipment (above ground level). 4.3.8. Earthing conductors crossing the road shall be either installed in Hume pipes or laid at greater depth to suit the site conditions. 4.3.9. Wherever earthing conductor cross underground service ducts, pipes, trenches, tunnels, railway tracks, etc., it shall be laid in Hume pipes at minimum 300 mm below them. The earthing conductor shall be re-routed in case it fouls with equipment foundations. 4.3.10. Wherever earthing conductor passes through walls, floors, etc. galvanized conduit / HDPE pipe sleeves shall be provided for the passage of the conductor. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves. The seals, in addition, shall be fire proof if the specifications/project drawings call for the same. 4.3.11. Earthing of Electronics, including Instrumentation and control systems, shall include dedicated earth pits.		
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4.4. EARTHING SYSTEM INSTALLATION 4.4.1. The spacing between two electrodes shall be at least equivalent to twice the length of the electrode. 4.4.2. Earthing conductor running exposed on column, walls, etc., shall be supported by suitable cleating, at intervals of 750mm. 4.4.3. The earthing conductor crossing the road / track shall be laid in Hume pipe or laid at a greater depth to avoid damage. 4.4.4. When earth conductor passes through floors, walls, etc., suitable pipe sleeves shall be provided and the same shall be sealed after installation. 4.4.5. The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks & splices. 4.4.6. Metallic conduits and pipes shall not be used as earth continuity conductor. 4.4.7. Street lighting poles, flood light poles & towers, their junction boxes shall be connected to the earthing conductor to be run along with supply cable. This earth conductor shall be in turn connected to earth grid at two extreme points. 4.4.8. Flexible earth conductors shall be provided at expansion joints for earthing the gates, operating handles etc. 4.4.9. Equipment bolted connection after being checked and tested shall be painted with anti-corrosive paint / compound. 4.4.10. Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint. 4.4.11. The cable sheaths screens armour shall be earthed at both ends for multi-core cables. For single core cables the same shall be done at one end (switchgear end) only. 4.4.12. All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.		
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4.4.13. Electronic earthing pit for PLC/SCADA/I&C equipment shall be provided. Insulated copper cables shall be used for electronic earthing. 4.4.14. Electrical conduits, pipes and cable tray sections shall be bonded to ensure electrical continuity and connected to earthing conductors at regular intervals. Apart from intermediate connections, end and beginning points shall also be connected to earthing system. 4.4.15. Steel/RCC columns, metallic stairs, handrails, cable trays, metallic conduits and pipes shall not be used as earth continuity conductor. 4.4.16. A separate earthing conductor shall be provided for earthing luminaire, receptacles, switches, junction boxes, lighting conduits, poles, etc. This conductor in turn shall be connected to the main earth. 4.4.17. Steel pipe racks in the process units and off-site areas should be earthed at every 25m and at minimum 2 points. 4.4.18. Connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded/brazed type. For rust protection, the welds should be treated with zinc chromate and afterwards thickly coated with bitumen compound / bitumastic paint to prevent corrosion. 4.4.19. Steel to copper and copper to copper connections shall be brazed type. Welding shall be adopted in case of steel. Welding shall be done as per IS 816. 4.4.20. The jointing, whether bolted, welded or brazed shall be such that the resistance of the joint is not more than the resistance of the equivalent length of the conductor 4.4.21. All welded 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. 4.4.22. (a) Main earthing conductors shall be buried in earth around the building. More than two taps-off from this earthing loop shall be taken inside the building and connected to the earthing grid embedded in the floor slab with approximately 50mm concrete cover. (b) Each RCC / Steel column of the building shall be interconnected to the floor earthing grid.		
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(c) Cable trays, steel pipes / conduits, steel columns, etc., shall not be used as earth continuity conductors. (d) All electric system equipment shall be provided with a dedicated earthing system suitable for the equipment. (e) Earthing grids of the buildings, outdoor yards shall be interconnected to form a single grid. (f) Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm. (g) If required, For UPS / SCADA an independent earthing system and electrodes shall be provided based on the recommendation of SCADA supplier. 4.4.23. The shields or armour of three core power cables shall be earthed at both ends whereas the same for single core cables will be done at supply end only. Three Core Cables - The shields of solid type cables are earthed at terminations provided cable sheaths are bonded at joints. Single core cables - The sheaths of single core cables shall be earthed at the trifurcating box. In case of single core mains, earthing shall be done at the end of trefoil formation and the cable glands at sealing ends. 5.0 LIGHTNING PROTECTION SYSTEM 5.1. The building / switchyard and the scope as covered in the tender specification shall be provided with lightning protection system. 5.2. Lightning Protection System Layout (a) The lightning systems design and installation shall generally comply with IS/IEC 62305 code of practice for the protection against lightning. (b) Each down conductor shall be connected to a rod electrode, which in turn shall be connected to the earthing system through test links. (c) All the buildings, equipment & structures shall be provided with Lightning protection. 5.2.1. Lightning Protection System Installation 5.2.2. Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.		
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5.2.3. Down conductors shall be cleated on outer side of the building wall at 750 mm interval or welded to outside building columns at 1000 mm interval 5.2.4. Connection between each down conductor and rod/pipe electrode shall be made via test link located approximately 1000 mm above ground level. 5.2.5. Lightning conductors shall not pass through or run inside GI conduits. 5.2.6. All metallic structures within a vicinity of 2000 mm in air shall be bonded to the conductors of lightning protection system. 5.2.7. For outdoor substations and switchyards, Lightning Mast shall be provided for lightning protection. 5.2.8. In case of installations demanding use of shield wires, the shield wires shall comprise 7/3.65 mm, 70 mm² galvanised steel wire strung across pinnacles of the tower structures or separate lightning masts. These shall be brought down on every alternate tower, cleated along the tower leg, up to the test link mounted at 1000 mm from ground level. Conductors from test links shall be connected to separate rod/pipe electrodes (which in turn shall be connected to main grid). 5.2.9. Wherever required, for fuel-oil and other inflammable liquid storage tanks lightning protection shall be provided with horizontal conductors strung between tall poles covering the entire area. 5.2.10. Lightning conductor on concrete roof will not be directly cleated on surface of the roof. Concrete upstands shall be used for conductor fixing at an interval of 1500 mm 5.2.11. Joint in the down conductors, if unavoidable, shall be of welded type. However, number of joints in the lightning conductor shall be kept minimum 5.2.12. Down conductor shall follow a straight path to earth. There shall not be any sharp bends, turns and kinks in the down conductors 5.2.13. The lightning protection system shall not be in direct contact with underground metallic service ducts, cables, conduits, and metal enclosure of electrical equipment. However all metal projections, railings, vents, tanks etc. above the roof shall be bonded together to form a part of roof grid. 5.3. AS BUILT DRAWINGS Any changes in earthing conductor / lightning protection conductor layout carried out by CONTRACTOR to suit the site conditions, shall be incorporated in the relevant project drawings by the CONTRACTOR for which the PURCHASER / ENGINEER will furnish soft copy of the original drawings. The CONTRACTOR shall submit hard and editable soft copies after incorporating all changes carried out at site and forward the same to PURCHASER / ENGINEER for further action		
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5.4. TESTS

After the installation of the earth grid, the Contractor shall carryout the earthing system resistance measurements. If the value of the earth resistance is not meeting the design value (1 Ohm), additional earth rods and earth conductors shall be installed to improve the earth resistance to the design value.

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1.0 SCOPE 1.1. This specification covers the design, engineering, manufacture, inspection, testing at BIDDER's and/or his sub-vendor's works, packing, transportation, delivery to site, including transit insurance, erection, testing & commissioning of lighting system equipment. 1.2. Lighting system shall be provided for Indoor rooms, outdoor yard, roads etc. 1.3. Quantities of items for Lighting system refer BOQ / Schedule. 2.0 CODES & STANDARDS 2.1. The design, manufacture, testing and performance of equipment shall comply with all currently applicable standards, codes of practice, regulations and safety codes in the locality where the equipment will be supplied. Nothing in this specification shall be construed to relieve the VENDOR of his responsibility. In case of conflict between these standards and this specification, more stringent of the two requirements shall govern. 2.2. The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant/ Owner in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of the code/ standard. Consultant/ Owner may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed. 2.3. The VENDOR shall ensure that instruments and gauges to be used for testing and inspection shall have valid calibration and the accuracy can be traced to National and International Standards as applicable. 3.0 LIGHTING 3.1. The Indoor lighting shall be executed by direct wall/ceiling mounting / Recess mounting and conduit wiring as per lighting layout.		
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3.2. The outdoor lighting shall be executed by street lighting pole / wall mounted lighting pole / suitable supports.

3.3. The control of all indoor area lighting/sockets shall be done through switch boxes connected from LDB and the control of all outdoor area lighting shall be done automatically through multi-programmable timer units or manual switching 'on' and 'off' facility from LDB.

3.4. The main distribution board / LDB will be by 415V, 3 phase, 4 wire, 50Hz supply with effectively earthed neutral.

3.5. Necessary circuits shall be allotted at LDBs for lighting.

3.6. **ILLUMINATION LEVELS AND CHOICE OF LIGHTING FIXTURES**

The area-wise distribution of average illumination levels and type of luminaires shall be as given below.

Sl. No	Area/ Structure	Aver.- age Lux Level	Type of Fixture	Type of Luminaire
(a)	Switchgear room / Battery Room	250	Industrial LED light fixture with polycarbonate housing aluminium gear tray and opal cover of polycarbonate suitable for surface mounting. Minimum degree of protection IP 66.	2 x 20 W LED
(b)	Toilet Corridor /	150	Industrial LED light fixture with round panel with body made from die cast aluminium and CRCA covering, powder coated suitable for surface mounting. Minimum degree of protection IP 20.	18 W LED
(c)	Switchyard outdoor	50	Industrial LED Street light fixture with extruded aluminium housing as heat sink, heat resistant toughened	120W / 20W LED

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			glass, control gear compartment. Degree of protection IP 66.	
(d)	Roads	20	Industrial LED Street light fixture with extruded aluminium housing as heat sink, heat resistant toughened glass, control gear compartment. Degree of protection IP 66.	120W / 20W LED

The illumination levels for areas, which are not specifically covered above, shall be decided based on illumination levels indicated for similar areas or in relevant standards.

The above list is tentative. Final model/type will be decided during detailed engineering.

3.7. LED LIGHTING FIXTURES

- (a) All luminaries shall be complete with accessories like lamps, ballasts, Driver, power factor improvement capacitors, starters etc.
- (b) Necessary Active Power Filters for the LED fixtures to be considered.
- (c) All LED luminaries shall be provided with toughened glass and shall have thickness of sufficient strength and high efficiency prismatic diffuser under the LED chamber to protect the LED and luminaries.
- (d) Suitable reflector / lenses may also be provided to increase the illumination uniformity and distribution for LED.
- (e) The fixture shall be designed so as to have lumen maintenance of at least 70% at the end of 50,000 hours (L70) at design temperature of 35 degree C.
- (f) Adequate heat sink with proper thermal management shall be provided.
- (g) Minimum view angle of the LED shall not be less than 120 degree.
- (h) Power factor of complete fitting shall be more than 0.95 at full load 240V and THD<8%.
- (i) The LED luminaries shall be free of glare. Colour rendering index (CRI) shall be ≥ 75 . System luminous efficacy for indoor area shall be ≥ 80 .

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(j) The luminaries should be an inbuilt surge protection of not less than 4 KV to prevent in damage to the driver in case of sudden voltage surge. (k) LED fixture shall be selected suitable such that if there is any repair/damage, it should be easily replaceable of the component of LED fixture only instead of complete fixture. (l) Lumen maintenance report as per LM 80 guidelines shall be produced for the LEDs used. The test report shall contain description of the source tested/Ambient Condition (Airflow, Temperature etc.)/Electrical Condition/Lumen Maintenance Data/Observation of failure (Lumen depreciation monitored every 1000 hours)/LED Monitoring Interval/Chromaticity shift over time. The LED chips shall have system luminous efficacy of 100 lm/W or more and LED fixture shall have system efficacy of 70 lm/W or more. (m) Bidder shall submit LM 79 (Electrical & Solid-State measurement of solid state lighting products/fixtures). The test report shall contain Total lumen output of the fixture/luminaire intensity distribution/electrical power/luminous efficacy/colour characteristic of the fixture i.e. CCT & CRI. 3.8. LIGHTING DISTRIBUTION BOARD (LDB) The lighting panels shall be provided with one incoming 4P MCB & shall have per phase isolations with DP RCCB on each phase as sub- incomer. The outgoings shall be SP MCBs. The panel shall conform to IS-862. • 415V, 32A/63A, FP MCB Isolator • Required no.of 10A/16A/20A, RCBO outgoing feeders with neutral links & 20% Spare feeders. • 20A/32A/63A TP contactor with timer, photocell and bypass switch arrangement for outdoor lighting. • It shall be sheet steel enclosed and shall be fully dust and vermin proof, with a degree of protection of IP 54. Outdoor panels shall be weather proof type with IP 55 degree of protection & Rain hood arrangement. • The lighting panel's hinged, latched front door shall be provided with key-locking facility and a slotted bakelite sheet inside. Only the ELCBs/MCBs operating knobs shall project out of the bakelite sheet slots for safe operation and neat appearance		
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3.9. SWITCHES AND RECEPTACLES (a) The lighting circuits shall be controlled directly from the MCBs in the lighting panels, if there are no separate switch boxes. Wherever the lighting panel is not in the same area, separate switches shall be provided. For cabins, rooms etc., separate switches shall be provided for each point. Similarly for entrances, building periphery lighting separate switches shall be provided. (b) For outdoor lighting, it will be controlled directly from the MCBs in the lighting DB. These outdoor lighting circuit will be having with timer, photocell and bypass switch arrangement for automatic and manual switching on/off provision. (c) 240V, 50Hz, 3 pin power receptacles (5A and 15A) shall be provided in all building/areas of the plant. Also inside a building, receptacles shall be provided at regular intervals so that any point of the building is not more than 10m with a minimum of 2 nos., in an enclosed area. Inside each cabins at least two receptacles shall be provided. The same shall be indoor / outdoor. (d) The welding receptacle shall be of 32 A, industrial heavy duty type with 5pin (with earth connection) suitable for 415 V, 3 phase, 50 Hz supply. The receptacle, RCBO shall be housed in a sheet steel enclosure complete with gasket, cable glands etc. The enclosure shall be min. 2 mm. thick galvanized sheet steel and shall conform to the degree of protection IP-55 class. All receptacles shall be provided with matching plug tops. The receptacle and switch shall be interlocked with the plug such that it shall not be possible to remove the plug with the switch in 'ON' position. (e) The switch boxes, receptacle boxes etc., shall be made up of 18 SWG sheet steel. 3.10. WIRING (a) 1100V grade multi stranded copper conductor, PVC insulated wires laid in GI conduits shall be used for lighting in non-hazardous area / indoor. In the hazardous areas/outdoor cable wiring with 1100V grade multi stranded copper conductor, XLPE insulated, PVC inner sheathed, GI wire armoured and outer sheathed with extruded FRLS PVC compound type ST2 complying with IS: 7098.		
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(b) Minimum size of wires in case of conduit wiring shall be 2.5Sq.mm in case of lighting and 4Sq.mm in case of receptacle wiring. Minimum cable size in case of cable wiring shall be 4Sq.mm. (c) Wires of different phases shall be run in separate conduits. However wires of same phase but having different circuit nos. can be run in same conduit. Wires of lighting and power receptacles shall be carried out in separate conduits and on separate circuits. Wires of AC and DC lighting systems shall be carried out in separate conduits. (d) For Phase, neutral & earthing copper wire / cable shall be used. (e) All cables shall be FRLS type and provided with anti-rodent treatment. 3.11. LIGHTING CIRCUIT DESIGN In an area, the lighting fixtures shall be arranged in different phases/LPs such that even in case one phase goes faulty complete lighting is not affected. (a) The circuit loading on each circuit shall be restricted to 80% of the RCBO/MCB rating. (b) The voltage drop from LDB and any fixture shall not exceed 3%. 3.12. LIGHTING POLES FOR STREET LIGHTING (a) Lighting poles shall be of swaged curved type steel poles as per applicable standards. Lighting pole shall be GI. Minimum height of pole shall be 11 meter from FGL. (b) The supply of poles shall be complete with fixing bracket/necessary pipe reducer for fixing the fitting and also include the necessary associated pole mounted junction boxes. Junction boxes with hinged door & suitable locking with key arrangement shall be provided at the bottom of each street lighting pole. This box shall contain 6 Amps HRC fuses, neutral links, terminal blocks suitable for loop-in loop-out of at least 3 ½ C, 35 sq mm aluminium cables, ground stud etc. GI conduit shall be embedded in muff for incoming & outgoing cables. Supply to luminaires shall be taken through 1100 V, 3x2.5 sq mm PVC insulated, unarmoured cable with stranded copper conductor. (c) It shall be ensured earth continuity from the luminaire body to earth grid through pole/looping box. Two numbers of welded earth terminals with bolts shall be provided on the pole. (d) Refer attached street Lighting pole drawings.		
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3.13. EARTHING

- (a) Lighting fixtures, receptacles, switches, conduits and junction boxes shall be properly earthed using copper wire / cable.
- (b) The third core of each single-phase cable circuit shall be used as earthing conductor.
- (c) Each street lighting pole shall be provided with Earth rod for grounding purpose.

4.0 TESTS

4.1. Type tests, acceptance tests and routine tests for the lighting fixtures, Poles and accessories covered by this specification shall be carried out as per the relevant standard for the respective fixtures and their accessories.

4.2. The MANUFACTURER's type and routine test certificates shall be submitted for tests conducted as per relevant standards for the fixtures and accessories. The BIDDER shall submit with his proposal copies of available test certificates of the luminaire offered.

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DATA TO BE FURNISHED ALONG WITH THE BID.

SL. NO.	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
1.0	Name of the manufacturer & type lighting fittings		
2.0	Applicable standard		
3.0	Nominal working voltage		
4.0	Maximum permissible supply voltage variation for satisfactory operation of :		
	(i) Fitting	± %	
	(ii) Accessories	± %	
5.0	Power factor at nominal working voltage and frequency		
6.0	Lighting distribution boards and lighting panels		
7.0	Degree of protection provided for following applications :		
	(i) Indoor	± %	
	(ii) Outdoor	± %	
8.0	Thickness of sheet steel	mm	
9.0	Lighting Wires		
9.1.	Make		
9.2.	Applicable standard		
9.3.	Voltage grade		
9.4.	Conductor material	Cu/Al	

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	TITLE MV INDOOR CT-PT PANEL	
1.0 SCOPE This Specification covers the requirements of sizing, design, engineering, material selection, constructional features, manufacture, inspection and testing at the VENDOR'S or his SUB-VENDOR'S Works, delivery to site including transit insurance and supervision of erection, testing & commissioning of Medium Voltage indoor CT-PT panel. 2.0 CODES AND STANDARDS 2.1. The design, material, construction, manufacture, inspection, testing and performance of equipment shall comply with all currently applicable standards, codes of practice, regulations and safety codes in the locality where the equipment will be supplied & installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. 2.2. The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant/ Owner in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of the code/ standard. Consultant/ Owner may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed. 2.3. In case of conflict between the applicable standards and this specification, the more stringent of the two shall govern. 3.0 MV Indoor Panels 3.1. The following list of MV Panels are covered under is specification. Additional details refer data sheet A: a) 22 kV CT-PT indoor panel -3 Nos. The panel shall comply with MSEDCL requirement for metering. 3.2. The preliminary details such as continuous current rating of the bus bar, CT, PTs, and meters, etc to be provided as shown in the Single line diagram. The Contractor shall review the rating of equipment required for the system offered,		
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the meters for effective monitoring of the equipment being supplied and add additional relays/meters and suitable rated equipment as required to meet local Electricity board & project requirement. 3.3. The complete panel shall be procured from the same source to ensure interchangeability of components. 3.4. The CT-PT panel shall comply with MSEDCL & STU requirement for metering. 4.0 CONSTRUCTIONAL FEATURES 4.1. The switchboard shall be indoor, floor mounted, metal clad, draw-out having separate metal enclosed compartments for (a) Phase bus bars (b) Instrument transformers (c) Power cable terminations (d) Metering / Marshalling 4.2. Adjacent cubicles (panels) shall have sheets on either side to ensure complete isolation. The bottom of each panel shall be covered by sheet steel and necessary glands plates. Switchgear shall be suitable for extension on both sides. 4.3. Total height of the switchgear panels shall not exceed 2600 mm. The height of switches, push buttons and other hand operated devices shall not exceed 1800 mm and shall not be less than 700 mm. 4.4. The switchboard shall have passed internal arc testing (A FLR) for 1 second at the rated switchgear fault current. Pressure relief flaps and Gas duct shall be provided at the top of the switchboard with suitable exhaust arrangement to release hot over-pressurised gases in case of an internal fault to vent arc flash & hot gases away from operator (outside the building). The internal arc time could be 0.5 sec or 0.1 sec at switchgear rated fault current in case rapid fault clearance time initiated by detectors sensitive to light, pressure, or heat or by bus bar differential protection is provided. Notes: (a) A stands for: Authorised (b) F stands for: Front (c) L stands for : Lateral (d) R stands for : Rear		
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4.5. Required number of auxiliary relays, timers, contact multiplication relays, etc. shall be provided in the panels to meet the system requirements and to meet the system operation philosophy. 4.6. The VT shall be draw out type 4.7. The current transformers shall be mounted in the fixed portion of the switchgear. Adequate space shall be available for termination using heat shrinkable type cable termination in cable compartment. 4.8. All non-current carrying metal work of the switchgear shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible. 4.9. Switchgear shall be supplied completely wired and inter panel wiring between cubicles of same switchgear shall be provided. 4.10. Communicable fault annunciator covering faults shall be provided. 4.11. Space heaters of adequate capacity shall be provided. 4.12. Each switchgear panel shall be provided with 240Volts, 1 phase, 50Hz, 5amps, 3 pin receptacle with switch located in a convenient position. 4.13. Provision shall be made for receiving, distribution, isolating and fusing of auxiliary DC and AC supplies for controls, space heating, etc. as required 4.14. The rating of instrument transformers indicated in the one-line diagram is preliminary. However, the Bidder shall confirm adequacy of the same based on connected load, lead burdens, changes during engineering stage, if any, and adequate margin. 4.15. The termination kit shall be heat shrinkable / cold shrinkable type. 4.16. MV switchgear - Should have proper LOTO arrangement. 4.17. In MV switchgear Back doors should have adequate safety interlock system as well as the indication of live circuit to be provided. 4.18. Suitable temperature detection system in the bus and cable compartment to be provided.		
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4.19. Cable lugs for all power, control and instrumentation cable connections shall be supplied. The lugs shall be tinned copper/aluminium depending on cable conductor and of solderless crimping type. The cable glands shall be of double compression brass cable glands shall be supplied. 4.20. Earthing busbar tinned copper to be provided. 4.21. Cable live indicator shall be provided on each feeder with following features: ➤ Voltage present indication shall be self-powered and independent of aux. supply. ➤ Suitable for Aux. supply of 0-250V DC system (with centre tap grounding) ➤ Provision shall be available for measurement of secondary voltages, which shall be used for phasing in measurements. ➤ Secondary voltages shall be minimum of 10V with respect to ground at service voltage of switchboard. ➤ It shall have 2 relay output contacts for remote indication & interlocking. ➤ TEST mode to check the healthiness of indication & contacts. 4.22. PAINTING 4.22.1. All switchgear panels shall be painted providing an aesthetically pleasing appearance, free from dents and uneven surfaces. Paint shade shall be RAL 7032 for both internal & external. 4.23. BUSBARS 4.23.1. Material of main and tap off busbars shall be of electrical grade and shall be of copper. 4.23.2. Busbars shall be rated to meet the service conditions and the rated continuous and short time current ratings. Maximum temperature of the main busbars and busbar connections, under operating conditions, when carrying rated normal current at rated frequency shall not exceed 90/105°C for non-silver plated/silver plated joints/connections. Busbar temperature limits shall be adhered to without forced cooling method. 4.23.3. All busbar joints and bus tap joints shall preferably be silver faced.		
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4.23.4. Unless supported by impulse voltage withstand test results, phase to phase and phase to earth clearances in air for the busbars and live parts shall not be less than those specified. 4.23.5. Busbars shall be adequately supported on insulators, to withstand dynamic stresses due to short circuit current specified. 4.23.6. Main busbars shall be located in air insulated enclosures and segregated from all other compartments of the cubicle. Direct access or accidental contact with busbars and primary connections shall not be possible. 4.23.7. The busbars shall be with flame retardant heat shrinkable sleeve. All joints shall be provided with removable shrouds. 4.23.8. The busbar sleeves and shrouds shall be suitable for continuous operating temperature of 5°C higher than the maximum permissible operating temperature of busbars / joints. 4.23.9. The sleeving material shall not crack, peel or loosen on the busbars when subjected to thermal cycling during service and shall be of such quality as not to require replacement for life of switchgear. 4.24. INSTRUMENT TRANSFORMERS 4.24.1. The current transformers (CTs) and voltage transformers (VTs) shall conform to the requirements stipulated in relevant standards. It shall be the responsibility of the Contractor to choose the rating and parameters of the instrument transformers to ensure that the ratings/parameters are adequate for the meters specified taking into consideration the lead resistance for the remote connected equipment. The parameters of the instrument transformers shown in the Single line diagrams shall be for guidance only compatible with the type of metering provided. 4.24.2. The CTs and VTs shall be of cast resin type (with winding insulation of B) and shall be able to withstand the thermal and mechanical stress resulting from the rated short time withstand and peak withstand current of the switchgear. All CTs shall be window type.		
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4.24.3. CTs and VTs shall have polarity marks indelibly marked on each transformer and at the associated terminal block. Facility shall be provided for short circuiting and earthing the CT secondary at the terminal blocks. 4.24.4. VTs shall be of the single-phase type and mounted on a draw out trolley. VTs shall be protected on their primary side by current limiting fuses and secondary side by MCBs. MCBs shall be suitably located to permit easy replacement while the switchgear is energized. MCB's shall be provided with auxiliary contacts. Precautions shall be made such that the primary fuses can be handled only in the de-energised position. Draw out contacts for Phase and Neutral terminals shall be identical. Also shutters shall be provided to automatically seal off the high voltage spouts when voltage transformers are withdrawn. 4.25. WIRING AND ACCESSORIES 4.25.1. All wiring shall be carried out with 1100V grade, single core, FRLS-PVC, flexible multi stranded copper conductor wires and shall be vermin and rodent proof. 4.25.2. The internal wiring shall be with 1.5sq.mm or 2.5 Sqmm multi stranded copper conductor for control wiring and 6sq.mm for CTs and for PTs and suitably sized for power wiring with a minimum of 4 Sq.mm copper. 4.25.3. Wire color shall be Red, Yellow, Blue for respective Phases/PT wires, Black for neutral, Green / Yellow for earthing circuits, Grey for control wiring etc. 4.26. TERMINAL BLOCKS 4.26.1. Terminal blocks shall be colour coded 750V grade, 10Amps rated, one piece moulded, complete with insulated barriers, stud type terminals, washers nuts and lock nuts and identification strips. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams. 4.26.2. Terminal blocks for CT and PT secondary leads shall be provided with test links and isolating facilities. Also, CT secondary leads shall be provided with short circuiting and earthing facilities. 4.26.3. Not more than one wire shall be terminated on either side of a terminal. When it is required to terminate two or more wires on the same terminal, the wires		
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shall be terminated on adjacent terminals and these terminals shall be shorted using suitable shorting links. 4.26.4. At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks. This shall include 10% spare terminals for inter cubicle wiring also. 4.26.5. Sufficient number of spare contacts and terminals of the panel mounted equipment, and devices shall be wired to terminal blocks. 4.26.6. Protective covers of transparent plastic for placing over live parts of the terminal blocks shall be provided. 4.26.7. There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate. Also, the clearance between two rows of terminal blocks shall be a minimum of 150mm. 4.26.8. Moulding terminals shall be self-extinguishing or resistant to flame propagations, substantially non-hygroscopic and shall not carbonise when tested for tracking. The insulation between any terminal & framework or between adjacent terminals shall withstand a test of 2kV for one minute. The mouldings shall be mechanically robust to withstand handling while making terminations. 4.26.9. Suitable barriers shall be provided between two terminals connected to different voltage supplies. 4.27. CABLE BOXES & GLANDS 4.27.1. Cable terminating boxes along with termination kits shall be supplied complete with all accessories. Cable box shall withstand the short circuit rating of the switchgear. Cable termination kits shall be heat shrinkable / cold shrinkable type. 4.27.2. Necessary number of cable glands/lugs shall be provided for terminating power and control cables. 4.28. PLUG POINT		
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A 240V, 1 phase, 50Hz, AC plug point shall be provided in the interior of panel with an on-off switch for connection of hand lamps.

4.29. INTERIOR ILLUMINATION

Metering/wiring cubicle shall be provided with LED / CFL fitting for illumination.

5.0 TESTS AND TEST REPORTS

- 5.1. Routine tests shall be carried out on completely assembled equipment as per relevant standards.
- 5.2. Functional tests shall be carried out to demonstrate the specified control and interlocks.
- 5.3. Copies of the test certificates for all brought out items shall be submitted for the PURCHASER'S approval.
- 5.4. The contractor shall furnish copies of all valid type test reports as per the relevant standards. Type tests shall be carried out free of cost to prove the design if not tested in the previous five years.

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DATA SHEET-A1			
SL No.	DESCRIPTION	UNIT	CLIENT'S SPECIFICATION
1.0	Switchboard cubicles and Bus bar ratings		
1.1.	Nominal voltage, phases, and frequency	V, Ph, Hz	22000 V, 3Ph, 50 Hz
1.2.	System neutral earthing		Effectively earthed (solid earthing)
1.3.	Maximum system voltage	V	24000
1.4.	One minute power frequency withstand voltage	kV(rms)	As per Standard
1.5.	1.2/50 microsecond impulse withstand voltage	KV (peak)	As per Standard
1.6.	Bus bar support insulator	kV	24
1.7.	Bus bar rating	A	Refer SLD
1.8.	Short circuit current rating and duration	kA / Sec	Refer SLD
1.9.	Dynamic rating	kA	65 kA
1.10.	Design ambient temperature of the offered items		50 deg C
2.0	Constructional		
2.1.	Thickness of sheet steel enclosures, doors and covers	mm mm	2.0 mm (Cold rolled) 2.5 mm (Hot rolled)
2.2.	Degree of protection		Bus bars – IP 4X Others – IP 2X
2.3.	Colour finished shade (Enamel / epoxy)		Interior: Glossy white Exterior: RAL 7032
2.4.	Material of main bus	mmxmm	Copper
2.5.	Material of earthing bus	mmxmm	Tinned copper 50x6mm (minimum)
2.6.	Minimum clearance in air of live parts	mm mm	Phase to Phase – IS/IEC Phase to Earth – IS/IEC
3.0	Current transformer		

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TITLE	MV INDOOR CT-PT PANEL DATA SHEET – A	

DATA SHEET-A1			
SL No.	DESCRIPTION	UNIT	CLIENT'S SPECIFICATION
3.1.	Type		Cast resin bar primary
3.2.	System voltage and frequency	V, Hz	22000 V, 50 Hz
3.3.	Class of insulation		Class 'B' or better
3.4.	Short circuit withstand current and duration		Refer SLD
3.5.	Rated Primary current & ratio		As per SLD
3.6.	Accuracy class & Burden		As per SLD
4.0	Voltage transformer		Refer SLD also,
4.1.	Type		Cast resin
4.2.	Rated voltage - Primary	V	22000 / $\sqrt{3}$
	- Secondary	V	110/ $\sqrt{3}$ / 110/ $\sqrt{3}$
4.3.	Method of connection - Primary		Star earthed
	- Secondary		Star / Open
4.4.	Rated voltage factor		1.2 Continuous & 1.9 for 30secs
4.5.	Class of insulation		Class 'B' or better
4.6.	Accuracy Class		Metering – 0.2
4.7.	Burden		As required

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DATA SHEET-A2

APPLICABLE STANDARDS

1.0	CIRCUIT BREAKERS	IS/IEC 62271-100	
2.0	METAL ENCLOSED SWITCHGEAR	IEC 62271-200	
3.0	CURRENT TRANSFORMERS	IS 2705	IEC 61869-2
4.0	VOLTAGE TRANSFORMERS	IS	IEC 61869-3
5.0	ARRANGEMENT FOR SWITCHGEAR BUSBARS, MAIN CONNECTIONS AND AUXILIARY WIRING	IS 5578 / IS 11353	
6.0	BUSBAR SUPPORT INSULATORS	IS 2544	IEC 60273
7.0	DEGREE OF PROTECTION	IS/IEC 60529	
8.0	ELECTRICAL RELAYS FOR POWER SYSTEM PROTECTION	IS 3231	IEC 60255
9.0	ELECTRICAL INDICATING INSTRUMENTS	IS 1248	IEC 60051
10.0	HIGH VOLTAGE FUSES	IS 9385	IEC 60282
11.0	A.C. ELECTRICITY METERS	IS 1595	IEC 60359
12.0	ALUMINIUM BUSBARS	IS 5082	IEC 60105
13.0	CODE OF PRACTICE FOR PHOSPHATING IRON AND STEEL	IS 6005	IEC 255
14.0	A.C DISCONNECTORS AND EARTH SWITCHES	IS/IEC 62271-102	
15.0	LOW VOLTAGE FUSES	IS/IEC 60947-3	

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DATA TO BE FURNISHED ALONG WITH THE BID. (For each board)

SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
1.0	Manufacturer/s name		
2.0	Applicable standards		
3.0	Max. continuous voltage	kVrms	
	(a) Switchboard		
	(b) CT / VT		
4.0	Impulse withstand voltage / PF withstand voltage	kVp / kVrms	
	(a) Switchboard		
	(b) CT / VT		
5.0	SC current withstand capability (current / duration)	kA / sec	
	(a) Switchboard		
	(b) CT		
6.0	Momentary current withstand	kAp	
7.0	Degree of protection for switchboard		
	(a) Bus bar compartment		
	(b) Other compartment		
8.0	Bus bar		
	(a) Material		
	(b) Continuous current rating under site conditions		
	(c) Temperature rise over the design ambient of 50°C		
9.0	PTs		

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DATA SHEET – B

SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
9.1.	Make		
9.2.	Type		
9.3.	Voltage Ratio		Primary: Secondary 1: Secondary 2: ...
9.4.	Rated voltage factor		
	(a) Continuous		
	(b) 8 hours		
9.5.	Class of insulation		
9.6.	Accuracy Class		
9.7.	Burden		Primary: Secondary 1: Secondary 2: ...
10.0	Current Transformer		
10.1.	Make		
10.2.	Type		
10.3.	System voltage and frequency	V, Hz	
10.4.	Current ratio		
10.5.	No. of cores		
10.6.	Accuracy class & Burden		
10.7.	Class of insulation		
10.8.	Short circuit withstand current and duration		
11.0	Earthing arrangement for		

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SL. NO	DESCRIPTION	UNIT	TO BE FILLED BY BIDDER
11.1.	Bus bar		
11.2.	Cables		

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1.0	<u>GUIDELINES FOR INSTALLATION OF ELECTRICAL EQUIPMENT</u>	
1.1	The work shall be carried out in the best workman like manner in conformity with relevant specifications / codes and standards. In addition, work shall also confirm to the requirements of latest editions / amendments of the following: • Indian Electricity Act and rules framed there under. • Regulations laid by the office of the Chief Electrical Inspector to Government • CEIG requirement. • The factory Act. • Any other regulations laid down by the local authorities.	
1.2	Manufacturer's drawings, instructions and recommendations shall be correctly followed in handling, erecting, testing and commissioning of all items/equipment and care shall be exercised in handling to avoid distortion to stationary structures, the marring to finish, or damaging of delicate instruments or other electrical parts.	
1.3	All electrical equipment shall be installed in a neat, professional manner so that it is level, plumb, squat and properly aligned and oriented. Tolerances shall be as established in the Manufacturer's drawings.	
1.4	The Bidder shall ensure that instruments and gauges to be used for testing and inspection have valid calibration and the accuracy can be traced to National Standards.	
1.5	It shall be the Bidder's responsibility to obtain approval from local statutory authorities including Electrical Inspector/CEA, wherever applicable, for carrying out any work or for installation carried out which comes under the purview of such authorities.	
1.6	It is the responsibility of the Bidder to provide watch & ward and security for the equipment / component parts covered in this contract.	
1.7	The Bidder shall carry out touch-up painting on any equipment, if the finish paint on the equipment is soiled or marred during installation/handling.	
1.8	The Bidder shall ensure workmanship of good quality and shall assign qualified supervisors/engineers and competent labour who are skilled having valid licence/authorisation/work permit, careful and experienced in carrying out similar works. The Owner/Consultant shall reserve the right to reject non-competent person employed by the Bidder, if the workmanship is not found	
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satisfactory. Wherever required the Bidder shall include loaning of skilled/unskilled personnel for work by Owner/other agencies, on Man-hour/Man-day rates, for normal & overtime work to meet the project schedule. 1.9 The Contractor shall do detailed supervision at each stage of the work, in all areas so that any improvements modifications required to meet site conditions/layouts is effected in time. 1.10 The Contractor shall be fully and finally responsible for proper erection, safe and satisfactory operation of the equipment under his scope of work to the entire satisfaction of the Owner. Equipment and material, which are wrongly installed, shall be removed and re-installed to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner. 1.11 The installation shall be carried out in such a manner as to provide access to other equipment installed. The Contractor shall restore floor / wall chipping, road cuttings & other such works done including replacement of equipment removed back to its place and make good damages done to original. 1.12 The Contractor shall effectively protect his work, equipment and materials under his custody from theft, damage or tampering. Finished work where required shall be suitably covered to keep it clean and free from defacement or injury. Contractor shall be held responsible for any loss or damage to equipment and material issued to him until the same is taken over by the Owner according to contract. 1.13 All safety rules and codes as applicable to work shall be followed without exception. All safety appliance and protective devices including belts, hand gloves, aprons, helmets, shields, goggles, safety shoes etc. shall be provided by the Contractor for his personnel. 1.14 The Contractor shall provide guards and prominently display caution notices if access to any equipment / area is considered unsafe and hazardous. In order to avoid hazards to personnel moving around the equipment such as switchgear etc. which is kept charged after installation, before commissioning, such equipment shall be suitably cordoned off to prevent anyone accidentally going near it 1.15 The contractor shall have a separate cleaning gang to clean all equipment under erection as well as the work area and the project site at regular intervals to the satisfaction of Owner. In case this is not done, the Owner will have the right to carry out the cleaning operation and any expenditure incurred in this regard will be to the contractor account. 1.16 It shall be the responsibility of the Bidder to obtain necessary Licence/ Authorisation/permit for work for his personnel from the Licensing Board of the locality/state where the work is to be carried out. The persons deputed by		
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the Bidder's firm should also hold valid permits issued or recognised by the Licensing Board of the locality/state where the work is to be carried out. 2.0 <u>INSTALLATION WORK SCOPE</u> 2.1 Temporary Lighting Arrangement for the Work Area The contractor shall on his own arrange for the temporary lighting arrangement for the work area to carry out the installation work in the plant premises. 2.2 CONSTRUCTION POWER Construction power including power for testing and temporary lighting shall be in Bidder scope. 3.0 <u>EQUIPMENT INSTALLATION</u> 3.1 MOTORS Unless otherwise specified, the motors will be installed by the driven equipment VENDOR. However, the CONTRACTOR under this specification shall undertake pre-commissioning checks and testing of the motors. The installation/commissioning shall be as per the applicable code of practice, MANUFACTURER's instructions and commissioning check list. 3.2 SWITCHGEARS, MCCS, PCCS, PDBS, CONTROL & RELAY PANELS 3.2.1 All the AC/DC Switchgears, MCCs, PCCs, PDBS and control and relay panels/desks, lighting distribution boards etc. shall be installed in accordance with specified Code of Practice, drawings furnished and the MANUFACTURER's instructions and respective commissioning check lists. The switchgear/panels shall be installed on finished surfaces or concrete or steel sills. These panels may be bolted on to the foundation pockets or welded to base frame members as detailed in the drawings to be furnished to the CONTRACTOR. The CONTRACTOR shall be required to install and align any channel sills which form part of the foundations. Proper aligning, joining of various vertical shipping sections, busbar connections, inter panel wiring etc. will be the responsibility of the CONTRACTOR. In joining shipping sections of the switchgear/panels/control centres together, adjacent housing or panel sections provided shall be bolted together after alignment has been completed. Power bus enclosures, ground and control splices of conventional nature shall be cleaned and bolted together, being drawn up with torque wrench of proper size or by other approved means.		
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3.2.2 The CONTRACTOR shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever, the instruments and relays are supplied separately, they shall be mounted only after the associated control panels/desks have been erected and aligned. The blocking materials/mechanism employed for the safe transit of the instruments and relays shall be removed after ensuring that the panels/desks have been completely installed and no further movement of the same would be necessary. Any damage to relays and instruments shall be immediately reported to the OWNER/ENGINEER. 3.3 TRANSFORMERS 3.3.1 Site inspection, storage, installation, testing and commissioning of transformers shall be in accordance with the specified code of practices, MANUFACTURER's instructions. 3.3.2 The CONTRACTOR shall (a) assemble the transformers with all fittings such as bushings, cooler banks, radiators, conservators, valves, pipings, cable boxes, marshalling boxes, OLTC, cooling fans/pumps etc. (b) arrange for oil filtration before filling, (c) Provide wedges/clamps to rigidly station all transformers on rails, (d) connect up the transformer's terminals and (e) lay and terminate the cables/conduits between all the accessories mounted on the transformer tank/cooler and the transformer marshalling kiosk. 3.3.3 Care shall be taken during handling of insulating oil to prevent ingress of moisture or foreign matter. In the testing, circulating, filtering or otherwise handling of oil, rubber hoses shall not be used. Circulation and filtering of oil, heating of oil by regulated short-circuit current during drying runs and sampling and testing of oil shall be in accordance with the MANUFACTURER's instructions/specified Code of Practice. 3.4 BATTERY, BATTERY CHARGER & UPS 3.4.1 Installation and testing of battery, battery chargers & UPS shall be carried out in strict compliance with the MANUFACTURER's instructions. Each cell shall be inspected for breakage and condition of cover seals as soon as it is received at site. Each cell shall be filled with electrolyte in accordance with the MANUFACTURER's instructions. 3.4.2 Battery shall be erected on MS rack or frame stands and insulators supplied by the manufacturer of the batteries. The cells shall not be lifted by the terminals. Contact surfaces of battery terminals and intercell connectors shall be cleaned, coated with acid resistant grease and assembled. Each connection shall be properly tightened. 3.4.3 Electrolyte shall be filled as per manufacturer's instructions. Inter row connections shall be made with the leads supplied by the manufacturer Supervision for preparation and filling of electrolyte, terminal connections etc. will be carried out		
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by the manufacture of the batteries wherever specifically mentioned. Each cell shall be tested with hydrometer and thermometer and results logged. Freshening charge, if required, shall be added. Charging, discharging and recharging shall also be carried out under the supervision of the manufacturer. 3.4.4 When handed over to the PURCHASER, the battery shall be fully charged and electrolyte shall be at full level and of specified specific gravity. 3.4.5 The Contractor shall also carryout tests on the complete Battery, Charger & UPS. 3.5 LOCAL PUSH BUTTON STATIONS 3.5.1 The push button stations shall be installed near the motors to be controlled. Individual channel supports shall be used for each of the push button stations. These shall be installed as per approved erection detail drawing. Control station for hazardous areas shall be CMRS certified and CCE approved. 3.5.2 All push button/control stations shall have necessary canopies. Wiring of push button control station shall be checked before giving control supply. 3.6 MISCELLANEOUS ITEMS 3.6.1 Whenever applicable, communication equipment, space heater panels, local starters, capacitors and every other electrical equipment covered in the tender specification shall be installed, tested and commissioned as per respective equipment VENDOR's instructions, relevant code of practice and the drawings furnished by OWNER/VENDOR. Suitable brackets, angle/channel section for wall mounted equipment shall be provided by the CONTRACTOR. 3.7 The tests to be carried out on the equipment at pre-commissioning stage shall include following but not limited to the following: (a) Checking of continuity of the system. (b) Checking safe accessibility of all operating points (c) Check availability of control auxiliary supply. (d) Ensure availability of first aid box, fire fighting equipments, earth discharge rods, rubber mats, rubber glove. (e) Placement of shock treatment chart, danger boards provision of boards indicating 'Man on work' 'Do not switch ON' 'Do not switch OFF'. 'EARTHED' etc.		
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4.0 <u>SAFETY MATERIAL</u> 4.1 The Contractor shall supply and install all danger plates as per IS: 2551. The danger plates shall be written in Hindi, local language and English and shall be provided as required for Electrical equipment. 4.2 Rubber mats of checkered profile shall be laid before each switchboard in all switchgear rooms. They shall be suitable voltage grade and of black colour. In the switchgear room and inside plant area, first aid boxes shall be supplied as per the requirements of Indian Electricity Rules & Regulations. 4.3 The Contractor shall supply and install steel buckets with stand as per applicable standards near oil filled equipment such as Transformers. The bucket shall be painted red. The bucket shall be filled with sand. 4.4 The Contractor shall provide guards and prominently display caution notices if access to any equipment / area is considered unsafe and hazardous. 4.5 The Contractor shall provide shock treatment chart, danger notice boards and portable fire extinguisher in each switchgear room and control room. 5.0 <u>TESTING AND COMMISSIONING</u> 5.1 The Contractor shall take full responsibility of testing at erection, pre-commissioning and commissioning stages of all the equipment/system system being installed by him. The Contractor shall submit to the Engineer a checklist for testing and commissioning and the activities shall be carried out in accordance with the checklist. The Contractor shall carry out the commissioning tests and checks after erection at site as per applicable standards and also as recommended by the Manufacturers. 5.2 On completion of erection work, the contractor shall request the Owner for inspection & test. The Owner shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor. The installation shall be then tested and commissioned in presence of the representative of Owner and put on trial run for stipulated contract period. 5.3 The Contractor shall arrange for inspection of his installation work by Electrical Inspector and shall obtain necessary approval certificate for his installation work. Any modification work required by Electrical Inspector must be undertaken by the Contractor at his own cost. All rectification, repair or adjustment work found necessary during inspection, testing, commissioning and trial run shall be carried out by the Contractor without any extra cost. 5.4 The Contractor shall have to bring all testing equipment & instruments in sufficient numbers to carry out the job simultaneously in more than one area.		
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Tests shall be conducted by qualified & experienced personnel. Valid calibration certificates for the testing equipment shall be produced. 5.5 All documents/records regarding test data and all other measured values shall be submitted to Engineer for approval and subsequent record and reference. The results of all tests shall conform to the specification requirements as well as any specific performance data guaranteed during finalisation of contract. 5.6 All checks and tests as per the Manufacturer's drawings/manuals, relevant code of installation and commissioning check lists for various electrical equipment e.g. Transformers, breakers, motors, switchgear, relays, meters etc. shall be carried out. 5.7 The Contractor shall perform operating/functional tests on all switchgear and panels to verify operation of switchgear/panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal AC or DC voltage to the circuits and operating the equipment for functional checking of all control circuits, e.g., closing, tripping, control interlock, supervision and alarm circuits. All connections in the switchgear shall be tested from point to point for possible grounds or short circuit. 5.8 The Contractor shall ensure the continuity of all conductors and joints. The Owner may ask for earth continuity tests, earth resistance measurements and other tests which in his opinion are necessary to prove that the system is in accordance with the design, specifications, code of practice and Electricity Rules. 5.9 All site connections and shortings and interpanel wiring etc. required to be carried out at site on terminals of any electrical equipment shall be carried out by the CONTRACTOR at no additional cost. 5.10 Insulation resistance tests shall be carried out by following rating meggers: (a) Control circuits upto 220V : by 500 V megger (b) Power circuits, bus bars, connections upto 11kV : by 1000V megger (c) Power circuits, bus bars, connections above 11kV & upto 33 kV : by 2500V motor operated megger (d) Power circuits, bus bars, connections above 33 kV : by 5000V motor operated megger		
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5.11	The BIDDER shall make available the following Testing and Commissioning equipment for testing and commissioning of various equipment in the plant in general: a) 500V and 1000V hand operated meggers b) 5000V/2500V motor operated meggers. c) Earth resistivity testing equipment d) Phase sequence indicators e) Frequency meters f) Micrometers g) High potential testing sets suitable for testing cables upto 11 kV grade complete with rectifier stack, instruments and control h) Miscellaneous instruments/accessories like clip-on ammeters, voltmeters, watt meters, multi-meters, power factor-meters, time-interval meters, single-phase and three-phase variacs, portable transformers, switches etc i) Continuity testers j) Primary injection equipment k) Secondary injection testing kit l) Insulating oil breakdown test set with accessories m) Equipment for measuring the thermal resistivity of the soil n) Transformer oil filtration equipment. o) Relay test kits p) Breaker timing device for Circuit breaker opening/closing time measurement q) CT & VT testing apparatus r) Low resistance measuring instrument s) Partial discharge measuring equipment	
5.12	The OWNER's authorised representative shall be present during every test as called for by the OWNER. The CONTRACTOR shall record all test values and furnish the required copies of the test data to the OWNER. Electrical circuits and equipments shall be energised or used at normal operating voltage only after such reports have been accepted as satisfactory by the OWNER.	
5.13	Typical checks to be carried out at site are listed in item below.	
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a) Cable trays - Check for installation as per layout drawings, cable installation notes, specification etc. - Check for proper separation between groups and proper sequence between safety & non-safety trays, power and control trays. - Check the alignment and spacing of trays. - Check for proper painting and identification numbers of the cable trays - Check for continuity of power and C&I cable trays over the entire route. - Check for proper application of fire break coating and its location in the tray routing. - Check that all sharp corners, burrs and waste materials have been removed from the trays. - Check for interference with reference to piping and ducting for proper clearance. - Check for proper seating/ installation of cable tray covers and tightness of clamps for covers. - Check for proper installation of fire barriers in the cable tray routes. - Check for earth continuity and earth connections of cable trays. - Check for physical damage. b) Cables - Preliminary Checks as per specification & physical damage - Commissioning Check for Megger test between each core and armour/sheath Megger test between all cores. Continuity check Connections c) Earthing - Measure resistance of earth pit/electrode by isolating the same from station grid as well as from other earth pits/electrodes and then measure resistance of two earths at a time by D.C. drop method. - Check continuity of grid conductors and wires. - Overall resistance measurement of the earth grid. d) Miscellaneous Systems - Emergency stop push button box - Wiring done as per approved scheme - Functional check - Continuity and IR check (1mega ohm with 500V megger). - Tests on the lighting system shall be conducted by the CONTRACTOR as specified in Lighting Installation Notes forming part of this specification.		
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	TITLE ERECTION, TESTING & COMMISSIONING OF ELECTRICAL SYSTEM																																	
6.0 <u>SAFETY PROCEDURE</u> 6.1 Contractor shall have safety plan and procedure complying with the relevant standards which must be followed strictly including engagement of certified safety officers/ supervisors to control and monitor safety aspects during execution of the work. They shall also follow OWNER/ ENGINEER's requirement of safety as applicable. 6.2 Contractor shall carry out safety training program regularly at site for his personnel and workmen before any execution work is taken up. 6.3 It is the responsibility of the CONTRACTOR to arrange safety shoes, helmets, safety goggles, welding protectors, safety belts, flash proof dress, grounding equipment etc as required. 7.0 <u>STANDARDS</u> 7.1 The applicable standards for installation and testing of equipment are indicated in the table below: <table><tr><td>(a)</td><td>Installation and Maintenance of Induction Motors</td><td>:</td><td>IS:900</td></tr><tr><td>(b)</td><td>Guide for safety procedures and Practices in Electrical work</td><td>:</td><td>IS:5216</td></tr><tr><td>(c)</td><td>Hot dip galvanising</td><td>:</td><td>IS:2629</td></tr><tr><td>(d)</td><td>Electrical wiring installations for voltages > 650V</td><td>:</td><td>IS:732</td></tr><tr><td>(e)</td><td>Fire safety of buildings (General) – Electrical Installations</td><td>:</td><td>IS:1646</td></tr><tr><td>(f)</td><td>Installation and maintenance & supervision of transformers</td><td>:</td><td>IS: 10028</td></tr><tr><td>(g)</td><td>Danger notice plates</td><td>:</td><td>IS: 2551</td></tr><tr><td>(h)</td><td>Electrical maintenance of mineral insulating oil in equipment</td><td>:</td><td>IS: 1866</td></tr></table>			(a)	Installation and Maintenance of Induction Motors	:	IS:900	(b)	Guide for safety procedures and Practices in Electrical work	:	IS:5216	(c)	Hot dip galvanising	:	IS:2629	(d)	Electrical wiring installations for voltages > 650V	:	IS:732	(e)	Fire safety of buildings (General) – Electrical Installations	:	IS:1646	(f)	Installation and maintenance & supervision of transformers	:	IS: 10028	(g)	Danger notice plates	:	IS: 2551	(h)	Electrical maintenance of mineral insulating oil in equipment	:	IS: 1866
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	TITLE SPARES	
<u>STARTUP, ESSENTIAL AND RECOMMENDED SPARES</u> 1.0 <u>Spares</u> 1.1. The BIDDER shall include in his scope: (a) Start-up Spares as necessary and (b) Essential spares as specified and (c) Recommended spares. A detailed list of Recommended Spares shall be furnished by the BIDDER. However, it shall be noted that Recommended Spares will not be considered in the Bid evaluation. 1.2. The spares supplied shall be directly interchangeable with parts for which they are intended for replacement. 1.3. The spares shall be treated and packed for long storage (minimum 5 years) under the climatic conditions prevailing at the site. 1.4. The BIDDER shall indicate the service expectancy periods for all the spare parts in terms of hours of operation under normal operating conditions after which replacement will become necessary. 2.0 <u>Start-Up Spares</u> The Start-Up Spares are those spares which will be required during start-up and commissioning of the equipment/systems until the equipment/systems are handed over to the OWNER after completion of performance testing. The prices of the Start-Up Spares shall be included in the lumpsum supply price of the total system. An adequate stock of Start-Up Spares shall be available at the site such that the start-up and commissioning of the equipment/systems, performance testing and handing over the equipment/ systems to the OWNER can be carried out without hindrance or delay. All Start-Up Spares which remain unused after the taking over the plant shall remain the property of the OWNER. The BIDDER shall furnish the Schedule of Start-up Spares with unit prices. BIDDER's quoted lumpsum price for the supply of the equipment shall be inclusive of the cost of Start-Up Spares. 3.0 <u>Recommended Spares</u> 3.1. BIDDER shall furnish in his bid a list of Recommended Spares with unit prices. The OWNER reserves the right to buy any of the Recommended Spare parts as considered necessary by him. 3.2. The Recommended Spares shall include the following: a) Spares to be stored in the power station for Five (5) years trouble free operation. b) Any strategic spares or consumables which the VENDOR recommends the OWNER to hold to avoid delay in return to service following a breakdown. Justification for such holdings shall form part of the tender submission. ISSUE P1		

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	TITLE SPARES	

3.3. Spares held off-site by the Manufacturer in his works shall not be included in Recommended Spares list. BIDDER can however indicate the details of such spares normally held by him.

3.4. The price of the Recommended Spares shall be kept firm up to twelve (12) months from the expiry of the validity of the offer for main equipment. Purchase of these spare parts will be covered by a separate order or an amendment to the contract and will be normally considered for ordering only after the receipt of the complete information such as instruction manuals/general arrangement and spares identification drawings, etc. for the equipment from the VENDOR to enable the OWNER to finalise the exact requirements. Subsequent to placement of order for Recommended Spares, VENDOR shall furnish details/dimensional drawings for all such spares.

3.5. The VENDOR shall guarantee to the OWNER that before going out of production of spare parts for the equipment furnished, he shall give at least twelve (12) months advance notice to OWNER so that the latter may order his requirement of spares in one lot if he so desires.

4.0 Essential Spares

Essential / Mandatory spares are the spares to be included in scope of Bidder and shall be included in lumpsum supply price of the total system. The list of spares to be included are indicated in Table – 1 below. If any of the spare indicated is not applicable to Bidder's design, the quantity of that spare shall be indicated as "0" and clarification shall be provided in the remark's column. Bidder to furnish the unit prize against each spare

TABLE – 1: List of Essential spares

<u>SL.NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1.0	<u>22 KV SWITCHYARD</u>	
1.1.	Insulators	1 set of each type & rating
1.2.	HT Fuse	1 set of each type & rating
1.3.	Limit switch	2 sets
1.4.	Contact fingers for male & female contacts	2 sets

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	TITLE SPARES	
2.0	<u>415 V SWITCHGEAR / DISTRIBUTION BOARD</u>	
2.1.	MCCB with Accessories	1 No of each type & rating
2.2.	MPCB with Accessories	1 No of each type & rating
2.3.	Overload Relay (OLR)	1 No of each type & rating
2.4.	Contactors	3 Nos of each type & rating
2.5.	Current Transformer	3 Nos of each type & rating
2.6.	Voltage Transformer	1 No of each type & rating
2.7.	Fused	3 Nos of each type & rating
2.8.	MCB	3 Nos of each type & rating
2.9.	Indication Lamps	3 Nos of each type & rating
2.10.	Meters	1 No of each type & rating
2.11.	Switches	3 Nos of each type & rating
2.12.	Push button	3 Nos of each type & rating
2.13.	Interposing relay (IPR)	3 Nos. of each type & rating
2.14.	Terminal Blocks	1 set of each type & rating
2.15.	Internal wiring control cables	1 coil for each type
3.0	<u>METERING PANEL</u>	
3.1.	Meters	1 No. of each type & model installed
3.2.	Indicating Instruments	2 Nos. of each type & model installed
3.3.	Timer	1 No of each type

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3.4.	Indicating lamps	20% of each type
3.5.	Selector switches, push buttons	2 Nos. of each type
3.6.	MCBs	2 Nos. of each type & model installed
3.7.	Test block/Test jack (where applicable)	1 No.
4.0	<u>BATTERIES & CHARGERS</u>	
4.1.	Complete set of Spare battery cell	2 Nos.
4.2.	Set of Control Cards	1 Set
4.3.	Set of switches	1 set
4.4.	Fuses	2 sets of each type and rating
4.5.	SMPS module	1 No.
4.6.	Meters	1 No.
4.7.	MCB	1 No of each type & rating
5.0	<u>MV CT PT PANEL</u>	
5.1.	Current Transformer	1 set of each type & rating
5.2.	Voltage transformer	1 set of each type & rating
5.3.	HT Fuses	2 sets of each type & rating
5.4.	MCB/MCCB	2 Nos of each type & rating
5.5.	Indication Lamps	3 Nos of each type & rating
5.6.	Terminal Blocks	2 sets of each type & rating
5.7.	Internal wiring control cables	1 coil for each type

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	TITLE SUB VENDOR LIST	

<u>SL.NO.</u>	<u>DESCRIPTION OF EQUIPMENT</u>	<u>ACCEPTABLE MAKE / SUB-VENDOR</u>
1.0	<u>ELECTRICAL</u>	
1.1.	LV Switchgears	• L&T • Siemens • Schneider Electric • ABB • Hitachi • GE • C&S
1.2.	Lightning Arrestor	• ABB • LAMCO • CGL • RAYCHEM • OBLUM
1.3.	Batteries	• Amara Raja • EXIDE • HBL
1.4.	Battery Charger / DC System	• Amara Raja • HBL • Vertiv • Chloride Power
1.5.	MV/LV - CT/PT (cast resin)	• Pragati Electricals • AE • Kappa • Schneider • CGL / Indicoil • Vidyut Udyog • Electrical Control & Systems • (Make Approved by MSETCL)
1.6.	MV Switchgears	• ABB • Hitachi • SIEMENS • Schneider Electric
1.7.	Meters	• AE • ABB • MECO • RISHABH • SCHNEIDER • SIEMENS • Secure Meters
1.8.	MFM	• AE • ABB

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	TITLE SUB VENDOR LIST	

<u>SL.NO.</u>	<u>DESCRIPTION OF EQUIPMENT</u>	<u>ACCEPTABLE MAKE / SUB-VENDOR</u>
		• MECO • RISHABH • SCHNEIDER • SIEMENS • Satec
1.9.	Tariff meter / Revenue Meters (KWH/TVM)	• Secure • L&T • (Make Approved by MSETCL)
1.10.	Tariff meter / Revenue Meters Panel	• Secure • (Make Approved by MSETCL)
1.11.	Protection Relays	• ABB • Siemens • GE • Alstom • Toshiba • SEL
1.12.	Protection Relays (LV System)	• ABB • Siemens • GE • Alstom • Schneider • Ashida • Toshiba
1.13.	LV Power Cables	• Finolex • Universal Cables • Nicco Corporation • Polycab • KEC/RPG • Cable Corporation • KEI Cables • Torrent
1.14.	Cable Trays & Accessories	• INDIANA • PATNI • RELIANCE • SADHNA • STERLITE
1.15.	Control Panels	• Rittal • Pyrotech Controls (I) Pvt. Ltd. • Industrial & Commercial Enterprises • Positronics Pvt. Ltd.

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	TITLE DRAWINGS / DOCUMENT SUBMISSION	
<u>SWITHYARD</u> 1.0 <u>Drawings / Documents to be submitted during Bid Submission.</u> 1.1. Technical offer 1.2. Catalogues/drawings and datasheets for major item 2.0 <u>Drawings / Documents to be submitted After Award of Contract</u> 2.1. Equipment General arrangement drawings & layouts 2.2. Detailed data sheets 2.3. Sizing calculations 2.4. Wiring drawings & BOQs 2.5. Erection drawings 2.6. Loading details 2.7. Test certificates 2.8. Quality assurance plan 2.9. Operation & maintenance manual 3.0 <u>Drawings / Documents to be submitted After Award of Contract</u> 3.1. General outline drawings showing plan, front elevation, and side elevation, with all fittings and accessories, foundation details and weights 3.2. Rating and diagram plate drawing 3.3. Wiring diagram of marshalling box 3.4. Catalogues of the temperature sensors and scanners/indicators 3.5. Quality assurance plan for PURCHASER'S approval 3.6. Test certificates <u>LV INDOOR SWITCHGEAR</u> 4.0 <u>Drawings / Documents to be submitted during Bid Submission.</u> 4.1. Technical offer 4.2. Dully filled Datasheet B 4.3. Type test certificate of similar type of comparable rating. 4.4. General Arrangement drawings of LV Switchgear 4.5. Vendor list 4.6. Catalogues of LV Switchgear and its accessories.		
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	TITLE DRAWINGS / DOCUMENT SUBMISSION	
4.7. Transportation details 5.0 <u>Drawings / Documents to be submitted After Award of Contract</u> 5.1. General arrangement drawings 5.2. Detailed data sheets 5.3. Sizing calculations 5.4. Wiring drawings, TBs & BOQs 5.5. Erection drawings 5.6. Loading details 5.7. Catalogues & product manufacturer technical information 5.8. Test certificates 5.9. Quality assurance plan 5.10. Transportation & packaging details 5.11. Instruction manuals 5.12. Operation & maintenance manual <u>METERING PANEL</u> 6.0 <u>Drawings / Documents to be submitted during Bid Submission.</u> 6.1. Technical offer 6.2. Dully filled Datasheet B 6.3. Type test certificate of all major items. 6.4. Vendor list for various components, fittings and accessories. 6.5. Catalogues of meters, models & major items. 6.6. Supporting documentation for MSEDCL approvals 7.0 <u>Drawings / Documents to be submitted After Award of Contract</u> 7.1. Complete panel drawings (GA, Wiring, TBs, BOQs, etc.) 7.2. Data sheets 7.3. Test Certificate 7.4. Quality assurance plan 7.5. Operation & maintenance manual		
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9.15. Instruction manuals C. <u>DC SWITCHGEAR</u> 9.16. Complete assembly drawings of the switchgear showing plan, elevation, typical sectional views of equipment mounted in each module and location of terminal blocks for wiring connections, cable entry slots, etc. 9.17. Foundation plan showing location of channels, sills, foundation bolts, etc. 9.18. Complete wiring diagrams including terminal wiring designations of each module including all spare terminals and inter-modular and inter panel wiring. 9.19. Itemised bill of material for each module, listing all devices mounted indicating MANUFACTURER's type, rating quantity, etc. 9.20. Test certificates in respect of major component equipment and complete switchgear assemblies. 9.21. Operation and maintenance manual for individual equipment and for complete switchgear. 9.22. Quality assurance plan <u>CABLE & CABLING SYSTEM</u> 10.0 <u>Drawings / Documents to be submitted during Bid Submission.</u> 10.1. Technical offer 10.2. Data sheet for cables 10.3. Vendor list for various components, fittings and accessories. 11.0 <u>Drawings / Documents to be submitted After Award of Contract</u> 11.1. Data sheet for cables & trays 11.2. GA of trays & construction / cross section of cables 11.3. Test certificates 11.4. Quality assurance plan <u>EARTHING & LIGHTNING SYSTEM</u> 12.0 <u>Drawings / Documents to be submitted during Bid Submission.</u> 12.1. Technical offer 12.2. GA of Earth electrode 12.3. Vendor list for various components, fittings and accessories. 13.0 <u>Drawings / Documents to be submitted After Award of Contract</u>		
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17.2. Data sheets

17.3. Test Certificate

17.4. Quality assurance plan

17.5. Operation & maintenance manual

CONSTRUCTION POWER SUPPLY

18.0 Drawings / Documents to be submitted during Bid Submission

- 18.1. Tentative power supply requirement details
- 18.2. Details of power supply details

19.0 Data to be furnished by vendor after award of contract

- 19.1. Contractor shall furnish the electrical scheme, for Owner approval the distribution of construction power supply.
- 19.2. Contractor shall supply and install firefighting equipment as per the regulations of the local electrical inspectorate / statutory bodies for the temporary electrical installation.

NOTES:

- (a) The CONTRACTOR shall be entirely responsible for the correctness of the internal wiring diagrams.
- (b) The vendor shall furnish specified number of copies of the instruction manual which would contain detailed step by step instructions for all erection, operational and maintenance requirements. The manual shall include, among other information, the following aspects:
 - Storage for prolonged duration
 - Unpacking
 - Handling at site
 - Erection
 - Pre-commissioning tests
 - Operating procedures
 - Maintenance procedure
 - Precautions to be taken during operation and maintenance work.
 - Outline dimension drawings showing relevant cross-sectional views and constructional features.
 - Catalogue numbers of all components liable to be replaced during the life of the switchgear.

ISSUE P1

THE TATA POWER COMPANY LIMITED

STANDARD TECHNICAL SPECIFICATION FOR GENERAL REQUIREMENTS OF QUALITY ASSURANCE & INSPECTION

[SHALL BE A PART OF GENERAL TECHNICAL CONDITION]

(DOCUMENT NO - TPQAIT-QAXX-00-GN-QSP-214 R4)



Tata Power

Rev. No	Date	Description	Prepared By	Checked By	Approved By
R04	03/09/2021	Revision	DP/RP R.P.	SR/RS	CRB/CPT
R03	20/07/2020	Revision	SR	RP	CRB
R02	10/05/2017	Revision	DP /RP/RG/PU	SKJ/ RM/CRB	SS
R01	21/07/2016	Revision	SKJ / DP	RG	SS
R00	21/04/2015	First Issue	RG / SKJ / PU	SS	SS

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1.0 PURPOSE

Purpose of these requirements is to provide uniform general requirements for implementation of Quality Management System for projects being executed by OWNER.

2.0 SCOPE

- 2.1 Scope of these requirement covers pre-requisites of the Bidder's/ Supplier's/ Contractor's Quality Management System (QMS) applicable for all phases of contract execution including design, procurement, manufacture, factory testing, erection, field testing and commissioning, applicable other services and further to establish specific factors for which control shall be carried and put into continuing operation by the Bidder/ Supplier /Contractor to ensure that all supplies and services comply with the contract requirements.
- 2.2 The required/ specified reliability & other characteristics of quality should initially be "designed in" and then "built in". It is emphasized that, satisfactory product and system performance can be achieved only through strict control of all design, manufacturing and erection/ installation processes as well as test and inspection.
- 2.3 During bid stage itself, BIDDER shall submit requisite documents to demonstrate that as a supplier/ contractor they have well defined and implemented QMS. They shall also establish that their QMS is taking care of their sub-supplier/agencies, and continually improve its effectiveness in accordance with the requirements of their QMS as per ISO 9001, or any other quality standard.

BIDDER shall submit a project specific organization chart defining the permanent positions responsible for QMS accompanied by a brief description of each position's function and responsibility.

3.0 DEFINITION

- **OWNER**

Tata Power or its subsidiaries/ JV partners.

- **BIDDER**

An organization/ agency, who propose to submit their offer against RFQ/enquiry floated by OWNER. Only successful bidder will be converted to supplier/ contractor on award of contract by OWNER.

- **Supplier / Contractor**

An organization referred as Supplier/ contractor, who execute the contract awarded by Contracts department of OWNER. It also covers the Agency involved in execution of site/ field activities or provides services (as a contractor) when awarded by Contracts department of OWNER. A Supplier can also be a manufacturer for part of supply for his in-house products.

- **Sub-Supplier/ Sub-vendor**

An organization, who manufactures, supplies the system or equipment or item and provides services to the supplier. It also covers manufacturer who manufactures and supplies the equipment or its components or items to the sub-suppliers to complete the system supply. It

should also cover the agencies which also support execution of main supplier by providing qualified manpower/ services.

- **Third Party Inspection Agency (TPIA)**
Any third-party organization or neutral agency mutually agreed, deputed for conducting inspection or quality surveillance activities on case to case basic.
- **Inspection Agency (IA)**
An organization or any agency deputed by OWNER for conducting inspection or quality surveillance activities on behalf of OWNER on case to case basic.
- **Inspection Categorization Plan (ICP)**
This document shall categorize the Quality Plan and Inspection scope of all equipment/ items in the package. This will also include the schedule for submission and approval of all Quality related documents.
- **Standard Quality Plan (SQP)/ Standard Field Quality Plan (SFP)**
SQP shall comprise of minimum basic requirements of all tests/ checks to be carried out during manufacturing to meet/ conform technical requirement. SQP may be in the form of Inspection & Test Plan (ITP)/ Technical Specification as part of Bid Document.
Similarly, SFP shall comprise of minimum basic requirements of all field tests/checks to be carried out during execution of the project.
- **Manufacturing Quality Plan (MQP)**
MQP shall comprise of all tests/ checks indicated in standard Quality Plan (SQP) and tech specifications. It shall also include any additional quality checks/ tests required as per discussions (pre & post bid) to be followed during manufacturing of particular item/ equipment.
- **Field Quality Plan (FQP)**
FQP shall detail out the activities and steps to be performed at project site and shall be followed from receipt of material to pre-commissioning stage. Shall include all tests / checks in Standard Field Quality Plan (SFP) & technical specification. FQP shall be prepared by contractor and to be submitted to OWNER at post award stage of contract for OWNER's approval.
- **Hold Point/ Customer hold point (CHP)**
A check point for an activity mentioned in approved MQP/ FQP, which requires inspection/ verification, and acceptance by the OWNER or its representative for this stage before any further work is permitted.
Supplier shall not process beyond a CHP without written acceptance & clearance of that activity by OWNER in writing.
- **Witness Point**
A check point for an activity mentioned in the approved MQP/ FQP, which will be witnessed by OWNER or its representative.
Supplier will obtain consent from OWNER to proceed for further work, in case OWNER or its representative is not able to attend the activity within notification period.

- **Review / Verification Point**

A check point for an activity mentioned in the approved MQP/ FQP that requires review of document/ test record by OWNER or its representative performed by the Supplier for acceptance.

- **Test Report Record**

Such reports / records are document prepared by Supplier/ Sub-Supplier for test/ check conducted indicating details / types of test including test results, relevant codes etc.

- **Inspection Report (IRT)**

Such report which covers details of all the checks / activities carried out as per approved MQP. It also covers details of the observations and NCRs during those checks / inspection.

- **Inspection Release Note (IRN)**

IRN is a document issued on standard format after successful quality checks/inspection and confirming to compliances of all observations and NCs if any.

- **Non-Conformity Report (NCR)/ Quality Correction Action Report (QCAR)**

It is a report on deviation/ non-compliance with respect to the requirements laid down in the PO/ Technical Specification, MQP, Codes & standards. NCR shall be applicable during inspection at Shop as well during site Audits and QCAR shall be applicable for site inspection / surveillance.

4.0 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder/ Supplier /Contractor's works or at his sub-vendor's premises or at site or at any other place of work are in accordance with the specifications, Bidder/ Supplier/ Contractor shall adopt suitable project specific QMS based on his organization's Quality Management System, regular practice, statutory requirements etc. as specified for the contract and submit the same for approval of OWNER, to control such activities at all points, as necessary. Such program shall be outlined by the Bidder/ Supplier/ contractor. Any deviation with respect to all above requirements (as specified in SQP, SFP, Technical specification as minimum quality requirements) shall be brought out clearly in the pre-bid stage by bidder.

4.1 OWNER Quality Document Approval Process & Inspection Process

OWNER uses Wrench software as an online platform for Engineering and Quality documents approval. Further, raising inspection call for STAGE / FINAL inspection for Category A items, Document review and material clearance for Cat B & Cat C items shall also be processed through Wrench. Access for Wrench system and necessary user training will be imparted to the authorized personnel of the supplier post award of contract.

5.0 SUPPLIER QUALITY MANAGEMENT SYSTEM (QMS)

- 5.1 All materials, components and equipment covered under the contract including bought out items shall be procured, manufactured and tested at all the stages as per a comprehensive Quality Assurance Program. It is the Bidder/ Supplier / Contractor's responsibility to draw up and implement such program duly approved by the OWNER.

- 5.2 All items/equipment in the scope of the contract shall be classified into categories according to the criticality or other attributes of items/ equipment. A detailed proposal addressing vendor approvals and quality control of all such items/ equipment shall be proposed to OWNER for approval.
- 5.3 The detailed quality plans for shop manufactured items and for field activities including civil works (if applicable) shall be drawn up by the Bidder/ Supplier / Contractor separately as per the requirement of the specification, standards mentioned therein, quality practices and procedures followed by Supplier's/ his sub vendor's quality control department. MQP shall be prepared by manufacturer and submitted through supplier post award stage of contract for OWNER's approval. OWNER approved MQP to be referred during manufacturing & shop inspection. Typical format of Manufacturing Quality Plan is enclosed as **Exhibit A**.
- 5.5 Field quality plans shall detail out for all equipment, the quality practices and procedures etc. to be followed by the execution agency, during various stages of site activities right from receipt of materials/ equipment at site to commissioning stage covering receipt, storage, erection & pre-commissioning tests. It shall comprise of all tests / checks indicated in SFP & Technical Specification including any additional quality checks / tests required as per discussions (pre & post bid). It shall also take care of minimum basic requirement of OEM/manufacturer (as the execution agency may not be part of OEM/manufacturer). OWNER approved FQP is to be referred during execution of work. FQP shall have 5 stages: Receipt, Storage, Pre-erection/ pre-fabrication, Erection/ Execution and pre commissioning checks with categorization of checks as Critical (Cr), Major (Mj) and Minor (Mn). Typical format of Field Quality Plan is enclosed as **Exhibit B**.
- 5.6 In these approved manufacturing and field quality plans, OWNER shall identify "Customer Hold Points" & "Witness Points". "Customer Hold Points" are test/checks which shall be carried out in presence of the OWNER's Engineer or its authorized representative and beyond which the work shall not proceed without consent of OWNER/ its authorized representative in writing. "Witness Points" are tests/checks which shall be carried out in presence of the OWNER's Engineer or its authorized representative but the work can proceed to next operation/ stage in case OWNER's Engineer doesn't attend on the mutually agreed date. The above procedure shall be applicable to the Bidder/ Supplier / Contractor's bought out equipment/ items also.
- 5.7 All the critical & major items shall be procured from the sub-vendors approved by OWNER. A tentative/ preferred list of sub-vendors for some of the items are indicated in Technical Specification. Based on which Bidder/Supplier/Contractor shall propose a list of sub vendors for bought out items for approval from OWNER. Detailed list of such sub-vendors offered by supplier/vendor/contractor shall be submitted not later than 7 days after the LOI/ Placement of order whichever is earlier and shall be frozen within 15 days of submission. Request for additional sub-vendors shall not be entertained from the Bidder/ Supplier / Contractor after the sub-vendor list is finalized and frozen. Only in case of Force Majeure Condition, Supplier/ contractor shall establish such condition and propose new/ alternative source. Contractor / supplier shall provide requisite documents for consideration of OWNER. OWNER has right to accept/ reject based on review of details. If required, physical assessment shall be made before conveying such decision. Delays arising out of such exercises shall be entirely to the account of Supplier/ Contractor and shall not relieve him from any obligation, duty or

responsibility under the contract. For intended manufacturer/ sub-vendors/ sub-suppliers, credential / details to be submitted are as indicated below:

- i. Company Profile.
- ii. Name of the equipment proposed for approval with rating / capacity.
- iii. Financial reports for the past 3 years.
- iv. Organizational structure (including QA/QC set-up, man-power & qualification details).
- v. In-house design capability, R&D facility & Technical collaborations (if any).
- vi. In house manufacturing facilities (Including process flow charts).
- vii. In house Testing facilities.
- viii. Type Test Reports (as applicable).
- ix. List of sub-suppliers for critical/major Raw material & bought out items.
- x. In-coming material inspection plan and manufacturing quality plan.
- xi. Certification by reputed agencies (ISO/ NABL/ NSIC/ ASME/ CE/ UL/API etc.) & government agencies (Factory licenses).
- xii. Product approval certificates from other customers and regulatory Authority etc.
- xiii. In case of non- ISO Company, details of quality system followed.
- xiv. Experience (Past track records) for last 3 yrs. for similar product from the facility.
- xv. Performance certificates issued by other customers.
- xvi. Customer / Supplier complaints handling and resolution records
- xvii. After Sales / Services details
- xviii. Details of out-sourced activities, if any.

5.8 Non-Conformance Report (NCR) / Quality Correction Action Report (QCAR)

Wherever the non-conformity is found during inspection either by Supplier or OWNER or its representatives, NCR / QCAR shall be issued in prescribed format. Manufacturer /Supplier shall indicate the Correction / CAPA and submit these NCRs/QCARs to OWNER or its representative for their review & resolution. Till such time identified item/ equipment will be kept under quarantine. Upon satisfactory completion of the rectification work, final acceptance of the item/equipment shall be documented on the NCR/QCAR format.

Supplier has to close all NCR / QCAR in systematic & time bound manner including all corrective and preventive actions. Job shall progress only after effective resolution of NCR / QCAR.

Note: If OWNER observes that any material or equipment is unacceptable with respect to potential safety, reliability, interchangeability or workmanship, OWNER shall issue a non-conformance report NCR / QCAR in this regard to the Supplier/ Contractor. Such NCR/QCAR shall be dealt as above.

- 5.9 No material shall be dispatched from the Bidder's/ Supplier's/ Contractor's /manufacturer's works before the dispatch instruction is given in writing by the OWNER, Subsequent to pre-dispatch inspection including verification of records of all previous tests/ inspections by OWNER/ authorized representative. Any such item/material dispatched by party without clearance from OWNER shall be at suppliers' risk & cost only. No IRN/ dispatch clearance shall be issued for the same as post facto.
- 5.10 OWNER or its nominated representative reserves the right to carry out quality audit/ quality surveillance of the systems and procedures of the Bidder/ Supplier/ Contractor's or their sub-vendor's Quality Management System and control activities without prior intimation. The Bidder/ Supplier/ Contractor shall provide all necessary assistance to OWNER or its nominated representative to carry out such audit/ surveillance.

- 5.11 The Bidder/ Supplier/ Contractor shall be responsible for providing, controlling, calibrating, and maintaining the 'measuring & test equipment' required by them for demonstrating compliance of supplies within contract requirements at shop and at site. All the measuring instruments shall be calibrated at periodic intervals determined by Bidder/ Supplier/ Contractor/ sub-vendor on the basis of his suitability, purpose and usage as per the system adopted by him for calibration of such measuring and test equipment. However, in no case, shall the interval between successive calibrations be more than 12 months. All measuring and test instruments shall have valid calibration certificates and calibration data shall be made available to OWNER or its nominated representative on demand.
- 5.12 Quality surveillance/ approval of the results of the tests and inspection shall not, however, prejudice the right of the OWNER to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder/ Supplier / Contractor in ensuring complete conformance of the materials/ equipment supplied to relevant specification, standard, data sheets, drawings etc.
- 5.13 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable. Inspection of all mandatory spares and commissioning spares shall be in line with the approved MQP of respective equipment/item. Interchangeability Certificate shall also be part of quality records for all spares.
- 5.14 **Statutory Inspection**
Supplier to ensure that Equipment/ items which fall under statutory requirements of country where the equipment will be installed, shall be inspected by statutory authority like IBR etc. In case of imported items, statutory inspection will be carried out by the agency as nominated by Statutory Authority or Statutory authority of the country of origin. Original certificates endorsed by statutory authorities shall be submitted to Project Manager as identified in the contract.
Such items shall also be offered to OWNER for inspection irrespective of country of origin.
- 5.15 **Failure to Pass Tests**
If any item/ equipment fails to pass any test, the Bidder/ Supplier shall rectify or replace the same and, unless OWNER agrees to dispense with repetition of the test, shall repeat the test following a further notice. The cost and expense of any such retest shall be fully borne by the Bidder/ Supplier only.
- 5.16 Major repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the OWNER/ its authorized representative.
- 5.17 All tests shall be carried out to the satisfaction of the OWNER/ its authorized representative either in their presence or as agreed by OWNER. All reports/ protocols, site and shop inspection reports shall be developed specific to the requirements of the project which is acceptable to OWNER. The same shall be applicable to erection testing and pre-commissioning reports and protocols also.

Only tested, inspected and accepted (by OWNER) material as listed in PO / ICP shall be dispatched to project site. Any diversion of such accepted material without any prior approval shall be considered as deviation/ breach of contract and a minimum penalty of 5 times the cost of inspection will be levied.

- 5.18 Approval of any concession shall be the prerogative of the OWNER and approval of concession for a particular case shall not be set as a precedent.
- 5.19 All the equipment shall be of proven design and type tested. Valid type test reports shall be furnished to engineering for review and acceptance prior to offering equipment for inspection.
- 5.20 All documents/ reports/ records shall be issued either in English language or bilingual with English.

6.0 INSPECTION CATEGORIZATION PLAN, WELDING & NDT REQUIREMENT

6.1 Inspection Categorization Plan (ICP)

This document shall be prepared by supplier and to be submitted to OWNER for approval in attached standard format for all package items within 15 days of award of contract.

The schedule shall be prepared considering that all MQP should be approved at-least 15 days prior to start of any manufacturing activity and FQP with related procedures shall be finalized at least 15 days prior to dispatch schedule/ site mobilization.

ICP, MQP, FQP and related procedures shall form part of Master Drawing List (MDL)

All the items/equipment in the scope of the contract shall be classified into categories (A/ B/ C) according to the criticality or other attributes of items / equipment. A detailed proposal addressing vendor approvals and quality control of all such items /equipment shall be proposed to OWNER by the Supplier/ Contractor for approval.

Category “A”: Manufacturing Quality Plan (MQP) shall be approved by Tata Power. Stage &/ or Final Inspection including document review by EPC Contractor and Tata Power (or its appointed Inspection Agency) as per approved MQP.

Category “B”: Manufacturing Quality Plan (MQP) shall be approved by Tata Power Stage &/ or Final Inspection including document review by EPC contractor or Tata Power (in case no EPC Contractor) as per approved MQP. Inspection report of EPC contractor/ Supplier with supporting documents review by Tata Power.

Category “C”: Supplier shall carry out inspection as per their regular practice/ standard manufacturing quality plan. Supplier shall submit test report and COC (Certificate Of Conformance) to EPC Contractor/ Tata Power for approval/acceptance. COC shall be in standard format of Tata Power.

6.2 Welding & Non-Destructive Testing (applicable for shop as well project site)

- 6.2.1 Bidder / Supplier/ Contractor shall submit the following documents in requisite copies for review and approval of OWNER/ its authorized representative at least FOUR weeks prior to commencing fabrication/ manufacturing and finalize before start of job. All such submissions shall be made in ENGLISH language only.

- i. Welding procedures together with the relevant procedure qualification records.
- ii. Non-destructive testing procedures.
- iii. Heat treatment procedures.

- iv. Any other special procedure (as applicable) proposed to be used during project execution Welding procedures and welders' qualifications in accordance with the latest revision of ASME Boiler & Pressure Vessels Code, Section IX, (structural welding as per AWS D1.1) or equivalent standard covering all essential & non- essential variables shall be acceptable to OWNER.
- 6.2.2 Only qualified welders shall be deployed. Welders shall be qualified as per approved WPS in presence of OWNER/ its authorized representative. Electrode/ welding rod used at project site shall be of OWNER approved make. Supplier/ Contractor shall take prior approval.
- 6.2.3 Weld repair procedures are subject to approval of the OWNER. No welding is permitted on C.I. Castings. OWNER reserves the right to examine and witness acceptance tests, prior to and following weld repairs and subsequent post weld heat treatment, mechanical tests etc, at the material manufacturer/ Supplier works.
- 6.2.4 Should any of these welds prove to be defective on inspection, the number of welds to be tested in that system shall be twice that of originally selected. Should any of the second incremental welds prove to be defective, then 100 % of the welds in that system/ group shall be tested.
- 6.2.5 NDT operators shall be qualified in accordance with an agreed nationally accredited scheme such as the Personnel Certification in Non-destructive testing (PCN) scheme and shall be certified to level II or higher of that system.
- 6.2.6 Plate thickness $\geq 32\text{mm}$ (for structure), Plate thickness $\geq 25\text{mm}$ (for pressure vessel), Forging / Bar dia. $\geq 40\text{mm}$ (finished) shall be UT tested (Ultrasonic).

7.0 INSPECTION AT SHOP

7.1 Inspection Scope

The scope of inspection shall be as per Witness/ Hold Point as defined in approved MQP/ SQP. Supplier has to ensure that all applicable and agreed approved Drawings, Data Sheet etc. are available for any inspection and equipment used for measurement are calibrated. Supplier shall intimate all such cases in advance (as inspection rolling plan) and also through inspection call as per contract agreement.

7.2 Inspection Coordination

Supplier has to identify single point of contact for coordination of the entire inspection activities on behalf of Supplier/ sub-supplier. Supplier to ensure that monthly and 3 monthly rolling inspection plans are prepared and submitted in advance to OWNER by 1st working day of each month for effective inspection coordination.

7.3 Inspection Request

- 7.3.1 Depending upon the stages of inspection as agreed in manufacturing quality plan, supplier to send Inspection Request through Wrench system with approved inspection reference documents to OWNER Project Manager for inspection activities to be attended at supplier's /sub-supplier's premises. Supplier to confirm the possibility for conducting remote inspection through Video calling system (preferably MS Teams), if required. Further, supplier to discuss & confirm the readiness of material by submitting internal test reports of the item/ equipment offered for inspection, job readiness pictures and testing schedule

through email. Supplier has to give sufficient advance notice, as defined below for inspection of any stage. Contractor/Supplier to strictly adhere to notice period indicated below and the testing schedule shared. Any additional expenses incurred due to the improper planning at supplier end for travel/ accommodation shall be in Supplier / Contractors scope.

7.3.2 The minimum advance notice period for inspection shall be given below:

- i. Inspection within INDIA : 7 Days
- ii. Overseas (Outside India) Inspection : 30 Days

Supplier to strictly adhere the above mentioned minimum advance notice period.

7.3.3 Supplier shall plan the inspection visits required in a manner so as to achieve maximum inspection stages attended with minimum possible inspection visits/ time where-in more than one external inspection agencies are involved for single inspection activity, inspection by all agencies may be done concurrently.

7.4 Inspection Methodology

7.4.1 Suppliers shall ensure internal inspection before offering inspection to OWNER or its representative. Internal test certificates and previous stage inspection reports submitted for review and made available during inspection.

7.4.2 During inspection, Supplier to produce copies of the latest revision of the approved MQP along with drawings, Data Sheet, Standard and accepted type test reports as indicated in approved MQP / agreement to ensure that the inspection is carried out as per the latest revision and approved documents. **If required, supplier to arrange the necessary codes and standards for reference purposes.**

In case inspection cannot be completed or undertaken due to reasons such as non-readiness of material, back up documents, false inspection calls etc. then such reason shall be recorded in inspection report. **If supplier fails to offer the item / equipment for inspection as per the agreed date, supplier liable to pay for the time and expenses for the abortive visit of the OWNER or its representative.**

7.4.3 All inspection related documents i.e. mill test reports, supplier inspection/ tests reports, all inspection/ tests carried out including other records such as stress relieving charts, radiographic reports and other non-destructive testing records in accordance with provision of contract shall be submitted in original form. All such reports shall be duly endorsed/ certified by the main supplier.

7.4.4 Results of tests and copies of inspection report, test reports, original material test certificates (MTCs), calculations, performance curves etc. shall be promptly made available to the OWNER or its appointed representative by the Supplier, in accordance with this document and shall form part of the subsequent Manufacturers Test Record Book in accordance with the requirements of this document.

7.4.5 Supplier to ensure that all the materials are properly identified/ coded to confirm traceability and correlation purposes.

7.4.6 Supplier shall take special care including packing to protect the final painting and finish product (equipment / item) during handling, transportation, storage and execution stage so

that there is no damage occur. In case of any such damage, joint inspection to be carried out at site and necessary action to be taken.

- 7.4.7 Supplier to ensure finish product is properly identified after completion of inspection and are suitably recorded in Inspection Report by inspection engineer.
- 7.4.8 Corrosion testing as per ASTM A262 Practice E for Austenitic Stainless Steel and ASTM A923 Practice A and C for Duplex Stainless Steel components has to be carried out.
- 7.4.9 For rubber lining application, following checks shall be carried out on raw material for rubber – Grade identification, Tensile Strength, Elongation, Maximum Compression test, Ageing Test, Water Absorption test, Specific Gravity, Hardness, Ash Content, Bleed resistance, Ozone resistance test.

7.5 Inspection Report & Clearance

7.5.1 Inspection Report (IRT)

All inspection by OWNER or its appointed agency shall be supported by an inspection report as per the standard format (sample enclosed). Any shortcoming observed w.r.t. approved MQP/ Drawing/ Data Sheet / specification etc. shall be recorded as NCR. IRT shall have detail references of all such NCRs. All such inspection report / NCR shall be jointly signed by supplier and Inspection Engineer. IRT shall be issued to all concern including Supplier and Sub-supplier/ Manufacturer. Same will be uploaded in Wrench system by OWNER

7.5.2 Inspection Release Note (IRN)

IRN shall be issued through Wrench system by QA&I dept. to Project Manager of OWNER, only after satisfactory compliance for Inspection remarks.

IRN for Category 'A' item (as defined in ICP) shall be issued only after ensuring inspected Equipment / Item meets the requirements of the applicable documents and all NCs have been closed to the satisfaction of OWNER.

For Category 'B' items (as defined in ICP) IRN shall be issued through Wrench after review of supplier inspection report, compliance report and required applicable documents as per approved MQP & Closure of NCs if any are verified and accepted to the satisfaction of OWNER

For Category 'C' items (as defined in ICP), IRN shall be issued through Wrench after review of original manufacturer test certificates, Certificate of Conformance (CoC) from supplier/contractor in OWNER standard format and required applicable documents as per MQP approved by main supplier / as per their standard procedure are verified and accepted

7.6 Material Dispatch Clearance Certificate (MDCC)

Supplier shall obtain dispatch clearance certificate (MDCC) through Wrench from project / Plant Manager depending on the project progress and material requirement at site based on IRN prior to dispatch of any billable material/ equipment / item from Manufacturer place to OWNER Project Site / Plant. One set of Quality Dossier (hard copy) for which MDCC has been issued, shall be sent to project site along with material / equipment/ item.

MDCC is not required for material / equipment/ item/ Part supply which are dispatched from one sub-supplier works to another sub-supplier/ supplier works for further assembly and

testing (to make it billable). However, clearance in the form of Inspection Report (IRT) is needed in this regard.

8.0 QUALITY DOSSIER (FOR SUPPLY PORTION) [Package wise]

Supplier shall compile and submit all stage and final inspection reports as per approved MQP, duly reviewed and endorsed by inspection engineer for reference and records of OWNER. Documents shall be submitted with-in 4 weeks of issuance of final MDCC

Dossier shall consist of following documents, as minimum:

- i. Index Sheet
- ii. Approved bill of material of package.
- iii. All Approved documents (MQP, Drawings & Data Sheet etc.)
- iv. MDCC, IRN & IRT along with all closed NCR of all items.
- v. Factory Acceptance Test (FAT) reports.
- vi. Raw material and bought out item MTC's
- vii. Test Reports corresponding to IRT & MQP.
- viii. Supplier internal inspection reports as per MQP.
- ix. Copy of Statutory and IBR certificates as applicable.

Note:

1. Each package compilation shall be done on the basis of unit wise and common systems.
2. Each volume/ dossier shall be spiral/ hard bounded. Each sheet of dossier to have running numbers.
3. One hard copy (in addition to the dossier dispatch with material / equipment/ item) and 2 Soft copies of documents to be submitted as final dossier (shall also be uploaded in Wrench System for future reference.

9.0 FQC DURING CONSTRUCTION AND PRE-COMMISSIONING.

- 9.1 Supplier Quality Management System is applicable for field activities also and for his further sub agencies deputed at project / plant. Refer clause no: 5.0 (applicable part). Supplier/ Contractor shall deploy sufficient number of QA/ QC persons to take care of daily activities as per agreed/ approved Quality documents. Some of such activities are detailed below. Also, supplier Project Manager shall regularly co-ordinate with OWNERs FQC team.
- 9.2 Raising of inspection calls on regular basis for various activities as indicated in approved FQP/ other document, carrying out inspection activities along with OWNER's execution / FQC department and maintaining the records duly signed by all concerned.
- 9.3 Various inspection/ quality assurance procedures/ methods at different stages of erection and pre-commissioning will be as per OWNERs approved field quality plans/ codes/ IBR and other statutory provisions and as per OWNER's engineer's instructions.
- 9.4 Preparation of quality assurance log sheets and protocols, welding logs, NDE and post weld heat treatment records, testing & calibration records and other quality assurance documentation as per OWNER's engineer's instructions is within the scope of work/ specification. These records shall be submitted to OWNER for approval from time to time.

- 9.5 A daily logbook of all measurements and testing/ calibration should be maintained by contractor on the job inspection details for various equipment. Contractor to depute competent engineer for site testing and pre-commissioning of equipment's (as applicable).
- 9.6 All the workers of contractor / sub contractor/it's agencies shall carry identity cards as per the Performa prescribed by OWNER. Only workers duly authorized by OWNER shall be engaged on the work.
- 9.7 Contractor shall provide all the measuring and monitoring devices (MMD) required for completion of the work satisfactorily. These MMDs shall be calibrated & conform to job requirement in respect of measurement range, accuracy level & any other specification.
- 9.8 Re-work necessitated on account of use of invalid MMD shall be entirely to the contractor's account. Contractor shall be responsible to take all corrective actions, including resource augmentation if any, as specified by OWNER to make-up for the loss of time.

OWNER's FQC team / QAI representative will have the right to carry out Surveillance and Audit of supplier/contractor and their agencies including their store without any prior intimation.

- 9.9 Regular Internal audit shall be conducted by supplier/ contractor QA/QC team of their agencies and their other dept. Such audit reports shall be made available whenever ask for by OWNER FQC team. OWNER FQC/ QA&I have the right to carryout 2nd party audit of supplier/ contractor and their agencies as per predefined Audit schedule.

In course of work OWNER may counter/ finally check the measurements with their own MMDs. Contractor shall render all assistance in conduct of such counter check/ final measurements.

9.10 **Communication**

Direct, formal communication between the SUPPLIER's field QC and OWNER's field QC representative is mandatory. All inspection activities as per field quality plan shall be intimated to OWNER in the form of Request for Inspection (RFI) at least 24 hrs. in advance with intimation to OWNER execution group.

Whenever any major issues / deviations related to design or fabrications are noticed, the same shall be immediately informed to OWNER's field QC by supplier's field QC/ Supplier Project Head. On completion of above activity, joint inspection reports/ protocol shall be made and circulated to concern agencies. Any part of work at the site shall not be **covered up or made inaccessible** without the OWNER Representative's prior approval in the form of joint protocol or otherwise.

Contractor to prepare acceptance test records as indicated in field quality plan for all Minor/ Major / Critical checks or activities, such as site register for all storage and receipt of materials, erection protocol for pre-rection and erection activities, testing and commissioning records for all testing, commissioning and charging activity as indicated in the FQP for a particular equipment or system and approved by OWNER. All the critical checks mentioned in the field quality plan to be documented strictly and to be approved by OWNER. All the FQP related Documents shall be uploaded in Wrench, as part of handing over dossier.

Further, SUPPLIER/ Contractor's in-progress inspection reports, logbook, follow up/ punch out sheets; records of all DT & NDT etc. shall be made available to OWNER field QC during entire course of the work. At the end of the work, SUPPLIER/ Contractor's standard inspection reports, check off sheets, radiographs, master copy of loop diagrams, electrical testing data sheets, etc. shall be handed over to OWNER in an organized and agreed format. SUPPLIER/ Contractor shall verify that all of the required documentation of the equipment has been received and placed in the equipment files. The SUPPLIER/ Contractor is responsible for obtaining any outstanding documentation from his sub-supplier/ agencies.

9.11 Dealing with Open Punch Points (NCR/QCAR):

All open points in the form of observations, non-conformities (NCR, QCAR etc.) that are not responded / closed in time as well as, those were not put up by supplier/ Contractor for resolution/ agreement to OWNER, the same will be considered as violation of contractual obligations and will be dealt suitably during closure of contract. Penalty clauses (if any) shall be applicable as per contract.

Supplier/ Contractor's Performance rating will be impacted as per prevailing policy of OWNER in this regard.

10.0 ATTACHMENT

1. Exhibit A – MQP Format
2. Exhibit B – FQP Format
3. Exhibit C – Shop Inspection Request Format
4. Exhibit D – ICP Format
5. Exhibit E – IRN Format
6. Exhibit F – Suggested MDCC Format
7. Exhibit G – RFI Format (For Site Inspection Request)
8. Exhibit H – NCR Format
9. Exhibit I – QCAR Format
10. Exhibit J – Weekly Progress Report format

Exhibit - A

Supplier Logo	THE TATA POWER COMPANY LIMITED				
Supplier Document No	PROJECT NAME		TATA POWER		
	Supplier Name & Address		Document No		
			Page 1 of 1		

Document Title: MANUFACTURING QUALITY PLAN (MQP)

Document No:

Consultant:

EPC Contractor:

Manufacturer Name & Address:

R1					
R0					
Revision	Date	Reason for Revision	Prepared By	Checked By	Approved By

Supplier Logo Supplier Document No	Manufacturing Quality Plan for Manufacturer Name & Address PACKAGE NAME	Document No. <i>(As given by PDM, Tata Power)</i> Date & Revision Page .. of
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SR. NO.	COMPONENT Description / Activity	CHARACTERISTICS	TYPE OF CHECK	EXTENT OF CHECK	REF. DOCUMENT / ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
							M	S/C	O	
1	2	3	4	5	6	7	8			9
1.0	<u>MATERIAL:</u>						P	R	R	
2.0	<u>IN-PROCESS INSPECTION:</u>									
3.0	<u>FINAL INSPECTION:</u>									
4.0	<u>ISSUANCE OF IRN (BY REVIEWING OF QUALITY DOSSIER)</u>									
N O T E a). Statutory requirements will be complied by the contractor/ Supplier. b). Material samples drawn for check testing will be witnessed by TATA POWER or its representative. c). For stage inspections, copies of relevant documents will be furnished to TATA POWER for review. d). The extent of check for manufacturer shall be 100%. e). Column 6 will be as per TATA POWER approved drawings / data sheets / contact documents wherever applicable. f). All instruments shall have valid calibration certificate with traceability to national level										

Legends: M – Manufacturer, S – Supplier C – EPC Contractor, O – Owner (Tata Power), P – Perform, W – Witness, R – Documents Review, H – Hold point, Rw (%) – Random Witness

Exhibit - B

EPC Logo	THE TATA POWER COMPANY LIMITED				
EPC Document No	PROJECT NAME		TATA POWER		
	Contractor's Name & Address		Document No		
			Page 1 of 1		

Document Title: FIELD QUALITY PLAN (FQP)

Document No:

Consultant:

EPC Contractor:

R1					
R0					
Revision	Date	Reason for Revision	Prepared By	Checked By	Approved By

		The Tata Power Company Limited Engineering (Generation)						
Doc. No.:		STANDARD FQP FOR					Date of Issue:	

Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
N O T E	A) STATUTORY REQUIREMENTS WILL BE COMPLIED WITH BY THE CONTRACTOR. B) FOR STAGES WITNESSED / DOCUMENTS REVIEWED BY TATA POWER, COPIES OF RELEVANT DOCUMENTS WILL BE FURNISHED TO TATA POWER. C) TATA POWER / ITS REP. IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED / GOT TRANSFERRED BY TATA POWER / IT'S REP AT APPROPRIATE STAGES.(IF REQUIRED). D) THE EXTENT INDICATED IN COLUMN 6 IS IN CONTRACTOR'S SCOPE.TATA POWER MAY INSPECT AS PER THIS COLUMN OR RANDOM SAMPLES AT IT'S DESCRETION. E) COLUMN 7 WILL BE AS PER TATA POWER APPROVED DRAWINGS / DATA SHEETS / CONTRACT DOCUMENTS WHEREVER APPLICABLE. F) INSTRUMENTS FOR LEAK TESTS AND PERFORMANCE TESTS WILL HAVE VALID CALIBRATION CERTIFICATE WITH TRACEABILITY TO NATIONAL LEVEL.							
	Critical Category is HOLD point.		This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing is permitted., 24 Hrs advance notice to be given to TATA POWER FQC. Contractor /sub contractor shall not process activity beyond HOLD point without written permission by TATA POWER FQC. This activity shall be performed by Main & Sub- Contractor (Execution + FQC) & witnessed jointly by TATA POWER (Execution + FQC). (Surveillance by Head FQC / Project Head).					
	Major Category is Witness point.		This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing. 24 Hrs advance notice to be given to TATA POWER (Execution) . Contractor /sub contractor shall not process activity beyond Witness point without written permission by TATA POWER (Execution). This activity shall be performed by Main and Sub- Contractor (Execution + FQC) & witnessed by TATA POWER Execution & Surveillance by FQC.					
	Minor Category is Review point.		This activity required review of documents by TATA POWER for the compliance & acceptance, However 24 Hrs advance intimation to be given to TATA power (Execution). This activity shall be performed by Main and Sub- Contractor (Execution +FQC) . (Surveillance by Execution / Project Head).					
	TATA POWER reserves the right to carryout surveillance at any point of time through FQC.							

		The Tata Power Company Limited Engineering (Generation)						
Doc. No.:		STANDARD FQP FOR				Date of Issue:		

Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
STORAGE TYPE: TYPE-1: OPEN AREA & ABOVE GROUND ON WOODEN PLANK WITH SLOPE FOR WATER DISPOSITION. TYPE-2: OPEN AREA & ABOVE GROUND ON WOODEN PLANK (WITH SLOPE FOR WATER DISPOSITION) AND COVERED WITH TARPAULIN. TYPE-3: OPEN SHED WITH FULLY FORMED FLOORING/CEMENT FLOORING. TYPE-4: COVERED SHED/STORE ROOM ON RACKS & IDENTIFIED LOCATION. TYPE-4A: CLOSED CHAMBER WITH TEMPERATURE & HUMIDITY CONTROL. NOTE: Items/equipments having shelf life like paints, alumina, desiccant etc. are to be stored seperately for identification purpose.								
Rev. No	Reason for Revision	Prepared By & Date	Checked By & Date		Approved By & Date		Issued By.	
R0	ISSUE FOR USE							

Confidential and Proprietary -- The Tata Power Company Limited

Exhibit - C**Request No:****Date:****Engineering (Generation)****Shop Inspection Request Format**

Project Name:	
Main Supplier	
Package Name:	
Tata Power P. O. / LOI No.	Date
Item / Equipment offered for inspection:	
Inspection Category:	A / B / C
Sub-supplier (Manufacturer) name & PO Number:	
Type of Inspection: (Please mention the stage number of MQP which will be completed during this inspection)	Stage / Final
Proposed Date of Inspection:	
Place of Inspection: (Please give complete address where material will be inspected, attach route map if required)	
Contact Person for this Inspection along with Mobile No.:	
MQP Doc. No.: Rev. No.: MQP Approval Status:	Yes / No
Inspection Reference Document No: (Drawing/ Data Sheet etc.) approval status	Yes / No
Tata Power PO Item numbers / Billing Breakup No./ Tag No (as applicable) and quantity to be inspected: (Please attach separate list if necessary)	
Current Manufacturing Status (in brief) of item / equipment being offered in this Inspection:	

We hereby confirm that the items have been fully inspected / tested by us, all stages of inspection as per approved MQP have been done and all material test certificates, Q.C. records, approved Drawing / Data Sheet, test reports and valid calibration reports of measuring / testing instruments with traceability are ready with us.

(Signature)

[Name & Designation of Contractor's Representative]

Exhibit - D

Supplier Logo Supplier Document No.	THE TATA POWER COMPANY LIMITED	 TATA POWER Document No Page 1 of 1
	PROJECT NAME	
	Supplier Name & Address	
	ICP - PACKAGE NAME	

Document Title: INSPECTION CATEGOROZATION PLAN (ICP)

Document No:

Consultant:

EPC Contractor:

Supplier:

R1					
R0					
Revision	Date	Reason for Revision	Prepared By	Checked By	Approved By

Document No: Given as per procedure of Tata Power

Supplier Logo Supplier Document No.	THE TATA POWER COMPANY LIMITED PROJECT NAME	 TATA POWER Document No Page 1 of 1
	Supplier Name & Address	
	ICP - PACKAGE NAME	

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Sl. No.	Item Description	Imported / Domestic	Manufacturing / Bought Out	Manufacturing Quality Plan No. (No. given as per TATA Power Procedure)	Inspection Category	First Schedule Submission Date*	Final Approval Date*
1	Example: PUMP				A / B / C		
2							
3							
4							
5							
6							

*Dates indicated are for monitoring purposes of Tata Power Quality Team.

Category "A"	Definition: Manufacturing Quality Plan (MQP) shall be approved by TATA POWER. Stage &/ or Final Inspection including document review by EPC Contractor and TATA POWER (or its appointed Inspection Agency) as per approved MQP.
Category "B"	Definition: Manufacturing Quality Plan (MQP) shall be approved by Tata Power. Stage &/ or Final Inspection including document review by EPC contractor or Tata Power (in case no EPC Contractor) as per approved MQP. Inspection report of EPC contractor/ Supplier with supporting documents review by Tata Power.
Category "C"	Definition: Supplier shall carry out inspection as per their regular practice/ standard manufacturing quality plan. Supplier shall submit test report and COC to EPC Contractor/ Tata Power. COC shall be in standard format of Tata Power.
Note:	1. Any item which is not appearing in above list, however, identified during detailed engineer, same need to be categorized as above. 2. If supplier is not able to submit test report for any Category "C" item, same needs to be finalize during ICP approval.

Document No: Given as per procedure of Tata Power

Exhibit - E

	TATA POWER COMPANY LIMITED	Engineering (Generation)
	Inspection Release Note	IRN No: Issue Date:

Project / Plant:	
Tata Power PO No.:	Dated:
Supplier & Sub-Supplier:	Shop Location:
Inspection Category as per MQP: A ☐ / B ☐ / C ☐	
Release Basis: Physical Inspection ☐ Document Review ☐	
Inspection Waiver/ Inspection Category : Change Reference (if applicable)	

Material / Equipment Details:

PO Item / BBU No.	DESCRIPTION OF ITEM / EQUIPMENT	Tag / ID No. / S. No.	QUANTITY CLEARED EARLIER	OFFERED QUANTITY (Current Lot)	ACCEPTED QUANTITY (Current Lot)

Reference Inspection Report (s)/ Documents Index:

Identification mark with location:

Inspected By:

NCR Status: OPEN ☐ CLOSED ☐ NIL ☐

Special Comments (if any):

Results of Inspection:

Documents reviewed and certify that Inspection carried out as per the approved MQP / Engineering Documents/ Drawings.
Above Equipment/ Item (s) cleared for issuance of MDCC.

Document Reviewed By*: Signature: Name: Date:	Approved By: Signature: Name: Date:	
Note: 1. Issuance of this report and acceptance of NC, if any are without prejudice to contractual obligations of the Supplier / manufacturer and does not absolve him from obligations and guarantees set forth in purchase order documents issued by Tata Power. 2. This is Tata Power internal communication. Project Manager/ Officer / User to ensure contractual, commercial & projects requirements before issuing Material Dispatch Clearance Certificate (MDCC) to contractor/vendor. 3. IRN shall be issued when all NC closed.		



TATA POWER

THE TATA POWER COMPANY LIMITED

MATERIAL DISPATCH CLEARANCE CERTIFICATE

MDCC REFERENCE:			DATE:	
PROJECT				
P.O. REF.				
PACKAGE		QA "Clearance For MDCC" REF No.		
SUPPLIER		SUB-SUPPLIER		

Dispatch clearance is hereby given for following equipment/ items:

Sr. No	PO Item No./ BBU	Item Description	Unit	Quantity	Identification/ S. No./ Remarks

PACKING AND DISPATCH INSTRUCTIONS			SUBMIT FOLLOWING TO TATA POWER				
1	Complete assembly with drive, base plate, accessories etc.		1	Quality Dossier		7	As built drawings.
2	Protect machined surfaces against corrosion.		2	Erection, O&M manual.		8	Calibration reports.
3	Blank nozzles and other openings.		3	T.C. for performance / leak tightness / balancing.			
4	Complete painting, affix name plates, tag no., sr. no., etc.		4	Performance calculations, curves.			
5	Pack to prevent damage/ deterioration in handling, transit & storage		5	Guarantee certificates.		9	Dispatch details.
6	Paint dispatch markings and weight.		6	Manufacturing Test Records/ Test Certificates/ COC			

(Please tick above Packing & Dispatch instructions and Documents Requirements as applicable)

Special Dispatch Instructions (If any):

	Prepared By:	Approved By:
Signature		
Name		
Designation		
Date		

NOTES:

- Acceptance / release of the above items is without prejudice to the terms and conditions of the contract and does not relieve the CONTRACTOR/ SUPPLIER of his guarantees and responsibilities to supply the items in accordance with the specifications, approved drawings, data sheets and other relevant contract documents / conditions.
- CONTRACTOR/ SUPPLIER shall comply with the packing and dispatch instructions and documentation requirements given above.

	Field Inspection Requisition		Requisition No.:
	Project :		Date:
	Name of package & Unit No:		
	Agency:		
	Sub Agency:		
INSPECTION/ TEST REQUISITION DETAILS			
1. FQP No. with Rev. & Category of Approval			
2. Test reference of FQP			
3. Category of Test nas per FQP			
4. Applicable Drawing No. with Rev:			
5. Location			
6. Date and time for inspection / test			
7. Open QCAR/NCR No. (if any) & date against this item/equipment			
It is hereby certified that all previous tests / checks are cleared and no QCAR other than above is pending against this item / equipment (Signature) Agency Representative		(Signature) OWNER (Execution)	
8. Post Inspection/ Test (Joint Protocol) : ACCEPTED / NOT ACCEPTED / ACCEPTED WITH CONDITION Brief Description:			
(Signature) Agency Representative		(Signature) OWNER (Execution)	
		(Signature) OWNER (FQC)	

	TATA POWER COMPANY LIMITED	Engineering (Generation)
	Non Conformity Report	NCR No: Date

Project / Plant:	
Tata Power PO No.	Package/Equipment:
Supplier:	Location:
Inspection Report Reference:	Date of issuance of NCR:
Reference Documents: (QA Manuals, Specification, Procedure, Drawing, etc.)	
Requirements as per approved documents, codes and standards: 	
Details of NC (Provide complete description, i.e. what, where, how many , item no. etc): 	
Root Cause Analysis: 	
Corrective Action Proposed: 	Preventive Action Proposed:
Supplier Representative Sign. / Date	Tata Power / TPIA Representative Sign. / Date
Engineering Review & Approval for proposed corrective action: Engg. Representative Sign. / Date	
Corrective Action Taken: Supplier Representative Sign. / Date	
Verification of Correction Action: Tata Power / TPIA Representative Sign. / Date	

Exhibit - I

	THE TATA POWER COMPANY LTD ENGINEERING (GENERATION) QUALITY CORRECTIVE ACTION REPORT (QCAR)	Format.No:QAI&T/QCAR Revision No.: B Revision Date: 17.01.18
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Project / Plant:		Report No. & date: (From QA DC if issued by QAI)	
Contractor:		Supplier/Package/Equipment:	
Date of observation:		Date of issuance of QCAR:	
Discipline (Mechanical/Electrical /Civil/C&I):		Package in Charge:	
Issued From		Email ID	
Issued To		Email ID	

Quality Observations:

Supplier	Contractor's sign /Date & Time		TATA POWER COMPANY LTD	
Sign /Date & Time	Construction Rep	QA/QC Rep	Construction Rep	QC Rep.

Root Cause Analysis:

Correction Proposed:	Corrective/Preventive Action (CAPA) Proposed:
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Sign of Supplier:

Sign of Contractor:

Acceptance of Proposed Correction and CAPA (Obtaining comments from concerned group, if required)

Sign of Tata Power QC Rep:

Verification of Correction and CAPA taken as per approved proposal or not:

Sign of Tata Power Construction Rep:
Rep.:

Sign of Tata Power QC

Closure of QCAR (Conditional acceptance, if any to be indicated):

Sign of Tata Power Project Manager:

Sign of Tata Power QC Rep:

Exhibit - J

Name of the Project FQC Team	<u>Name of the Project</u> <u>Weekly Field Quality Report (00/00/2024 - 00/00/2024)</u>								
FIELD QUALITY REPORT (CIVIL/ MECH./ELECT.)									
A. FIELD INSPECTIONS									
Sl. No.	Contractor/ Dept.	Work Area	FQ Activity/Test	UOM	Recd.	Acc.	Rep/Rej	Hold	Observations/Remarks
B. RA BILLS / GRN CLEARANCES									
Sl. No.	Contractor/ Dept.	Package	Description	UOM	Recd.	Acc.	Rep/Rej	Hold	Observations/Remarks
C. QCAR'S RAISED / AUDIT / DELTAS									
Sl. No.	Contractor/ Dept.	Package	Description	Date	Observations/Remarks				
D. MEETINGS - INTERNAL AND WITH CONTRACTORS									
Sl. No.	Contractor/ Dept.	Package	Date of meeting	Description					
E. AREAS OF CONCERN									
Sl. No.	Contractor/ Dept.	Package	Description						
F. OTHER ACTIVITIES									
Sl. No.	Contractor/ Dept.	Package	Description						

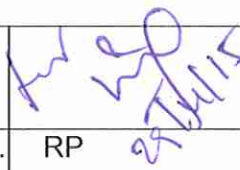
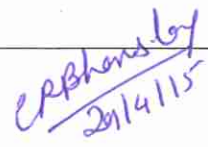
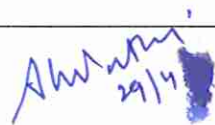
Note: Areas of concern/highlights shall also include long pending and critical non-conformities.

TATA POWER	The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing	
TPQAIT-QAXX-00-EX-SQP- 105 REV.0	STANDARD QUALITY PLAN FOR LOW VOLTAGE SWITCHGEAR PANELS.	Date of Issue: April 2015.

Document Title

STANDARD QUALITY PLAN FOR INDOOR LOW VOLTAGE SWITCHGEARS.

(415VOLT DISTRIBUTION BOARDS including, MCC, PCC, MLDB,ELDB, UPS DB,
BATTERY CHARGER DB (DCDB) & WELDING DB).

					
0	Initial Submission.	RP	CRB (Head QAI- E)	SGP Chief (QAIT)	
Revision No.	Reason for revision	Prepared By & Date	Checked By & Date	Approved By & Date	Issued by & Date

TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing.				
TPQAIT-QAXX-00-EX-SQP-105 REV.0		STANDARD QUALITY PLAN FOR INDOOR LOW VOLTAGE SWITCHGEARS. (415VOLT DISTRIBUTION BOARDS including, MCC, PCC, MLDB,ELDB, UPS DB, BATTERY CHARGER DB (DCDB) & WELDING DB).			Date of Issue: April 2015.	
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED		TYPE / METHOD OF CHECK	REMARKS	
1	2	3		4	5	
1.0	MATERIAL:	(Generally in-line with manufacturer standard / technical specification)				
1.1	Sheet Metal	1	Verification of raw material properties, dimension check, Mechanical, Electrical & Chemical Properties.	Test to be carried out by material / component supplier.	All items TCs to be reviewed by main supplier. (The TCs for CT, PT, Relay, interrupter, MFM are to be submitted to TATAPOWER as per requirement.)	
1.2	Copper bus bar	2	Purity of copper, conductivity, hardness,			
1.3	ACB	1	Contact Resistance	Test to be carried out by material / component supplier as per IS-13118/ IEC 62271-100 & 200		
		2	HV & IR test Test			
		3	Mechanical endurance test			
		4	Electrical endurance tests			
1.4	CT	1	CT Ratio, Polarity, kV, ISF, Accuracy (as applicable).	Test to be carried out by material / component supplier as per IS 2705/ IEC 60044		
		2	HV & IR test Test			
		3	Secondary Resistance			
		4	Interturn Insulation test with Voltage applied to appear in test report.			
1.5	PT	1	PT Ratio, Polarity,	Test to be carried out by material / component supplier as per IS 4146/ IEC 60044		
		2	Secondary Induced Voltage Test			
		3	HV Test & IR test			
		4	Primary and Secondary Resistance			
1.6	Multi Function Meter	1	Performance & Accuracy	Test to be carried out by material / component supplier		
		2	Dimension			
		3	Make Type Rating			
		4	2 kV HV test			
		5	IEC 61850 Compatibility			
1.7	Relay	1	Performance & Functional Checks	Test to be carried out by material / component supplier		
		2	Make, Type, Rating			
		3	2 kV HV test			
		4	IEC 61850 Compatibility			
1.8	Insulator	1	As per IS-731/5621, IEC 575, IEC 60233	Test to be carried out by material supplier		
2.0	INPROCESS INSPECTION: (Generally inline with manufacturing plan)					
1.0	Panel Fabrication	1	Dimensional Conformity, Bend Angle, Profile, Deburring & welding finish, slag removal.			
		2	Surface preparation			
		3	Surface Finish, Paint Shade, Finishing, Coating thickness.			



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Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED		TYPE / METHOD OF CHECK	REMARKS	
1	2	3		4	5	
2.0	Panel Assembly test	1	Functional tests,	Test to be carried out by material / component supplier	Verification of Records by TATA POWER.	
		2	Scheme checks			
		3	Clearance checks			
		4	HV & IR on power and control circuit.			
		5	Conformance to the GA drawing.			
		6	Tinning/ silver coating verification of bus bar joint			
		7	Contact Resistance of bus bar joint			
		8	Measurement of tightness of bus bar joints by torque wrench.			
3.0	FINAL INSPECTION:(As per approved GA, data sheet, wiring diagram, QAP&IEC 62271-100 &200/ IEC 60694)					
3.1	Routine tests	1	Visual & dimensional Check including layout, tag plates, paint shade, paint thickness, bus markings and sleeving, Joint shrouding of bus bar, clearance checks, creepage distance checks, maintenance accessibility, door alignment, IP class, lifting arrangement, earthing point, surface finish, Caution Labels etc.	Testing & Measurement as per IEC 60694/IEC 62271- 100 &200	CHP	
		2	Bill of material checks (Make, rating, Name plate etc.)			
		3	Interchangeability of identical modules / Feeders and rack-in and out operation.			
		4	Verification of bus bar support arrangements with respect to type tested panel drawings, provision of external cable termination and bus duct as applicable.			
		5	Wiring checks for control and auxiliary equipments circuits and aux. contacts			
		6	Measurement of tightness of bus bar joints by torque wrench.			
		7	Relay operation checks thru secondary injection (If applicable)			
		8	Insulation Resistance of main, aux. and control circuits before and after HV test			
		9	Functional checks for Panel indications, annunciations, any analog monitoring devices such as Ammeter, Voltmeter, Energy meter, Limit Switches, Spring Charging Motor, Interlocks of shutter assembly, Interlocks of Safety Barriers.			
		10	HV test on power and control circuit.			
		11	Communications checks between relays & HMI, HMI functional checks.			
		12	Measurement of insulation resistance of Circuit Breaker in closed, open position.			
		13	Measurement of milli-volt drop across Circuit Breaker main contacts, other joints and also across bus bar joint.			
		14	Measurement of resistance, IR value and drop-off/pick- up voltage of close and trip coils			

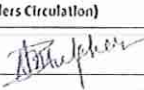
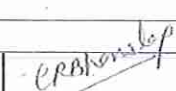


TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing.				
TPQAIT-QAXX-00-EX-SQP-105 REV.0		STANDARD QUALITY PLAN FOR INDOOR LOW VOLTAGE SWITCHGEARS. (415VOLT DISTRIBUTION BOARDS including, MCC, PCC, MLDB,ELDB, UPS DB, BATTERY CHARGER DB (DCDB) & WELDING DB).			Date of Issue: April 2015.	
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED		TYPE / METHOD OF CHECK	REMARKS	
1	2	3		4	5	
	Routine tests	15	Measurement of CT/PT polarity, ratio, secondary resistance and knee point voltage from terminal block.	Testing & Measurement as per IEC 60694/IEC 62271-100 & 200	CHP	
		16	Secondary injection of all metering circuits.			
3.2	Type Tests	1	Short circuit making and breaking tests of breakers.	Testing & Measurement as per IEC 62271-200/ IEC 60694 standard)	Valid TYPE tests certificate not older than 5 year is prerequisite.	
		2	Rated Short Time current withstand & peak withstand test.			
		3	Temperature Rise Test on bus bar and component contained in the metal enclosed switchgear.			
		4	Degree of protection of panels.			
		5	Electromagnetic compatibility (EMC).			
		6	Any other special / type test as per technical specifications.			
Any Separate Type/ Design validation tests shall be carried out in accordance with TATA POWER specification/ PO or as per mutually agreed in MQP.						
4.0 Document review & issuance of IRN						
4.1	PACKING & PRE-SHIPMENT.	1	Visual Verification.	Measurement & Visual by Main supplier		
		2	Quantity Verification & Packing in cartons			
		3	One hard copy of the as built drawing along with shipping			
		4	Identification.			
4.2	DISPATCH.	Issue of Release note / MDCC.			Customer Hold Point.	
N O T E	A) ALL MATERIAL SHALL BE AS PER APPROVED DRAWING/ DATA SHEET. B) STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR. C) TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY FOR MATERIAL TRACEABILITY. D) FINAL INSPECTION OF THE MAJOR ACTIVITIES ARE WITNESSED BY CLIENT AND IT IS HOLD POINT (AT THE DISCRETION TATA POWER) E) MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE. F) INSPECTION OF THE MAINTAINCE SPARES SHALL BE OFFERED ALONG WITH THE MAIN SUPPLY AS PER THE INSPECTION STAGES OF 1 TO 4. G) CALIBRATION CERTIFICATES OF THE EQUIPMENT USED FOR TESTING SHALL BE PROVIDED FOR REVIEW. H) TATA POWER RESERVES THE RIGHT TO DEMAND / VERIFY/ AUDIT/ WITNESS ANY OF THE CHECK POINTS MENTIONED IN THE SCOPE OF SUPPLIER. I) AS PER SPECIFICATION PROPER PAINTING & PACKING SHALL BE ENSURED BY VENDOR BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE.					
	Meant for (Internal Circulation / External – Stakeholders Circulation)					



TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing		
TPQAIT-QAXX-00-EX-SQP-154-REV 0		STANDARD QUALITY PLAN FOR BATTERY CHARGER		Date of Issue: <i>23 March 2016</i>
Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	Remarks
1	2	3	4	5
1.0	MATERIAL: All material shall be as per approved drawing/ data sheet/ Specifications.			
1.1	Raw Material: Copper Conductor/Flats,	Chemical composition, physical properties, impurities, Electrical properties, IS: 191	TC verification	Manufacturer TCs to be reviewed by main supplier and Tata Power.
1.2	Current Transformer	Routine Test Report as per relevant Standard/Data Sheet	Verification of Type, Rating, Vendor and correlated TC	
1.3	Capacitors			
1.4	Rectifier Element (SCR/DIODES/OTHER)			
1.5	Power Resistors, Potentiometers			
1.6	Meters and Transducers			
1.7	Protection Relays, Controller Unit			
2.0	INPROCESS INSPECTION: (Generally in line with manufacturer standard)			
3.0	FINAL INSPECTION (IS)			
3.1.1	Routine Tests	Visual, Name Plate, General Arrangement of Components, Dimensions, Door Alignment, Straightness, Gasketing Checks	Visual, Physical, Measurement	Customer Hold Point
3.1.2		Painting: Paint Type, Shade, Thickness, Peel off/Adhesion Test as per relevant standards and approved drawings	Visual, Physical, Measurement	
3.1.3		Bill Of Material	Visual check of Make, Model, Rating, etc.	
3.1.4		Verification of correct wiring, neatness and firmness of cards and terminalions	Electrical Testing as per relevant standards and approved drawing, GTP	
3.1.5		Insulation Resistance Before and After HV Test of Main and Auxiliary Circuits		
3.1.6		High Voltage Test of Main and Auxiliary Circuits		
3.1.7		Calibration check of metering and Protection circuits by primary voltage and primary current injection test		
3.1.8		Logic Simulation, Operation, Protection and Earth Fault testing		
3.1.9		Soft Start and Current Limiting Function Test		
3.1.10		Short Circuit Test		
3.1.11		No Load Test		
3.1.12		Load Test (Full Load Test)		
3.1.13		Ripple Measuremnt		
3.1.14		Voltage Regulation at Full Load		
3.1.15		Harmonic Measurement at 50% and 100% of Load		
3.1.16		Efficiency test at nominal input voltage at 25%, 50%, 75% and 100% loads		
3.1.17		Power Factor at nominal input voltage and rated Load		
3.1.18		Annunciation Test of Charger and for Battery Alarm Condition (AC and DC UV, OV, Earth Fault, MCB trip, AC Main Fail, Annunciation Supply Fail, SCADA contact)		

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23rd March 2016

TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing			
TPQA/IT-QA/XX-00-EX-SQP-151-REV 0		STANDARD QUALITY PLAN FOR BATTERY CHARGER		Date of Issue: 23 March 2016	
Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	Remarks	
1	2	3	4	5	
3.2	Type Test				
3.2.1	Type Test	Temperature Rise Test (Heat Run Test) at Maximum Rated Continuous Current in Float/Boost mode.	Verification of Type Test Report/Certificate as per specific IEC standard	Valid type test certificate for the same design not older than 5 years is a pre-requisite	
3.2.2		IP degree protection.	/conducting test as per mutual agreement		
3.2.3		Noise Level			
3.2.4		Electro Magnetic Compatibility Test			
4.0	Document review & Issuance of IRN				
4.1	Document review & Issuance of IRN	Review of Quality dossier (*) & Inspection report	Review	(*) along with index.	
N O T E	A). STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR.				
	B). ALL MATERIAL SHALL BE AS PER APPROVED DRAWINGS / DATA SHEET.				
	C). TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY.				
	D). FINAL INSPECTION OF THE MAJOR ACTIVITIES ARE WITNESSED BY CLIENT AND IT IS HOLD POINT (AT THE DISCRETION TATA POWER)				
	E). MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE.				
	F). INSPECTION OF SPARES SHALL BE MANUFACTURED & INSPECTED AS PER APPLICABLE CLAUSES OF THIS QUALITY PLAN. SPARES OFFERED FOR INSPECTION SHALL BE PREFERRED ALONG WITH MAIN ITEMS (IF ORDERD).				
	G). AS PER SPECIFICATION PROPER PAINTING & PACKING SHALL BE ENSURED BY VENDOR BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE.				
	H). ANY SEPARATE TEST SHALL BE CARRIED OUT IF CALLED FOR IN ACCORDANCE WITH TATA POWER TECHNICAL SPECIFICATION OR AS PER MUTUALLY AGREED IN MQP.				
Meant for (Internal Circulation / External - Stakeholders Circulation)					
Rev.No		 23 March 2016 AMZ	 CRB	 SS 23/03/16	
RO	Reason for Revision	Prepared By & Date	Checked By & Date	Approved By & Date	

SECTION-E3

TATA POWER		The Tata Power Company Limited Corporate Engineering - Quality Assurance & Inspection		
TPQA&I-QAXX-00-EX-SQP-188 REV.0		STANDARD QUALITY PLAN FOR LV INDUCTION MOTORS (Squirrel-cage rating upto 700 V)		Date of Issue: 14/2/17
Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	Remarks
1	2	3	4	5
1	MATERIAL: (All material shall be as per approved drawing/ data sheet/ Specifications)			
2	INPROCESS INSPECTION: (Generally in line with manufacturer standard)			
3	FINAL INSPECTION -			
3.1	Routine Tests	1 Measurement of winding Resistance 2 Visual, Dimension checks, Paint Shade & Thickness verification. 3 General Arrangements & Completeness verification. 4 High Voltage Test 5 Measurement of Insulation Resistance before and after HV Test for main winding, Space Heater, RTD & BTD 6 No load test at rated voltage to determine input current, power, direction of rotation and speed. 7 Locked Rotor Test and measurement of Current, Voltage and Power at suitable reduced voltage. 8 Noise Level 9 Vibration Measurement at DE & NDE ends 10 Reduced voltage running-up test at no load. 11 Visual checking for provision of greasing facility, Vibration Pads, Lifting Lugs, Earthing Pads and Cable Termination arrangements.	Testing and Measurement as per Approved Data Sheet/ Drawings IS 325/ IS 4029/ IS 4728/ IS 7816/ IS 12075/ IS 12065 IS/IEC 60034	TC Review - Less than 30 KW rating. Witness at works - 30 kW rating and more.
3.2	Type tests	1 Dimension* 2 Measurement of winding Resistance* 3 No load test at rated voltage to determine input current, power and speed.* 4 Reduced voltage running-up test at no load.* 5 Locked Rotor Test and measurement of Current, Voltage and Power at suitable reduced voltage.* 6 High Voltage Test & Insulation Resistance test.* 7 Noise Level* 8 Vibration Measurement at DE & NDE ends* 9 Full Load Testing at 100%, 75% & 50% load to determine efficiency, power factor and slip. 10 Temperature Rise test with all Accessories Installed. 11 Over speed Test and momentary overload test 12 Pullout and starting torque 13 IP Degree of complete motor along with Terminal Boxes and accessories mounted. 14 Any other special / type testing as per technical specifications.	Testing and Measurement as per Approved Data Sheet/ IS 325/ IS 4029/ IS 12802 /IEC 60034	Valid & Approved Type Test Report Review during final inspection. (Not older than 5 years)
4.0	Document review & Issuance of IRN	Review of Quality dossier & Inspection report	Review	along with index.
NOTES * Also covered under Routine Tests. A) STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR B) ALL MATERIAL SHALL BE AS PER APPROVED DRAWINGS / DATA SHEET. C) TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY. D) FINAL INSPECTION OF THE MAJOR ACTIVITIES ARE WITNESSED BY CLIENT AND IT IS HOLD POINT (AT THE DISCRETION TATA POWER) E) MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE INCLUDING ADDITIONAL TESTING REQUIREMENTS AS PER CONTRACT SPECIFICATION F) INSPECTION OF SPARES SHALL BE MANUFACTURED & INSPECTED AS PER APPLICABLE CLAUSES OF THIS QUALITY PLAN. SPARES OFFERED FOR INSPECTION SHALL BE PREFERRED ALONG WITH MAIN ITEMS (IF ORDERED). G) CALIBRATION CERTIFICATES OF THE EQUIPMENT USED FOR TESTING SHALL BE PROVIDED FOR REVIEW. H) AS PER SPECIFICATION PROPER PAINTING & PACKING SHALL BE ENSURED BY VENDOR BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE. I) TATA POWER RESERVES THE RIGHT TO DEMAND / VERIFY / AUDIT / WITNESS ANY OF THE CHECK POINTS MENTIONED IN THE SCOPE OF SUPPLIER. J) TYPE TEST REQUIREMENT: REVIEW OF PREVIOUS TEST REPORT OF REPUTED LAB OR WITNESS BY REPUTED AGENCY. IN CASE VALID TYPE REPORTS ARE NOT AVAILABLE, TYPE TEST NEEDS TO BE CONDUCTED.				
Confidential and Proprietary -- The Tata Power Company Limited.				
RO	First issue	RG CJ 13/2/17	CRB	SS 14/02/17
No	Reason for Revision	Prepared By & Date	Checked By & Date	Approved By & Date

TATA POWER		The Tata Power Company Limited Corporate Engineering - Quality Assurance & Inspection					TATA		
TPQA&I-QAXX-00-EX-SFP-176 REV.0		STANDARD FIELD QUALITY PLAN FOR LOW VOLTAGE (UP TO 690 Volt) MOTORS							Issued On: 20/1/16
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS	
1	2	3	4	5	6	7	8	9	
1.0	Receipt of Material & Storage	Check availability of Instruction manuals, motor characteristics, drawings & Quality Dossier including IRN/DRC. Verification of motor and accessories for any visual damage during transit.	Minor	Physical	100%	IRN/DRC, MDCC, Bill of Lading/Shipping List	Site Inspection register	Damage/ shortfall report shall be signed by FQC also after verification.	
		If Permanent location is not ready for placing the Motor, temporary storage should be done at suitable location with pollution free atmosphere & motor space heater in service.	Major	Physical	100%	No damages/ No shortfall			
		In case of long storage, periodically monitor IR Value of Motor winding.	Major	Measurement	100%	Storage "Type -2"/ Storage manual of manufacturer.			
		If Motor is stored for long time, Check rotation of motor shaft periodically, as per the manufacturer's recommendation.	Major	Physical	100%	Manufacturer's Instruction Manual.		If IR value found less, refer to OEM.	
2.0	Transportation from Storage Yard	Check strings, ropes, pulleys, rollers, cross bars etc. before transportation. Check proper loading and type of crane in the transportation vehicle and proper unloading at site up to positioning	Minor	Physical	100%	Manufacturer's Instruction Manual.	Site Inspection register		
			Minor	Physical	100%	Manufacturer's shipping list & Manufacturer's instruction.			

20/11/16

TATA POWER		The Tata Power Company Limited Corporate Engineering - Quality Assurance & Inspection					TATA	
TPQA&I-QAXX-00-EX-SFP-176 REV.0		STANDARD FIELD QUALITY PLAN FOR LOW VOLTAGE (UP TO 690 Volt) MOTORS						Issued On: 20/1/16
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
4.0	Pre-Erection	Check availability of all tools, tackles and ropes etc. required for erection work are available.	Minor	Physical/Visual	100%	Manufacturer's Instruction Manual.	Site inspection register	Joint inspection with Civil & mechanical department.
		Check that the motor foundation is ready with base frame.	Major	Physical / Measurement	100%	Site Approved Drawing.	Inter dept. handling over protocol.	
		Check that, approach to motor foundation is levelled.						
		Check that Motor is lifted using only the lifting lugs/ Eye bolts provided for the purpose.	Major	Physical	100%	Manufacturer's Instruction Manual.		
5.0	Erection	Check placement of Motor on foundation centering on both axes.	Major	Physical	100%	General Arrangement		Erection Protocol
		Check alignment of motor shaft & direction of rotation.	Major	Physical	100%	General Arrangement		
		Check tightness of foundation bolts for the motor with base frame after final alignment.	Major	Physical	100%	Site Approved Drawing.		
		Check connection of cables to Motor terminals using Bi-metallic washers (as applicable).	Critical	Physical	100%	Cable Schedule & Site Approved Drawing		
		Check termination of all cables, space heater cables, instrument cables etc.	Critical	Physical	100%			
		Check for installation of Vibration Sensors (as applicable)	Critical	Physical	100%			
		Ensure that locking arrangement of rotor shaft/ bearing is removed.	Major	Physical	100%	Manufacturer's Instruction Manual.		
		For Greased Bearings: check filling of bearing grease housing with manufacturers recommended Grease.	Major	Physical	100%	Manufacturer's Instruction Manual.		
		Check earthing to the Main Motor, Terminal Box, Shaft through collector (if applicable)	Critical	Physical	100%	Site Approved Drawing and		



TATA POWER			The Tata Power Company Limited Corporate Engineering - Quality Assurance & Inspection						TATA		
TPQA&I-QAXX-00-EX-SFP-176 REV.0			STANDARD FIELD QUALITY PLAN FOR LOW VOLTAGE (UP TO 690 Volt) MOTORS							Issued On: 26/11/16	
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS			
1	2	3	4	5	6	7	8	9			
6.0	Pre-Commissioning	Check IR Test of Motor Winding (Phase to phase & phase to Gnd)	Critical	Measurement	100%	Approved Drawing, Data Sheet Manufacturer's Test Certificate.	Site Inspection Report	In case of availability of external neutral formation, testing should be carried out on each phase as well combined.			
		Check Winding Resistance.	Critical	Measurement	100%						
		Space Heaters: Check IR & coil Resistance.	Critical	Measurement	100%						
		Check RTD & BTD for healthiness. Check if all the Unused RTDs / BTDs are shorted & earthed. BTD: Bearing Temperature Detector	Critical	Measurement	100%						
		Check operation of upstream breaker through local push button station keeping breaker in test position.	Critical	Physical	100%						
7.0	Commissioning	Check Bumping/ kick start of motor to Check for Direction of Rotation.	Critical	Visual, Measurement.	100%	Approved Drawing, Data Sheet Manufacturer's Test Certificate.	Commissioning Report.	Prior to first bumping, Tata Power Engineering approved relay setting specific to the motor should be available and adopted.			
		No load Running for 4 hrs. and check recording of parameters (hourly basis) i.e. Current, Voltage, Temperature, Noise and Vibration. Starting current will also be recorded during first uncoupled and first coupled run.						Coupled running with load to confirm all parameters as desired. Greasing / oil flow adjustment shall be carried out, if required.			

TPQA&I-QAXX-00-EX-SFP-176
REV.0

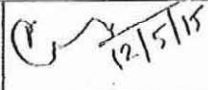
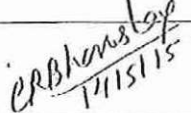
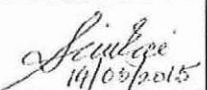
STANDARD FIELD QUALITY PLAN FOR LOW VOLTAGE (UP TO 690 Volt) MOTORS

Issued On:
20/11/16

Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED			CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9		
8.0	Handing Over	Protocol certification & handing over of Motor			Critical	Document verification	100%	Approved Drg, Data sheet.	Handing Over Protocol	
9.0	Final Documentation	Compilation of all field inspection protocol, test reports including closure of non conformance & QCAR, if any.			Critical	Visual	100%	NA	*SWCF	Site work completion file
A). STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR. B). FOR STAGES WITNESSED / DOCUMENTS REVIEWED BY TATA POWER, COPIES OF RELEVANT DOCUMENTS WILL BE FURNISHED TO TATA POWER. C). TATA POWER / ITS REP. IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED / GOT TRANSFERRED BY TATA POWER / ITS REP AT APPROPRIATE STAGES. (IF REQUIRED). D). THE EXTENT INDICATED IN COLUMN 6 IS IN CONTRACTOR'S SCOPE.TATA POWER MAY INSPECT AS PER THIS COLUMN OR RANDOM SAMPLES AT ITS DISCRETION. E). COLUMN 7 WILL BE AS PER TATA POWER APPROVED DRAWINGS / DATA SHEETS / CONTRACT DOCUMENTS WHEREVER APPLICABLE. F). INSTRUMENTS FOR LEAK TESTS AND PERFORMANCE TESTS WILL HAVE VALID CALIBRATION CERTIFICATE WITH TRACEABILITY TO NATIONAL LEVEL.										
Critical Category is HOLD point.		"This activity required inspection / verification & acceptance by inspection authority responsible for this stage before further processing is permitted. 24 Hrs advance notice to be given to TATA POWER "FQC". Contractor/ sub-contractor shall not process activity beyond this point without written permission by TATA POWER "FQC". This activity shall be formed by TATA POWER (Execution + "FQC"), Main & Sub-Contractor (Execution + "FQC"). (Also Surveillance by Head FQC / Project Head)								
Major Category is Witness point.		This activity required inspection / verification & acceptance by inspection authority responsible for this stage before further processing. 24 Hrs advance notice to be given to TATA POWER (Execution) . Contractor /sub contractor shall not process activity beyond Witness point without written permission by TATA POWER (Execution). This activity shall be performed by TATA POWER (Execution), Main and Sub- Contractor (Execution + "FQC"). (Surveillance by FQC)								
Minor Category is Review point.		This activity required review of documents by TATA POWER for the compliance & acceptance. However 24 Hrs advance notice to be given to TATA power (Execution). This activity shall be formed by Main and Sub- Contractor (Execution +FQC) . (Surveillance by Execution / Project Head).								
TATA POWER FQC is also authorized to carryout surveillance in any major & minor class of check at their discretion.										
STORAGE TYPE: TYPE-1: OPEN AREA & ABOVE GROUND ON WOODEN PLANK WITH SLOPE FOR WATER DISPOSITION. TYPE-2: OPEN AREA & ABOVE GROUND ON WOODEN PLANK (WITH SLOPE FOR WATER DISPOSITION) AND COVERED WITH TARPULIN. TYPE-3: OPEN SHED WITH FULLY FORMED FLOORING/CEMENT FLOORING. TYPE-4: COVERED SHED/STORE ROOM ON RACKS & IDENTIFIED LOCATION. TYPE-4A: CLOSED CHAMBER WITH TEMPERATURE & HUMIDITY CONTROL.										
NOTE: Items/equipments having shelf life like paints, alumina, desiccant etc. are to be stored separately for identification purpose.										
Meant for (Internal Circulation / External – Stakeholders Circulation)										
RO	Issue for use	RG		CB		SS				
Rev. No	Reason for Revision	Prepared By & Date		Checked By & Date		Approved By & Date		Issued By		

TATA POWER	The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing	 TATA
TPQAIT-QAXX-00-EX-SQP-113 REV.0	STANDARD QUALITY PLAN FOR LV (UPTO & INCLUDING 1.1 kV) POWER & CONTROL CABLES	Date of Issue: 14/5/15

Document Title
STANDARD QUALITY PLAN FOR
LV (UPTO & INCLUDING 1.1 kV)
POWER & CONTROL CABLES

		 12/5/15	 14/5/15	 14/05/2015	RG 14/5/15
0	Initial Submission	RG	CRB (Head QA-I- E)	SS Head (QA&I)	
Revision No.	Reason for revision	Prepared By & Date	Checked By & Date	Approved By & Date	Issued by & Date

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TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing		
TPQAIT-QAXX-00-EX-SQP-113 REV.0		STANDARD QUALITY PLAN FOR LV (UPTO & INCLUDING 1.1 kV) POWER & CONTROL CABLES		Date of Issue: 14/5/15
Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	Remarks
1	2	3	4	7
1	MATERIAL:	(All material shall be as per approved drawing/ data sheet/ Specifications)		
	PVC FRLS Outer Sheath, Inner Sheath, Insulation Compound, Copper Conductor, Galvanized Steel Flat Strip/Round Wire.	Relevant Standards & Specifications	Review of co-related MTC.	Additional sample testing for insulation, conductor & sheath by cable manufacturer
2	INPROCESS INSPECTION: (Generally in line with manufacturer standard)			
3	FINAL INSPECTION - CHP/ Witness by Tata Power.			
3.1	Routine Tests	1 Conductor Resistance 2 High Voltage Test	Testing and Measurement	100% test by cable manufacturer & review by Tata Power
3.2	Acceptance Tests	1 <u>Dimensions:</u> Thickness of Insulation, Inner and Outer Sheath & colour code, Armour Size Conductor Dia & Overall dia 2 Annealing test (for Copper) 3 Tensile Test (for Aluminium) 4 Wrapping Test (for Aluminium) 5 Tensile Strength and Elongation at Break for Insulation, Inner and Outer sheath 6 Insulation Resistance (Volume Resistivity) at Room Temperature and Elevated Temperature 7 Conductor Resistance 8 High Voltage Test 9 Hot Set Test (For XLPE Insulation) 10 Sheath Embossing/ Printing 11 Galvenizing Tests on armour 12 Rewinding of Drum to check for Length, Surface Defects, Finishing, Embossing, Printing etc. (Min.Two Drums from offered lot) 13 Anti Rodent and Anti Termite Test	Testing and Measurement as per relevant IS standard IS 1554 - Part 1 (for PVS Insulated Cables) / IS 7098 Part -1 (XLPE insulated Cables) on sample selected by Tata Power as per IS.	CHP
3.3	FRLS Tests (One Sample from offered lot) (If applicable as per contract technical specifications)	1 Oxygen Index 2 Temperature Index 3 Smoke Density Rating 4 Acid Gas Generation 5 Flammability Test	ASTM-D-2863/ NES- ASTM-D-2863 ASTM D-2843 IEC 60754-1 IS 10810-53, 61 & 62 (Category-A)	
3.4	Type tests	1 Test for Armour (wire/ strip) 2 <u>Physical Tests on Insulation</u> a Ageing in Air Oven b Shrinkage Test c Water Absorption Test (Gravimetric) (For XLPE) d Hot deformation (For PVC) e Heat Shock test (For PVC) f Loss of Mass in air oven (For PVC) g Thermal Stability (For PVC)	Table-5 (IS1554), Table (IS7098),IS 3965 IS 10810 - 11 IS 10810 - 12 IS 10810 - 33 IS 10810 - 15 IS 10810 - 14 IS 10810 - 10 IS 5831	Approved Type Test Report Review during final inspection.

TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing		
TPQAIT-QAXX-00-EX-SQP-113 REV.0		STANDARD QUALITY PLAN FOR LV (UPTO & INCLUDING 1.1 kV) POWER & CONTROL CABLES		Date of Issue: 14/5/15
Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	Remarks
1	2	3	4	7
3.4	Type tests	3 Physical Tests on Outer Sheath		Approved Type Test Report Review during final inspection.
		a Ageing in Air Oven	IS 10810 - 11	
		b Shrinkage Test	IS 10810 - 12	
		c Hot deformation	IS 10810 - 15	
		d Heat Shock test	IS 10810 - 14	
		e Loss of Mass in air oven	IS 10810 - 10	
		f Thermal Stability	IS 5831	
3.5	Optional Tests (If applicable as per contract technical specifications)	1 Resistance to Ultra Violet Radiation on outer sheath	The retention values of TS and ultimate elongation after the tests shall be minimum 60% of TS and ultimate elongation before test. (DIN 53387 or ASTM-G-154)	Test Certificates (not older than one year) from recognised testing laboratory to be furnished for review for similar design mix. In case test certificates are not available, test is to be conducted on randomly selected one sample by Tata Power, in approved lab before acceptance of cable.
		2 Accelerated water absorption test on PVC Insulation	NEMA-WC-70	
		3 Water Absorption on outer sheath	IS-10810 Part 33, Type-B compound as per IS-5831	Water Absorption value shall not exceed 10 mg/sq.cm
		4.0	Document review & Issuance of IRN	Review of Quality dossier (*) & Inspection report
N O T E	A) STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR. B) ALL MATERIAL SHALL BE AS PER APPROVED DRAWINGS / DATA SHEET. C) TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY. D) FINAL INSPECTION OF THE MAJOR ACTIVITIES ARE WITNESSED BY CLIENT AND IT IS HOLD POINT (AT THE DISCRETION TATA POWER) E) MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE INCLUDING ADDITIONAL TESTING REQUIREMENTS AS PER CONTRACT SPECIFICATION. F) INSPECTION OF SPARES SHALL BE MANUFACTURED & INSPECTED AS PER APPLICABLE CLAUSES OF THIS QUALITY PLAN. SPARES OFFERED FOR INSPECTION SHALL BE PREFERRED ALONG WITH MAIN ITEMS (IF ORDERD). G) CALIBRATION CERTIFICATES OF THE EQUIPMENT USED FOR TESTING SHALL BE PROVIDED FOR REVIEW. H) AS PER SPECIFICATION PROPER PAINTING & PACKING SHALL BE ENSURED BY VENDOR BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE. I) TATA POWER RESERVES THE RIGHT TO DEMAND / VERIFY/ AUDIT/ WITNESS ANY OF THE CHECK POINTS MENTIONED IN THE SCOPE OF SUPPLIER.			
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TATA POWER		The Tata Power Company Limited. Corporate Engineering-Quality Assurance Inspection & Testing.							
TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).				Date of Issue: September 2015.			
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS	
1	2	3	4	5	6	7	8	9	
1.0	MATERIAL RECEIPT.	Check cable type, quantity and size.	Major	Visual	100%	MDCC/IRN & Packing list.	Site register	Joint Report (site QC/store & contractor) to be prepared in case of damage.	
		Report shortage/damage, if any (including cable drum).	Major	Visual	100%		Site register		
		Unloading of cable without damage.	Major	Visual	100%		log book, store register.		Spreader to be used for the slings while unloading cable.
		Storage type: TYPE 1.	Major	Visual	100%		Site register		Cable drums are stored in cable yards in open plots. Proper access should be there for trailer and crane.
2.0	MATERIAL STORAGE.	Drum must be stacked or stored standing on the flanges, not lying flat. Wood chocks should be placed under the flanges to prevent accidental rolling. When stacking it is essential to have the flanges meet, particularly with heavy drums.	Major	Visual	100%	Manufacturer's instructions	Site register	For long storage, periodic visual inspection of cable drums to be carried out.	

NOTE: For Cable drums stored for long time (more than a year) in water logging area or with damaged drums, IR & HV (as recommended below) to be done before cannibalization and shifting to covered storage area for use at later stage.



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TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).				Date of Issue: September 2015.		
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
3.0	PRE-ERECTION (Preparedness).	Planning: Check availability of cabling notes, layout drawings, drum schedules etc.	Major	N/A	N/A	Engineering & approved notes and details	N/A	
		Route survey: i. Check availability of the route for laying of cable as per approved drawings. ii. Check for readiness of cable tray/ trench. iii. Check for any obstacles in conduits/ hume pipes. iv. Check for any crossover of water line/ drain line/ road etc. v. Preparation of bedding incase of directly buried trench.	Major	Visual	100%	Manufacturer's instructions	Site register	1) In trench diversion of other utilities may be required. 2) Joint bays to be prepared at either ends. 3) Check the trench for proper cable bending radius. 4) Barricading, Walkways and proper lighting should be provided on site.
		Availability of Resources: i. Check for arrangement of backfilling, protective tiles, caution tape and cable route markers etc. ii. Availability of tools and tackles: Like Drum handling equipment, cable pulling equipment, jacks, megger, rollers etc.	Major	Visual	100%	Manufacturer's instructions	Site register	Cable laying equipments like winch, power rollers and other rollers should be properly placed at site.



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TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).				Date of Issue: September 2015.		
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
		Transportation of cable drums to site (Check IR Value before shifting from stores).	Major	Visual	100%	Cable schedule/ Approved layout drawings.	erection protocol	
		Cable pulling (Check for use of rollers & tolls for pulling).	Major	Visual	100%	Manufacturer's instructions.	erection protocol	
		Cable cutting/laying: 1. HT, Power, Control & Instrumentation Cables shall be laid separately in the designated cable trays. 2. For trenches, minimum 300 mm gap shall be maintained between, HT/Power & Control/Instrumentaion cables.	Major	Visual	100%	Manufacturer's instructions/ Cable schedule/ Approved layout drawings.	erection protocol	
4.0	ERECTION.	For directly buried cables: following steps to be followed. 1. Cable trench (min 1.0 mtr deep/ as per drawing) to be prepared. 2. Ensure 4-6 inch sand bedding before laying of cable. 3. After laying of cable ensure 300 mm of sand over cable. 4. Place protective tiles above sand. 5. Fill soil above tiles. 6. Place Caution tape on Soil in the trench (below 300 - 450 mm of ground level). 7. Fill the trench with soil to level. 8. Conduits to be used for cable crossing water line/ drain line/ road etc.	Major	Visual	100%	Approved layout drawings/ IS:1255.	erection protocol	Fluidized Thermal Backfill (FBT) is recommended for Increased Ampacity & Thermal Stability. Recommended composition of FBT: 87% Sand. 11% Fly ash. 2% Cement.

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TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).				Date of Issue: September 2015.		
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
4.0	ERECTION.	MARKING & TAGGING: i. Ensure Route marking for cables routed through underground. ii. For Cables laid in cable trays, Tagging of cables along the cables to be done at 50 mtr intervals and at both sides of corners.	Major	Visual	100%	Cable schedule/ Approved layout drawings	erection protocol	
		Cables Dressing for HT cables: i. Use Trefoil clamps for single core cables (crossing at equal intervals and in reference with other laid trefoiled cables). ii. 3 core cables shall be laid in single layer. iii. Cables shall not be laid crossing each other, min gap of 300mm shall be ensured between cable, if crossing is necessary.	Major	Visual	100%	Cable schedule/ Guidelines.	erection protocol	
		Check Glanding, Termination, straight jointing (if required), support arrangement for cable & ferruling.	Major	Visual, Measurement	100%	Manufacturer's instructions/ Cable schedule/ Approved layout drawings	erection protocol	Certified Jointers to carryout the termination.
		For HT cables: End termination, cables straight jointing and installation of other accessories. Ensure clearances, earthing, protection from sharp edges & continuity of armour. (As applicable).	Major	Visual	100%		erection protocol	

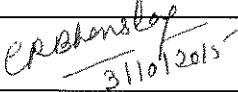
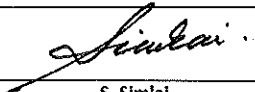


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TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).						Date of Issue: September 2015.
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
		Insulation Resistance measurement.	Major	Measurement	100%	Mfr's instructions/ IS 1255.	Test Report	
		HV test:						
		a. For PVC/PILC Cables: DC Hipot with 2 times the rated voltage of cable or 80% of the factory test voltage for 1 minute.	Critical.	testing.	100%		Test Report	
		b. For XLPE cable: AC Hipot / Very Low Frequency Hipot (less than 1Hz).	Critical.	testing.	100%	Manufacturer's instructions/ IS 1255/ Factory TC.	Test Report	
		After HV test for HT cables: Insulation Resistance measurement.	Critical.	Measurement	100%		Test Report	
		Phasing check at both ends for power cables.	Critical.	Visual	100%	Approved layout drawings	Test Report	
		Check loop checks, continuity checks for C&I cables.	Major	Visual	100%	Approved layout drawings	Test Report	
		For HT Cables: Check grounding of sheath (one end for single core cables & both ends for multi core cables).	Critical.	Physical.	100%	Manufacturers Instruction.	erection protocol	
		HT Cable system: Test charge at minimum relay settings and then the same is continued for next 24 hrs as Soak test.	Critical.	Measurement	100%	Manufacturer's instructions	Commissioning Protocol	
		On successful completion of Soak Test, the cable system to be released for Load service.	Critical.	Measurement	100%	—	Test Report	
5.0	Pre-commissioning & Commissioning checks.							



TATA POWER		The Tata Power Company Limited. Corporate Engineering-Quality Assurance Inspection & Testing.						
TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).				Date of Issue: September 2015.		
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
A) STATUTORY REQUIREMENTS WILL BE COMPLIED WITH BY THE CONTRACTOR. B) FOR STAGES WITNESSED / DOCUMENTS REVIEWED BY TATA POWER, COPIES OF RELEVANT DOCUMENTS WILL BE FURNISHED TO TATA POWER. C) TATA POWER / ITS REP. IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED / GOT TRANSFERRED BY TATA POWER / ITS REP AT APPROPRIATE STAGES. (IF REQUIRED). D) THE EXTENT INDICATED IN COLUMN 6 IS IN CONTRACTOR'S SCOPE. TATA POWER MAY INSPECT AS PER THIS COLUMN OR RANDOM SAMPLES AT ITS DISCRETION. E) COLUMN 7 WILL BE AS PER TATA POWER APPROVED DRAWINGS / DATA SHEETS / CONTRACT DOCUMENTS WHEREVER APPLICABLE. F) INSTRUMENTS FOR LEAK TESTS AND PERFORMANCE TESTS WILL HAVE VALID CALIBRATION CERTIFICATE WITH TRACEABILITY TO NATIONAL LEVEL.								
Critical Category is HOLD point.		This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing is permitted.. 24 Hrs advance notice to be given to TATA POWER FQC. Contractor /sub contractor shall not process activity beyond HOLD point without written permission by TATA POWER FQC. This activity shall be performed by Main & Sub- Contractor (Execution + FQC) & witnessed jointly by TATA POWER (Execution + FQC). (Surveillance by Head FQC / Project Head).						
Major Category is Witness point.		This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing, 24 Hrs advance notice to be given to TATA POWER (Execution) . Contractor /sub contractor shall not process activity beyond Witness point without written permission by TATA POWER (Execution). This activity shall be performed by Main and Sub- Contractor (Execution + FQC) & witnessed by TATA POWER Execution & Surveillance by FQC.						
Minor Category is Review point.		This activity required review of documents by TATA POWER for the compliance & acceptance. However 24 Hrs advance intimation to be given to TATA power (Execution). This activity shall be performed by Main and Sub- Contractor (Execution +FQC) . (Surveillance by Execution / Project Head).						
		TATA POWER reserves the right to carryout surveillance at any point of time through FQC.						
Fibre Optic cable is not covered in this FQP.								
STORAGE TYPE:								
TYPE-1: OPEN AREA & ABOVE GROUND ON WOODEN PLANK WITH SLOPE FOR WATER DISPOSITION.								
TYPE-2: OPEN AREA & ABOVE GROUND ON WOODEN PLANK (WITH SLOPE FOR WATER DISPOSITION) AND COVERED WITH TARPAULIN.								
TYPE-3: OPEN SHED WITH FULLY FORMED FLOORING/CEMENT FLOORING.								
TYPE-4: COVERED SHED/STORE ROOM ON RACKS & IDENTIFIED LOCATION.								
TYPE-4A: CLOSED CHAMBER WITH TEMPERATURE & HUMIDITY CONTROL.								
NOTE: Items/equipments having shelf life like paints, alumina, desiccant etc. are to be stored separately for identification purpose.								
Rev. No	Reason for Revision	Prepared By & Date	Checked By & Date	Approved By & Date	Issued By.			
RO	ISSUE FOR USE	SR / 08.09.2015	CE / 08.09.2015	SS				
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TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing				
TPQAIT-QAXX-00-EX-SQP-123 REV.0		STANDARD QUALITY PLAN FOR CABLE TRAY			Issue date: 03/10/2015	

Sr. No	COMPONENT / OPERATION		CHARACTERISTICS CHECKED	TYPE / METHOD	REMARKS
1	2		3	4	5
1.0	MATERIAL:	(All material shall be as per approved drawing/ data sheet).			
1.1	Aluminium alloy sheet/ lamination/ Extrusion	1	Chemical composition, Mechanical properties,	Review of MTC (IS:5082)	Corelated MTC review
1.2	Fasteners, Hardware, fish plates	1	Hot dipped galvanizing.	Review of MTC (IS: 2629)	
2.0	INPROCESS INSPECTION: (Generally in line with manufacturers standard)				
2.1	Fabrication of sheet	1	Welding Procedure Specification (WPS), Procedure Qualification Record (PQR), Welder Performance Qualification (WPQ), Weld visual	Review and checking of documents	Welding shall be done by qualified welder.
2.2	PRE Galvanizing	1	Cleaning by seven tank process	Testing & Measurement on each lot.	Verification of test records by customer at the Time of Final Inspection
3.0	FINAL TESTS: (as per IS 2633, IS 2629, IS 4759, Approved drawing, Datasheets & BOM)- CHP				
3.1	Routine Tests (Cable tray & MS support structure)	1	Dimension checks	Testing & Measurement on 10% of random sample	CHP (Customer hold point) To be witnessed by Customer
		2	Galvanizing test- Thickness & uniformity of zinc coating as per IS 2629 & 6745		
		3	Free from defects like zinc lumps, discoloration. Black spots, waviness, welding spatters, sharp edges.		
		4	Adhesion test (Knife test or by Pivot hammer test as per IS 2629)		
		5	Preece test as per IS 2633		
		6	Interchangeability of coupler plates and fasteners	Testing on one sample of each size / lot.	
		7	Deflection test (Bend test) at designed load in case of cable tray		
4.0	Document review & Issuance of IRN				
4.1	Document review & Issuance of IRN	1	Review of Quality dossier & Inspection report	Review	
NOTE	A) STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR. B) ALL MATERIAL SHALL BE AS PER APPROVED DRAWINGS / DATA SHEET. C) TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY. D) MAUFACTURER TO SUBMIT ROUTINE TEST RESULTS. FINAL INSPECTION OF THE MAJOR ACTIVITIES ARE WITNESSED BY CLIENT AND IT IS HOLD POINT (AT THE DISCRETION TATA POWER) E) MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE INCLUDING ADDITIONAL TESTING REQUIREMENTS AS PER CONTRACT SPECIFICATION. F) SPARES SHALL BE MANUFACTURED & INSPECTED AS PER APPLICABLE CLAUSES OF THIS QUALITY PLAN. SPARES OFFERED FOR INSPECTION SHALL BE PREFERRED ALONG WITH MAIN ITEMS (IF ORDERD). G) CALIBRATION CERTIFICATES OF THE EQUIPMENT USED FOR TESTING SHALL BE PROVIDED FOR REVIEW. H) AS PER SEPCIFICATION PROPER PAINTING & PACKING SHALL BE ENSURED BY VENDOR BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE. I) TATA POWER RESERVES THE RIGHT TO DEMAND / VERIFY/ AUDIT/ WITNESS ANY OF THE CHECK POINTS MENTIONED IN THE SCOPE OF SUPPLIER.				
	Meant for (Internal Circulation / External – Stakeholders Circulation)				
	R0		 R.R. Patil	 C.R. Bhonslay	 S. Simlai
	Rev No	Reason for Revision	Prepared By & Date	Checked By & Date	Approved By & Date

TATA POWER		The Tata Power Company Limited. Corporate Engineering-Quality Assurance Inspection & Testing.							
TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).					Date of Issue: September 2015.		
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS	
1	2	3	4	5	6	7	8	9	
1.0	MATERIAL RECEIPT.	Check cable type, quantity and size.	Major	Visual	100%	MDCC/IRN & Packing list.	Site register	Joint Report (site QC/store & contractor) to be prepared in case of damage.	
		Report shortage/damage, if any (including cable drum).	Major	Visual	100%		Site register		
		Unloading of cable without damage.	Major	Visual	100%		log book, store register.		Spreader to be used for the slings while unloading cable.
		Storage type: TYPE 1.	Major	Visual	100%		Site register		Cable drums are stored in cable yards in open plots. Proper access should be there for trailer and crane.
2.0	MATERIAL STORAGE.	Drum must be stacked or stored standing on the flanges, not lying flat. Wood chocks should be placed under the flanges to prevent accidental rolling. When stacking it is essential to have the flanges meet, particularly with heavy drums.	Major	Visual	100%	Manufacturer's instructions	Site register	For long storage, periodic visual inspection of cable drums to be carried out.	
		NOTE: For Cable drums stored for long time (more than a year) in water logging area or with damaged drums, IR & HV (as recommended below) to be done before cannibalization and shifting to covered storage area for use at later stage.							



TATA POWER		The Tata Power Company Limited. Corporate Engineering-Quality Assurance Inspection & Testing.						
TPQA/IT-QA/XX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).					Date of Issue: September 2015.	
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
3.0	PRE-ERECTION (Preparedness).	<u>Planning:</u> Check availability of cabling notes, layout drawings, drum schedules etc.	Major	N/A	N/A	Engineering & approved notes and details	N/A	
		<u>Route survey:</u> i. Check availability of the route for laying of cable as per approved drawings. ii. Check for readiness of cable tray/ trench. iii. Check for any obstacles in conduits/ hume pipes. iv. Check for any crossover of water line/ drain line/ road etc. v. Preparation of bedding incase of directly buried trench.	Major	Visual	100%	Manufacturer's instructions	Site register	1) Intr trench diversion of other utilities may be required. 2) Joint bays to be prepared at either ends. 3) Check the trench for proper cable bending radius. 4) Barricading, Walkways and proper lighting should be provided on site.
		<u>Availability of Resources:</u> i. Check for arrangement of backfilling, protective tiles, caution tape and cable route markers etc. ii. Availability of tools and tackles: Like Drum handling equipment, cable pulling equipment, jacks, megger, rollers etc.	Major	Visual	100%	Manufacturer's instructions	Site register	Cable laying equipments like winch, power rollers and other rollers should be properly placed at site.



TATA POWER		The Tata Power Company Limited. Corporate Engineering-Quality Assurance Inspection & Testing.						
TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).				Date of Issue: September 2015.		
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
4.0	ERECTION.	Transportation of cable drums to site (Check IR Value before shifting from stores).	Major	Visual	100%	Cable schedule/ Approved layout drawings.	erection protocol	
		Cable pulling (Check for use of rollers & tolls for pulling).	Major	Visual	100%	Manufacturer's instructions.	erection protocol	
		<u>Cable cutting/laying:</u> 1. HT, Power, Control & Instrumentation Cables shall be laid separately in the designated cable trays. 2. For trenches, minimum 300 mm gap shall be maintained between, HT/Power & Control/Instrumentation cables.	Major	Visual	100%	Manufacturer's instructions/ Cable schedule/ Approved layout drawings.	erection protocol	
		<u>For directly buried cables:</u> following steps to be followed. 1. Cable trench (min 1.0 mtr deep/ as per drawing) to be prepared. 2. Ensure 4-6 inch sand bedding before laying of cable. 3. After laying of cable ensure 300 mm of sand over cable. 4. Place protective tiles above sand. 5. Fill soil above tiles. 6. Place Caution tape on Soil in the trench (below 300 - 450 mm of ground level). 7. Fill the trench with soil to level. 8. Conduits to be used for cable crossing water line/ drain line/ road etc.	Major	Visual	100%	Approved layout drawings/ IS:1255.	erection protocol	Fluidized Thermal Backfill (FBT) is recommended for Increased Ampacity & Thermal Stability. Recommended composition of FBT: 87% Sand. 11% Fly ash. 2% Cement.



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Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
4.0	ERECTION.	MARKING & TAGGING: i. Ensure Route marking for cables routed through underground. ii. For Cables laid in cable trays, Tagging of cables along the cables to be done at 50 mtr intervals and at both sides of corners.	Major	Visual	100%	Cable schedule/ Approved layout drawings	erection protocol	
		Cables Dressing for HT cables: i. Use Trefoil clamps for single core cables (crossing at equal intervals and in reference with other laid trefoiled cables). ii. 3 core cables shall be laid in single layer. iii. Cables shall not be laid crossing each other, min gap of 300mm shall be ensured between cable, if crossing is necessary.	Major	Visual	100%	Cable schedule/ Guidelines.	erection protocol	
		Check Glanding, Termination, straight jointing (if required), support arrangement for cable & ferruling.	Major	Visual, Measurement	100%	Manufacturer's instructions/ Cable schedule/ Approved layout drawings	erection protocol	Certified Jointers to carryout the termination.
		For HT cables: End termination, cables straight jointing and installation of other accessories.	Major	Visual	100%		erection protocol	
		Ensure clearances, earthing, protection from sharp edges & continuity of armour. (As applicable).	Major	Visual	100%		erection protocol	



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TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).					Date of Issue: September 2015.	
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
		Insulation Resistance measurement.	Major	Measurement	100%	Mfr's instructions/ IS 1255.	Test Report	
		HV test:						
		a. For PVC/PILC Cables: DC Hipot with 2 times the rated voltage of cable or 80% of the factory test voltage for 1 minute.	Critical.	testing.	100%	Manufacturer's instructions/ IS 1255/ Factory TC.	Test Report	
		b. For XLPE cable: AC Hipot / Very Low Frequency Hipot (less than 1Hz).	Critical.	testing.	100%		Test Report	
		After HV test for HT cables: Insulation Resistance measurement.	Critical.	Measurement	100%		Test Report	
		Phasing check at both ends for power cables.	Critical.	Visual	100%	Approved layout drawings	Test Report	
		Check loop checks, continuity checks for C&I cables.	Major	Visual	100%	Approved layout drawings	Test Report	
		For HT Cables: Check grounding of sheath (one end for single core cables & both ends for multi core cables).	Critical.	Physical.	100%	Manufacturers Instruction.	erection protocol	
		HT Cable system: Test charge at minimum relay settings and then the same is continued for next 24 hrs as Soak test.	Critical.	Measurement	100%	Manufacturer's instructions	Commissioning Protocol	
		On successful completion of Soak Test, the cable system to be released for Load service.	Critical.	Measurement	100%	_____	Test Report	
5.0	Pre-commissioning & Commissioning checks.							

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TPQAIT-QAXX-00-EX-FQP-161 Rev.0.		STANDARD FQP FOR CABLE INSTALLATIONS (Upto 33KV).					Date of Issue: September 2015.	

Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
N O T E	A) STATUTORY REQUIREMENTS WILL BE COMPLIED WITH BY THE CONTRACTOR. B) FOR STAGES WITNESSED / DOCUMENTS REVIEWED BY TATA POWER, COPIES OF RELEVANT DOCUMENTS WILL BE FURNISHED TO TATA POWER. C) TATA POWER / ITS REP. IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED / GOT TRANSFERRED BY TATA POWER / ITS REP AT APPROPRIATE STAGES. (IF REQUIRED). D) THE EXTENT INDICATED IN COLUMN 6 IS IN CONTRACTOR'S SCOPE. TATA POWER MAY INSPECT AS PER THIS COLUMN OR RANDOM SAMPLES AT ITS DISCRETION. E) COLUMN 7 WILL BE AS PER TATA POWER APPROVED DRAWINGS / DATA SHEETS / CONTRACT DOCUMENTS WHEREVER APPLICABLE. F) INSTRUMENTS FOR LEAK TESTS AND PERFORMANCE TESTS WILL HAVE VALID CALIBRATION CERTIFICATE WITH TRACEABILITY TO NATIONAL LEVEL.							
	Critical Category is HOLD point.	This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing is permitted.. 24 Hrs advance notice to be given to TATA POWER FQC. Contractor /sub contractor shall not process activity beyond HOLD point without written permission by TATA POWER FQC. This activity shall be performed by Main & Sub- Contractor (Execution + FQC) & witnessed jointly by TATA POWER (Execution + FQC). (Surveillance by Head FQC / Project Head).						
	Major Category is Witness point.	This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing, 24 Hrs advance notice to be given to TATA POWER (Execution) . Contractor /sub contractor shall not process activity beyond Witness point without written permission by TATA POWER (Execution). This activity shall be performed by Main and Sub- Contractor (Execution + FQC) & witnessed by TATA POWER Execution & Surveillance by FQC.						
	Minor Category is Review point	This activity required review of documents by TATA POWER for the compliance & acceptance, However 24 Hrs advance intimation to be given to TATA power (Execution). This activity shall be performed by Main and Sub- Contractor (Execution +FQC) . (Surveillance by Execution / Project Head).						
	TATA POWER reserves the right to carryout surveillance at any point of time through FQC.							

Fibre Optic cable is not covered in this FQP.

STORAGE TYPE:

TYPE-1: OPEN AREA & ABOVE GROUND ON WOODEN PLANK WITH SLOPE FOR WATER DISPOSITION.

TYPE-2: OPEN AREA & ABOVE GROUND ON WOODEN PLANK (WITH SLOPE FOR WATER DISPOSITION) AND COVERED WITH TARPAULIN.

TYPE-3: OPEN SHED WITH FULLY FORMED FLOORING/CEMENT FLOORING.

TYPE-4: COVERED SHED/STORE ROOM ON RACKS & IDENTIFIED LOCATION.

TYPE-4A: CLOSED CHAMBER WITH TEMPERATURE & HUMIDITY CONTROL.

NOTE: Items/equipments having shelf life like paints, alumina, desiccant etc. are to be stored separately for identification purpose.

Rev. No	Reason for Revision	Prepared By & Date	Checked By & Date	Approved By & Date	Issued By.
RO	ISSUE FOR USE	SR / 06.09.2015	CB / 06.09.2015	SS	

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TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance & Inspection						
TPQAIT-QAXX-00-EX-FQP-130 REV.0		FIELD QUALITY PLAN FOR GALVANISED CABLE TRAY INSTALLATION WORK						
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS Checked	CLASS OF Check	TYPE OF Check	EXTENT / FREQUENCY OF Check	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
1.0	<u>Receipt of Material</u>	Avallability of Drawings, quality dossier including IRN. Joint inspection of material to check for any visual damage and shortage during transit.	Major	Physical	100% 100%	IRN, MDCC, Bill of material, shipping list	Site Inspection register	In case of transit damage/ short supply, report in this regard shall be considered as "critical activity".
2.0	<u>Storage & Preservation</u>	Storage in open area and above ground on wooden planks with slope for water disposition and covered with plastic paper in case of long storage (Storage Type-1) Check the cable tray laid as per Layout Drawing & Specification. Check the spacing of cable tray supports & alignment Check that cable trays are not interfering with any process lines, no blocking in hume pipes or ducts. Check the site welding quality of cable tray supports and painting or supports are anchored properly before tray installation.	Minor	Physical	100%	Instruction manual	Site Inspection register	
3.0	<u>ERECTION</u>	Check the continuity of trays and tightness of nut bolts of fish plates (at random) over the entire route (Welding should be avoided) Check welding of earthing strip with tray at every 10mtr interval and tapping for other trays (as required) Clamping and fixing of cable trays with support structure. Check for minimum gap of 300MM between adjacent cable tray tiers. Use of Pre-fabricated bends particularly at bends, joints and risers. (Cable trays shall be free from sharp edges) Check cable tray marking as per layout drawing (as applicable)	Major	Physical	100%	Approved drawing / Lay out	Site test report	
4.0	<u>Handing Over</u>	Area wise compilation of inspection protocol including closure of non conformance (if any)	Major Page 1 of 2	Physical	100%	NA	*SWCF	Site work completion file
	<u>Final documentation</u>							

Rev

TPQAIT-QAXX-00-EX-FQP-130
REV.0

**FIELD QUALITY PLAN FOR
GALVANISED CABLE TRAY INSTALLATION WORK**

Sr. No	COMPONENT / OPERATION	CHARACTERISTICS Checked	CLASS OF Check	TYPE OF Check	EXTENT / FREQUENCY OF Check	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
	Critical Category is HOLD point.	This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing is permitted.. 24 Hrs advance notice to be given to FQC. Contractor /sub contractor shall not process activity beyond this point without written permission by TATA POWER FQC. (This activity shall be formed by TATA POWER (Execution + FQC), Main & Sub- Contractor (Execution + FQC). (Also Surveillance by Head FQC / Project Head)						
	Major Category is Witness point.	This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing. 24 Hrs advance notice to be given to TATA POWER (Execution) . Contractor /sub contractor shall not process activity beyond Witness point without written permission by TATA POWER (Execution). This activity shall be performed by TATA POWER (Execution), Main and Sub- Contractor (Execution + FQC). (Surveillance by FQC)						
	Minor Category is Review point.	This activity required review of documents by TATA POWER for the compliance & acceptance, However 24 Hrs advance notice to be given to TATA power (Execution). (Surveillance by Execution / Project Head).						
		TATA POWER FQC is also authorized to carryout surveillance in any major & minor class of check at their discretion.						

STORAGE TYPE:

TYPE-1: OPEN AREA & ABOVE GROUND ON WOODEN PLANK WITH SLOPE FOR WATER DISPOSITION.

TYPE-2: OPEN AREA & ABOVE GROUND ON WOODEN PLANK (WITH SLOPE FOR WATER DISPOSITION) AND COVERED WITH TARPAULIN.

TYPE-3: OPEN SHED WITH FULLY FORMED FLOORING/CEMENT FLOORING.

TYPE-4: COVERED SHED/STORE ROOM ON RACKS & IDENTIFIED LOCATION.

TYPE-4A: CLOSED CHAMBER WITH TEMPERATURE & HUMIDITY CONTROL.

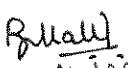
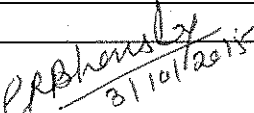
NOTE: Items/equipments having shelf life like paints, alumina, desiccant etc. are to be stored separately for identification purpose.

	 12/08/2016.	 12/08/2016.	
Rev. No	Reason for Revision	Prepared By & Date	Checked By & Date
RO	ISSUE FOR USE	RRP / 3.8.2016	CRB/ 3.8.2016
Approved By & Date SS /			

TATA POWER	The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing	 TATA
TPQAIT-QAXX-00-EX-SQP-131 REV.0	STANDARD QUALITY PLAN FOR EARTHING MATERIAL	Issue date 03/10/2015

Sr. No	COMPONENT / OPERATION		CHARACTERISTICS CHECKED	TYPE / METHOD	REMARKS
1	2		3	4	5
1.0	MATERIAL:	(All material shall be as per approved drawing/ data sheet).			
1.1	Aluminium Rod, Al flat, Al air termination rod, Al alloy material Carbon steel / MS steel Earthing spike, GI / MS flat,	1	Chemical.composition, Mechanical properties,	TC Verification (IS:5082)	Corelated MTC review
1.3	Copper Rod, CU plate, flat, air termination rod	1	Chemical Composition, Electrical conductivity, Copper purity, Tinning.	TC Verification (IS: 191)	
2.0	INPROCESS INSPECTION: (Generally in line with manufacturer standard)				
2.1	Fabrication of sheet	1	Welding Procedure Specification (WPS), Procedure Qualification Record (PQR), Welder Performance Qualification (WPQ), Weld visual	Review and checking of documents	Welding shall be done by qualified welder. <i>where applicable</i>
2.2	PRE Galvanizing	1	Cleaning by seven tank process	Testing & Measurement on each lot.	Verification of test records by customer at the Time of Final Inspection
3.0	FINAL TESTS: (as per IS 2633, IS 2629, IS 4759, IS 6745 Approved drawing, Datasheets & BOM)				
3.1	Routine Tests.	1	Dimensional checks	Testing & Measurement on 10% of random sample	CHP (Customer hold point) To be witnessed by Customer
		2	Visual for appearance & surface condition		
		3	Galvanizing test- Thickness & uniformity of zinc coating as per IS 2629 & 6745		
		4	Free from defects, zinc lumps and discoloration		
		5	Adhesion test (Kniff test or pivote hammer test)		
4.0	Document review & Issuance of IRN				
4.1	Document review & Issuance of IRN		Review of Quality dossier & Inspection report	Review	
NOTE	A) STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR.				
	B) ALL MATERIAL SHALL BE AS PER APPROVED DRAWINGS / DATA SHEET.				
	C) TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY.				
	D) MAUFACTURER TO SUBMIT ROUTINE TEST RESULTS. FINAL INSPECTION OF THE MAJOR ACTIVITIES ARE WITNESSED BY CLIENT AND IT IS HOLD POINT (AT THE DISCRETION TATA POWER)				
	E) MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE INCLUDING ADDITIONAL TESTING REQUIREMENTS AS PER CONTRACT SPECIFICATION.				
	F) SPARES SHALL BE MANUFACTURED & INSPECTED AS PER APPLICABLE CLAUSES OF THIS QUALITY PLAN. SPARES OFFERED FOR INSPECTION SHALL BE PREFERRED ALONG WITH MAIN ITEMS (IF ORDERD).				
	G) CALIBRATION CERTIFICATES OF THE EQUIPMENT USED FOR TESTING SHALL BE PROVIDED FOR REVIEW.				
	H) AS PER SEPCIFICATION PROPER PAINTING & PACKING SHALL BE ENSURED BY VENDOR BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE.				
	I) TATA POWER RESERVES THE RIGHT TO DEMAND / VERIFY/ AUDIT/ WITNESS ANY OF THE CHECK POINTS MENTIONED IN THE SCOPE OF SUPPLIER.				

Meant for (Internal Circulation / External – Stakeholders Circulation)

		 R. R. Patil	 C. R. Bhonslay	 S. Simlai
R0				
Rev No	Reason for Revision	Prepared By & Date	Checked By & Date	Approved By & Date

TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance & Inspection.					TATA	
TPQA&I-QAXX-00-EX-SFP-270 REV.0		STANDARD FQP FOR EARTHING INSTALLATIONS.					Date of Issue: March 2017.	
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9
		2.7	Check for overlapping (1.5 to 2 times) of joints for welding of earthing connection.	Major	Visual	100%	Approved drawing.	Erection protocol.
		2.8	Ensure welding at all sides of joint & application of bitumen for welded portion of earthing connection.	Major	Visual	100%		
		2.9	Check the earthing scheme and ensure that tapings are brought out from grid earth mat and connected to all structures, equipments, rails, gates, yard, fencing etc.	Minor		100%	Approved layout drawing.	Erection protocol.
		2.10	Ensure that earthing links are properly connected and tightened.	Major		100%	GA drawing.	
		2.11	Check for tightness of the earthing shield wire clamps for cable earthing.	Major	Physical.	100%		
		2.12	Measure grid earth resistance and check the interconnection of station earthing to main line earthing.	Major		100%	Installation drawing.	Erection protocol.
		2.13	Check for marking earth pit with resistance value and the completion of masonry work and fixing of cover on pit and identification.	Major		100%		
3.0	PRE-COMMISSIONING.	3.1	Check for earthing values for all earth pits.	Testing & Physical.	100%	Approved drawing, data sheet & Mfr. Installation manual.	Site Test Report	
		3.2	Check for tightness of all connections and provision for test links.					
		3.3	Ensure that the connected grid value is as per specification.					
4.0	COMMISSIONING.	Ensure that all links are connected.	Critical	Measurement.			Commissioning Protocol.	
5.0	Handing Over.	Submission of document dossier.	Critical					

Signature

TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance & Inspection.							
TPQA&IQAXX-00-EX-SFP-270 REV.0		STANDARD FQP FOR EARTHING INSTALLATIONS.					Date of Issue: March 2017.		
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	CLASS OF CHECK	TYPE OF CHECK	EXTENT / FREQUENCY OF CHECK	REFERENCE DOCUMENTS / ACCEPTANCE NORM	FORMAT OF RECORD	REMARKS	
1	2	3	4	5	6	7	8	9	
A) STATUTORY REQUIREMENTS WILL BE COMPLIED WITH BY THE CONTRACTOR. B) FOR STAGES WITNESSED / DOCUMENTS REVIEWED BY TATA POWER, COPIES OF RELEVANT DOCUMENTS WILL BE FURNISHED TO TATA POWER. C) TATA POWER / ITS REP. IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED / GOT TRANSFERRED BY TATA POWER / ITS REP AT APPROPRIATE STAGES (IF REQUIRED). D) THE EXTENT INDICATED IN COLUMN 6 IS IN CONTRACTOR'S SCOPE. TATA POWER MAY INSPECT AS PER THIS COLUMN OR RANDOM SAMPLES AT ITS DISCRETION. E) COLUMN 7 WILL BE AS PER TATA POWER APPROVED DRAWINGS / DATA SHEETS / CONTRACT DOCUMENTS WHEREVER APPLICABLE. F) INSTRUMENTS FOR LEAK TESTS AND PERFORMANCE TESTS WILL HAVE VALID CALIBRATION CERTIFICATE WITH TRACEABILITY TO NATIONAL LEVEL.									
Critical Category is HOLD point		This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing is permitted., 24 Hrs advance notice to be given to TATA POWER FQC. Contractor /sub contractor shall not process activity beyond HOLD point without written permission by TATA POWER FQC. This activity shall be performed by Main & Sub- Contractor (Execution + FQC) & witnessed jointly by TATA POWER (Execution + FQC). (Surveillance by Head FQC / Project Head).							
Major Category is Witness point		This activity required inspection / Verification & acceptance by inspection authority responsible for this stage before further processing. 24 Hrs advance notice to be given to TATA POWER (Execution) . Contractor /sub contractor shall not process activity beyond Witness point without written permission by TATA POWER (Execution). This activity shall be performed by Main and Sub- Contractor (Execution + FQC) & witnessed by TATA POWER Execution & Surveillance by FQC.							
Minor Category is Review point		This activity required review of documents by TATA POWER for the compliance & acceptance. However 24 Hrs advance intimation to be given to TATA power (Execution). This activity shall be performed by Main and Sub- Contractor (Execution +FQC). (Surveillance by Execution / Project Head).							
TATA POWER reserves the right to carryout surveillance at any point of time through FQC.									
STORAGE TYPE: TYPE-1: OPEN AREA & ABOVE GROUND ON WOODEN PLANK WITH SLOPE FOR WATER DISPOSITION. TYPE-2: OPEN AREA & ABOVE GROUND ON WOODEN PLANK (WITH SLOPE FOR WATER DISPOSITION) AND COVERED WITH TARPAULIN. TYPE-3: OPEN SHED WITH FULLY FORMED FLOORING/CEMENT FLOORING. TYPE-4: COVERED SHED/STORE ROOM ON RACKS & IDENTIFIED LOCATION. TYPE-4A: CLOSED CHAMBER WITH TEMPERATURE & HUMIDITY CONTROL. NOTE: Items/equipments having shelf life like paints, alumina, desiccant etc. are to be stored separately for identification purpose.									
Rev. No	Reason for Revision	Prepared By & Date	Checked By & Date	Approved By & Date					Issued By.
RO	ISSUE FOR USE	SR / 15.03.2017	CB / 15.03.2017	SS					
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TATA POWER

The Tata Power Company Limited
Corporate Engineering-Quality
Assurance
Inspection & Testing



TPQAIT-QAXX-00-EX-SQP-072
REV.0

STANDARD QUALITY PLAN
FOR INDOOR
MEDIUM VOLTAGE
SWITCHGEAR
(3.3KV TO 33KV)

Date of Issue:

Document Title
STANDARD QUALITY PLAN FOR
INDOOR MEDIUM VOLTAGE
SWITCHGEAR (3.3KV TO 33KV)

		<i>R. Kalil</i> 30/03/2015	<i>CRB Shende</i> 30/03/2015	<i>A. Shetty</i> 30/03/15	
0	Initial Submission.	RP	CRB (Head QAI- E)	SGP Chief (QAIT)	
Revision No.	Reason for revision	Prepared By & Date	Checked By & Date	Approved By & Date	Issued by & Date

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TATA POWER

The Tata Power Company Limited

Corporate Engineering-Quality Assurance Inspection & Testing



TATA

TPQAIT-QAXX-00-EX-SQP-072 REV.0		STANDARD QUALITY PLAN FOR INDOOR MEDIUM VOLTAGE SWITCHGEAR (3.3KV TO 33KV)			Date of Issue:
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	REMARKS	
1	2	3	4	5	
1.0	MATERIAL:	(Generally in-line with manufacturer standard / technical specification)			
1.1	Sheet Metal	1 Verification of raw material properties, dimension check, Mechanical, Electrical & Chemical Properties.	Test to be carried out by material / component supplier.	All items TCs to be reviewed by main supplier. (The TCs for CT, PT, Relay, interrupter, MFM are to be submitted to TATAPOWER as per requirement.)	
1.2	Copper bus bar	2 Purity of copper, conductivity, hardness,			
1.3	Interrupter	1 Contact Resistance	Test to be carried out by material / component supplier as per IS-13118/ IEC 62271-100 & 200		
		2 Vacuum bottle routine test			
		3 HV & IR test Test			
		4 Mechanical endurance test			
		5 Electrical endurance tests			
1.4	CT	1 CT Ratio, Polarity, kV, ISF, Accuracy	Test to be carried out by material / component supplier as per IS 2705/ IEC 60044		
		2 HV & IR test Test			
		3 PD Test			
		4 Secondary Resistance			
		5 Interturn Insulation test			
1.5	PT	1 PT Ratio, Polarity,	Test to be carried out by material / component supplier as per IS 4146/ IEC 60044		
		2 Secondary Induced Voltage Test			
		3 HV Test & IR test			
		4 PD Test			
		5 Primary and Secondary Resistance			
1.6	Multi Function Meter (MFM)	1 Performance & Accuracy	Test to be carried out by material / component supplier		
		2 Dimension			
		3 Make Type Rating			
		4 2 kV HV test			
		5 IEC 61850 Compatibility			
1.7	Relay	1 Performance & Functional Checks	Test to be carried out by material / component supplier		
		2 Make, Type, Rating			
		3 2 kV HV test			
		4 IEC 61850 Compatibility			
1.8	Insulator	1 As per IS-7315621, IEC 575, IEC 60233 IS 9431.	Test to be carried out by material/component supplier		
2.0	INPROCESS INSPECTION: (Generally inline with manufacturing plan)				
1.0	Panel Fabrication	1 Dimensional Conformity, Bend Angle, Profile, Deburring & welding finish, slag removal.	Checks/tests to be carried out by main supplier	Verification of Records by TATA POWER.	
		2 Surface preparation			
		3 Surface Finish, Paint Shade, Finishing, Coating thickness.			
4.0	Panel Assembly test	1 Functional tests,			
		2 Scheme checks			
		3 Clearance checks			
		4 HV & IR on power and control circuit.			
		5 Conformance to the GA drawing.			
		6 Tinning/ silver coating verification of bus bar joint			
		7 Contact Resistance of bus bar joint			
		8 Measurement of tightness of bus bar joints by torque wrench.			
3.0	FINAL INSPECTION: (As per approved GA, data sheet, wiring diagram, QAP & IEC 62271-100 & 200/ IEC 60694)				
3.1	Routine tests	1 Visual & dimensional Check including layout, tag plates, paint shade, paint thickness, bus markings and sleeving, Joint shrouding of bus bar, clearance checks, creepage distance checks, maintenance accessibility, door alignment, IP class, lifting arrangement, earthing point, surface finish etc	Testing & Measurement as per IEC 60694/IEC 62271-100 & 200	Customer Hold Point (CHP)	
		2 Bill of material checks (Make, rating, Name plates etc.)			
		3 Interchange ability of identical modules / Feeders and rack-in and out operation.			
		4 Verification of bus bar support arrangements with respect to type tested panel drawings, provision of external cable termination and bus duct as applicable.			
		5 Wiring checks for control and auxiliary equipments circuits and aux. contacts			
		6 Measurement of tightness of bus bar joints by torque wrench.			
		7 Relay operation checks through secondary injection.			
		8 Insulation Resistance of main, aux. and control circuits before and after HV test			

TATA POWER		The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing			
TPQAIT-QAXX-00-EX-SQP-072 REV.0		STANDARD QUALITY PLAN FOR INDOOR MEDIUM VOLTAGE SWITCHGEAR (3.3KV TO 33KV)		Date of Issue:	
Sr. No	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	REMARKS	
1	2	3	4	5	
	Routine tests	9 Visual as well as operational checks for Panel indications, annunciations, any analog monitoring devices such as Ammeter, Voltmeter or Energy meter 11 HV test on power and control circuit. 12 Communications checks between relay and data concentrator / HMI, if applicable 13 Electrical operation test at control (auxiliary) voltage-(Clause no IEC62271-200- 7.102) 13.1 5 Close and 5 Open operation at 110% of Rated control Voltage. 13.2 5 Close and 5 Open operation at 100% of Rated control Voltage. 13.3 5 Close operation at 85% of Rated control Voltage. 13.4 5 Open Operation at 70% of Rated control Voltage. 13.5 5 CO Operation at 100% of Rated control Voltage. 14 Measurement of insulation resistance of Circuit Breaker in closed, open position. 15 Measurement of milli-volt drop across Circuit Breaker main contacts, other joints and also across bus bar joint. 16 Measurement of resistance, IR value and drop-off/pick-up voltage of close and trip coils 17 Healthiness of limit switch contacts 18 Spring charging motor functional checks 19 Operational checks of all control functions and interlocks as per schematic drawings in service and test conditions. 20 Measurement of CT/PT polarity, ratio, secondary resistance and knee point voltage from terminal block. 21 Secondary injection of all metering circuits. 22 HMI operational and functional checks, if applicable 23 Shutter assembly interlock check and safety barrier operation check.	Testing & Measurement as per IEC 60694/IEC 62271-100 & 200	Customer Hold Point (CHP) *	
*CHP for 1, 2, 3, 8, 11, 17 will be 100% witness by TATA POWER, others tests can be done on random sample basis of typical (10% of qty or min 2).					
3.2	Type Tests	1 Short circuit making and breaking tests 2 Rated Short Time current withstand & peak withstand test. 3 Temperature Rise Test on bus bar and component contained in the metal enclosed switchgear. 4 Degree of protection of panels. 5 Lightning Impulse voltage test. 6 Electromagnetic compatibility (EMC). 7 Partial discharge test. 8 Internal Arc withstand test. 9 Any other special / type test as per technical specifications.	Testing & Measurement as per IEC 62271-200/ IEC 60694 standard). Will be conducted as per mutual agreement between supplier and customer	Valid TYPE tests certificate not older than 5 year is prerequisite.	
Any Separate Type/ Design validation tests shall be carried out in accordance with TATA POWER specification/ PO or as per mutually agreed in MQP.					
4.0	PACKING, PRE-SHIPMENT & DISPATCH:				
4.1	PACKING & PRE-SHIPMENT.	1 Visual Verification. 2 Packing in cartons. 3 Quantity Verification. 4 Identification.	Measurement & Visual.		
4.2	DISPATCH.	Issue of Release note / MDCC.		Customer Hold Point.	
N O T E	A) ALL MATERIAL SHALL BE AS PER APPROVED DRAWING/ DATA SHEET. B) STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR. C) TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY FOR MATERIAL TRACEABILITY. D) FINAL INSPECTION OF THE MAJOR ACTIVITIES ARE WITNESSED BY CLIENT AND IT IS HOLD POINT (AT THE DISCRETION TATA POWER) E) MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE F) INSPECTION OF THE MAINTENANCE SPARES SHALL BE OFFERED ALONG WITH THE MAIN SUPPLY AS PER THE INSPECTION STAGES OF 1 TO 4. G) CALIBRATION CERTIFICATES OF THE EQUIPMENT USED FOR TESTING SHALL BE PROVIDED FOR REVIEW. H) TATA POWER RESERVES THE RIGHT TO DEMAND / VERIFY / AUDIT / WITNESS ANY OF THE CHECK POINTS MENTIONED IN THE SCOPE OF SUPPLIER I) AS PER SPECIFICATION PROPER PAINTING & PACKING SHALL BE ENSURED BY VENDOR BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE.				
Meant for (Internal Circulation / External – Stakeholders Circulation)					

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Sl. No	DESCRIPTION	
1.0	PRICE SCHEDULE	
1.1.	GENERAL NOTES FOR PRICE SCHEDULE (Bill of Quantities)	
1.2.	SCHEDULE 1: RATES AND PRICES – SUPPLY, ERECTION TESTING & COMMISSIONING (ETC)	
1.3.	SCHEDULE-2: RATES AND PRICES FOR UNLOADING & SHIFTING OF THE ITEMS IN OWNERS SCOPE	
1.4.	SCHEDULE 2: GRAND SUMMARY	

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	TITLE GENERAL NOTES	
1.0 <u>GENERAL NOTES FOR PRICE SCHEDULE (Bill of Quantities)</u> 1.1 The Bill of Quantities shall be read in conjunction with the Technical Specification, tender drawings and tender documents. Bidder shall not rely merely on the description given in the Bill of Quantities. All the work shall conform to Technical Specification, and the quoted unit rates shall be deemed to include all works necessary to achieve this whether actually indicated under the item description or not. 1.2 Quantities of work indicated in the Schedule of Quantities are only approximate and are given to provide a common basis for tendering. No claim shall be entertained from Contractor if the actual quantities or items of work differ to any extent from those indicated herein. 1.3 The quotation submitted by Bidder should be based on the estimated quantities of the several items of work. It must be clearly understood that this Contract is not a lumpsum contract and that neither the approximate estimated quantities nor the values of the individual items nor the aggregate value of the entire tender will form a part of the Contract and the Owner does not in any way assure or guarantee Bidder that the work would correspond there to. 1.4 The quantities of work actually carried out (as evaluated from construction drawings and or field measurements) if directed by the Owner/Project Manager against each item will be measured and paid at the rates quoted in the Bill of Quantities, where applicable or otherwise at such rates and prices as may be fixed within the terms of the Contract. 1.5 Unit or lumpsum prices shall be quoted for all items and they shall be firm. If unit or lumpsum prices are not quoted against any of the items, the highest rate quoted among all other Bidder shall be consider for evaluation purpose. These rates shall include cost of all plant, labour, materials, oil and lubricant, transport, wastage, supervision, insurance, taxes, overheads, profits, etc. and every incidental and contingent cost and charges whatsoever required to complete the items of work in all respects and as per Technical Specification. 1.6 Bidder shall be deemed to have allowed in his unit rates and prices for the provision, maintenance and final removal of all temporary works of whatsoever nature required for the proper execution of the works. The unit rates shall also be deemed to include cost of any survey works that may be required to be carried out for laying out of all the works involved, cost of construction water and construction power. 1.7 Where there is a discrepancy between the unit rates and the amount entered, the unit rate shall govern for evaluating the correct amount. Rates and prices shall be entered only in the Bill of Quantities and rates given in any other format will be rejected and Bidder will be disqualified. 1.8 The rates quoted shall hold good for works above ground / below ground level irrespective of elevations including lifts or below ground/grade level inclusive of		
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dewatering where necessary. No extra amount is payable for dewatering under any circumstances. This shall also include the cost of materials utilized for testing. 1.9 The unit rates quoted shall hold good even if the shapes and sizes of members shown on bid drawings are modified while issuing the final drawings stamped 'Good for Construction'. No extra claims shall be entertained in this regard. 1.10 Basic rates of input materials shall be considered against all the items wherever applicable irrespective of its mention in BOQ item description. 1.11 Dewatering of any nature required for the entire scope of works & keeping the excavated area dry during execution, is included in the unit rates and no additional payment shall be made by the Owner in this regard. 1.12 During detailed design & engineering if requirement of any additional item arises the rate for the same shall be determined as mentioned in GCC/ SCC. 1.13 Bidder shall quote his Unit rates for all items in Price Schedules. The Owner reserves the right to operate /increase or decrease quantities in each item or omit any item included in price schedule at his discretion. Contractor shall have no claim, whatsoever, on grounds of loss of anticipated profit, etc. because of the same. 1.14 All works shall be carried out strictly as per the specification. 1.15 For all reinforced concrete works, bar bending schedule shall be prepared by the contractor and approval shall be taken from the Owner/Project Manager at site before cutting and placing the reinforcement. 1.16 The deviations taken from the drawings released for construction, during actual execution of work, shall be furnished in the form of a sketch / drawing by the Contractor for preparing As-built drawings. 1.17 Manufacturing and/or procurement shall be undertaken only after receipt of all requisite approvals from the Owner and issuance of approved construction drawings and shall be properly coordinated with the overall construction schedule. 1.18 Abbreviations used for the unit of various items are as below: t = tonne = MT= Metric Tons = 1000 kg kg = kilogram rm and m = running meter m³ = cubic meter (cum) m² = square meter (sqm) No. = Number Nos. = Numbers km = Kilometre LS = Lumpsum lit = litter		
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	TITLE PRICE SCHEDULE	

SCHEDULE-1: RATES AND PRICES

Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)			
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount
1.0	Installation, testing and commissioning of following MV Switchgear panel (including loading/unloading at site) as per specification & direction of Engineer-In charge										
1.1	MV Switchgear: 22 kV 3 phase, 50Hz, Floor mounted, Free standing, compartmentalised, draw-out type VCB panel (1 no. incomer + 2 nos. Outgoing feeder + 1No. Spare feeder+ Bus PT, refer SLD)	Set	1	NA	NA	NA	NA				
1.2	MV ICOG Panel: 22 kV 3 phase, 50Hz, Floor mounted, Free standing, compartmentalised draw-out type VCB panel (1 No. ICOG, refer SLD)	No	1	NA	NA	NA	NA				
2.0	Supply, Installation, testing and commissioning of following LV panel (including loading/unloading at site) as per specification & direction of Engineer In-charge										
2.1	415V, 3 phase, 50Hz, TPN, Floor mounted, Free standing, Compartmentalised, fixed type, 415V Substation Distribution board, refer SLD (Indoor Type)	No	1								
3.0	Supply, Installation, testing and commissioning of following Indoor Tariff metering panel & Audit metering panel (including loading/unloading at site) as per specification & direction of Engineer-In charge										
3.1	<u>Tariff metering panel at SS-1</u> a) Two meters: Secure Make Apex 150 3P4W, Self-Powered + Aux Power Accuracy Class: 0.2s PT: 22kV/√3 /110V/√3 CT: ***/1A, (Configurable 1-10A), RS-232, RS-485, Ethernet Configurable Pulse I/O: 4 Fixed Pulse O/P: 7 b) PQR (Power quality recorder) as per MSEDCL requirements c) Base Computer software: (M-cubed software with 5 year license) d) Meter Reading Instrument (MRI) Make-SANDS e) Meter to PC (Serial Communication Cable) f) USB to Serial Communication Cable Make : MOXA g) Modem Skyline E90, NbloT Modem Fall back to 2G	No.	1								
3.2	<u>Audit metering panel at SS-1</u> a) Four meters: Secure Make Apex 150 3P4W, Self-Powered + Aux Power Accuracy Class: 0.2s PT: 22kV/√3 /110V/√3 CT: ***/1A, (Configurable 1-10A), RS-232, RS-485, Ethernet Configurable Pulse I/O: 4 Fixed Pulse O/P: 7 b) PQR (Power quality recorder) as per MSEDCL requirements c) 8 Port Industrial LAN switch unmanaged	No.	1								

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	TITLE PRICE SCHEDULE											
Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)				
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount	
	d) Data Concentrator Unit (DCU)-Kalkitech Make											
3.3	DCU Sync & Configuration Services a) Integration of new meter with Kalkitech DCU (By MSETCL team) Coordination with MSETCL & Kalkitech team for data integration at SLDC. b) Supervision of Installation and Commissioning of APEX meters.	No.	1									
4.0	Supply, installation, testing and commissioning of following 22 kV MV Indoor CTPT panel as per specification & direction of Engineer-In charge											
4.1	22 kV Indoor metal clad CT PT Panel (Refer SLD) (To be complied MSEDCL requirement for metering)	Nos.	3									
5.0	Supply, installation, testing and commissioning of 22 kV Switchyard as per specification & direction of Engineer-Incharge											
5.1	22 kV, Double pole, 200x100mm RSJ structure with all supporting insulators, AB Switch with handle & locks, Lightning arrestor, LA copper rod, DO Fuse, Stay wire, required jumpers, bimetallic clamps, civil foundations, etc (Type -1)	Nos.	4									
5.2	22 kV, Double pole, 200x100mm RSJ structure with all supporting insulators, AB Switch with handle & locks, Lightning arrestor, LA copper rod, DO Fuse, Stay wire, required jumpers, bimetallic clamps, civil foundations, etc (Type -2)	No.	1									
5.3	22 kV, Double pole, 200x100mm RSJ structure with all supporting insulators, Lightning arrestor, LA copper rod, Stay wire, required jumpers, bimetallic clamps, civil foundations, etc (Type -3)	No.	1									
6.0	Installation, testing and commissioning of 22 kV Auxiliary transformer as per specification & direction of Engineer-Incharge											
6.1	Outdoor Transformer: 50 kVA, 22 kV/0.433 kV, ONAN, Z = *4%, OCTC with ±5% instep of 2.5%, including civil foundations.	No	1	NA	NA	NA	NA					
7.0	Supply, installation, testing and commissioning of Battery, charger & DB as per specification & direction of Engineer-Incharge											
7.1	1 x 100% 3phase, 415 V input & 110 V DC output, Float charger + Float cum Boost charger (FC+FCBC) suitable for 200Ah batteries (≥ 50 Amps) (It includes inward & outgoing cables of Batteries) with all accessories as required	No	1									
7.2	200Ah (1 x 100%) VRLA batteries with Battery racks and accessories as required (It includes cables for Batteries)	Lot	1									
7.3	110 V, DC Floor mounted Distribution board for the charger/battery, refer SLD.	No	1									
8.0	Installation, testing and commissioning of Single/Multicore, 22kV (E) grade stranded & compacted aluminium conductor, extruded semi conducting											

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	TITLE PRICE SCHEDULE	

Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)			
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount
	screen over conductor, XLPE insulated, semi-conducting followed by copper tape screened, extruded PVC Type ST – 2 inner sheathed, aluminium/GS wire armoured, overall FRLS PVC outer sheathed, conforming to IS 7098 (Part II) – Laid in overhead trays /trench/hume pipe/tunnel.										
	(Unit rate quoted for cable laying shall include supply & Installation of cable by 3mm nylon cord, Aluminium Cable identification plate at specified)										
8.1	3C X 300 Sq.mm	m	300	NA	NA	NA	NA				
9.0	Supply, installation, testing and commissioning of MV Power cable Terminations,										
	(Unit rate quoted for cable termination at one end shall include supply of all accessories like glands, lugs, etc as listed below, and dressing, connecting all the cores of the cables, making the requisite holes on the gland plate of the switchgear / any other panel / equipment, fixing glands, terminating the cables in the cable boxes, earthing of cable armour & glands, crimping of cable lugs on each, supply and fixing of core identifying ferrules on each, neatly clamping the cables inside switchgear / panel cable alleys, wiring troughs and connecting to terminals as per the wiring diagrams and schedules).										
9.1	22 kV (E) Grade cable termination including termination kit - indoor type										
9.1.1	3C X 300 Sq.mm	Nos.	12								
9.2	22 kV (E) Grade cable termination including termination kit - Outdoor type										
9.2.1	3C X 300 Sq.mm	Nos.	8								
9.3	22 kV (E) Grade cable joining including Jointing kit for the cables included in the scope										
9.3.1	3C X 300 Sq.mm	No.	1								
10.0	Supply, installation, testing and commissioning of 1.1 kV grade single/multi-core, stranded Copper/ Aluminium conductor, extruded XLPE insulated, with extruded PVC inner sheath (Type ST-2), armoured and overall sheath with extruded Flame Retardant Low Smoke (FRLS) PVC compound (Type ST-2). These cables shall conform to IS-7098-Part-I – Laid in overhead trays / trench / hume pipe / tunnel.										
	(Unit rate quoted for cable laying shall include supply & installation of cable by 3mm nylon cord, Aluminium Cable identification plate at specified interval)										
10.1	1.1 kV Grade Power cable										

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Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)			
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount
10.1.1	3C x 2.5 Sq.mm (Cu)	m	120								
10.1.2	4C x 4 Sq.mm (Cu)	m	60								
10.1.3	4C x 10 Sq.mm (Al)	m	20								
10.1.4	4C x 16 Sq.mm (Al)	m	30								
10.1.5	3.5C x 25 Sq.mm (Al)	m	50								
10.2	1.1 kV Grade Control cable (Copper)										
10.2.1	5C x 4 Sq.mm	m	90								
10.2.2	7C x 4 Sq.mm	m	90								
11.0	Supply, installation, testing and commissioning of LV Power, Control & signal cable Terminations,										
	(Unit rate quoted for cable termination at one end shall include supply of all accessories like glands, lugs, etc as listed below, and dressing, connecting all the cores of the cables, making the requisite holes on the gland plate of the switchgear / any other panel / equipment, fixing glands, terminating the cables in the cable boxes, earthing of cable armour & glands, crimping of cable lugs on each, supply and fixing of core identifying ferrules on each, neatly clamping the cables inside switchgear / panel cable alleys, wiring troughs and connecting to terminals as per the wiring diagrams and schedules).										
11.1	1.1 kV Grade cable termination – Power cable										
11.1.1	3C x 2.5 Sq.mm (Cu)	Nos.	12								
11.1.2	4C x 4 Sq.mm (Cu)	Nos.	20								
11.1.3	4C x 10 Sq.mm (Al)	Nos.	2								
11.1.4	4C x 16 Sq.mm (Al)	Nos.	6								
11.1.5	3.5C x 25 Sq.mm (Al)	Nos.	2								
11.2	1.1 kV Grade cable termination – Control cable (Cu)										
11.2.1	5C x 4 Sq.mm	Nos.	16								
11.2.2	7C x 4 Sq.mm	Nos.	16								

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	TITLE PRICE SCHEDULE	

Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)			
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount
12.0	Supply, installation, testing and commissioning of Heavy-duty GI Cable trays with associated accessories such as coupler plates, tees, elbows, nuts, bolts, clamps, washers, etc., for the HT/LT power, control & signal cables as per specification & direction of Engineer-Incharge										
12.1	Ladder Trays										
12.1.1	150 mm width	m	80								
12.1.2	300 mm width	m	10								
12.1.3	450 mm width	m	45								
12.1.4	600 mm width	m	10								
12.2	Perforated Trays										
12.2.1	50 mm width	m	5								
12.2.2	100 mm width	m	5								
12.2.3	150 mm width	m	35								
12.2.4	300 mm width	m	5								
13.0	Supply, installation, testing and commissioning of Fire Proof Sealing system as per specification & direction of Engineer-Incharge										
13.1	Fire Stop / Sealing system for Cables penetrations with minimum two-hour fire protection rating	sq.m	5								
13.2	Fire break coating for Cables & Cable trays with minimum two-hour fire protection rating	Lit	2								
14.0	Excavation & back filling compacting for directly buried cables including supply of necessary items as per specification & direction of Engineer-Incharge.										
	(Unit rate quoted for cable laying shall include protective covers, cable tags, markers & sand and all materials & accessories required for cable laying).										
14.1	300/450 mm Width X 1000 mm Depth	m	150								
14.2	700 mm Width X 1000 mm Depth	m	10								
15.0	Supply, design, installation, testing and commissioning of Conduits as per specification & direction of Engineer-Incharge										

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		TITLE PRICE SCHEDULE										
Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)				
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount	
15.1	25 mm GI Conduit with all associated fittings like couplers, bends and tees as required	m	70									
15.2	25 mm heavy duty PVC Conduit with all associated fittings like couplers, bends and tees as required	m	10									
16.0	Supply, design, fabrication, installation, testing and commissioning of MS supports including welding, bolting, riveting, supply of necessary anchor bolts and grouting etc, for structures as required including supply of all MS hardware materials, including all labour and materials for installation of cable tray supports, cable carrier structures in trenches / tunnels, vertical raceways, supports for mounting junction boxes / LPBS stations, equipment / panel supports as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.	MT	1									
17.0	Supply, design, installation, testing and commissioning of Lighting fixtures (Industrial type) as per specification of this tender and directions of Engineer-in-Charge: (Unit rates quoted for installation shall include all materials required to mount the fixtures on Pole / RCC slab / Column / Wall / PEB Structures, Providing suspension of high bay fixtures, GS conduit for suspension of fixtures, hooks in the RCC slab if required, Conduit Box with Ball & Socket suspension, fixing accessories including Galvanized screws, bolts and nuts including all labour and materials cable/wire terminations, etc.) (Model nos. of light fixture shall be considered same model or equivalent model in other makes as per vendor list can be considered.)											
17.1	120 Watts, Industrial LED Street light fixture with extruded aluminium housing as heat sink, heat resistant toughened glass, control gear compartment. Degree of protection IP 66. CGL ref.: Crompton RAPTOR PRO_120W or equiv.	Nos.	3									
17.2	20 Watts, Industrial LED Street light fixture with extruded aluminium housing as heat sink, heat resistant toughened glass, control gear compartment. Degree of protection IP 66. CGL ref.: Crompton Wanderer _20W or equiv.	Nos.	8									
17.3	2 x 20 Watts, Industrial LED light fixture with polycarbonate housing aluminium gear tray and opal cover of polycarbonate suitable for surface mounting. Minimum degree of protection IP 66. CGL ref. Cat. No.: IPFC112LT8-20 or equiv.	Nos.	18									
17.4	18 Watts, Industrial LED light fixture with round panel with body made from die cast aluminium and CRCA covering, powder coated suitable for surface mounting. Minimum degree of protection IP 20. CGL ref. Cat. No.: LCDSPLN-R-18-CDL or equiv.	Nos.	2									
17.5	2X10 Watts, automatic, industrial LED light fixture with CRCA sheet steel housing and opal diffuser suitable for surface / suspended / wall mounted consisting of rechargeable NI-CD battery (MIN 4 HOURS BACK UP), battery charger, & change-over circuitry in one compact unit housing inside the luminaire (IP20)	Nos.	2									
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Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)			
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount
18.0	Supply, design, installation, testing and commissioning of Lighting Poles as per specification & direction of Engineer-Incharge (Unit rates quoted shall include junction box, Pipe sleeve, excavation of soil, cable terminations, lugs and glands, cable between junction box and lighting fixtures, backfilling, foundations, 4m-earthing rod with 25x6GS flat for pole earthing including all labour and materials, etc)										
18.1	Swaged single arm curved street light pole – Height 11 m from FGL (total height 13m)	Nos.	3								
18.2	1.5-meter height Pipe support for wall mounted street light fixture	Nos.	8								
19.0	Supply, design, installation, testing and commissioning of the following items of Lighting system & accessories: (Unit rates quoted for installation shall include all materials required to mount the following item on RCC slab / Column / Wall/PEB Structures, fixing accessories including Galvanized screws, bolts and nuts including all labour and materials, as per specification of this tender and directions of Engineer-in-Charge)										
19.1	32A LDB (Incoming-32 A MCB 4pole, Outgoing: 16A, TPN,4P, RCBO+ASTRO TIMER-3 Nos., DP RCBO 16A- 3Nos., DP RCBO 10A- 6Nos.,	No.	1								
19.2	1no. 10A Switch with 2nos. 5A socket with switchbox, cover plate	Nos.	3								
19.3	5/15A combined switch socket outlet	Nos.	3								
19.4	4 No of 5A SWITCH with suitable metal box and plain cover plate.	Nos.	4								
19.5	32A three phase outdoor type, welding receptacle with RCBO & necessary interlocks.	No.	1								
19.6	1.1 kV FR PVC, stranded 2.5 Sq.mm CU wire	m	200								
19.7	1.1 kV FR PVC, stranded 4 Sq.mm CU wire	m	140								
20.0	Supply, installation, testing and commissioning of following size earthing strip/rod along the buildings, cable trenches or cable trays including welding at joints, providing anti-corrosive paint or bitumen for welded portion, clamping and necessary hardware for connecting, etc., including all labour and materials, as per specification of this tender and directions of Engineer-in-Charge										

SPEC.NO. TCE.13376D-EL-4028-4004	Tata Power Company Limited (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F1 SHEET 8 of 10
	TITLE PRICE SCHEDULE	

Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)			
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount
20.1	25 mm dia MS rod buried in ground at a depth of around 600 mm deep, formed as ring / grid arrangement including excavation & backfilling	m	250								
20.2	50 x 10 GS Flat – Sub grid	m	90								
20.3	8 SWG GS Conductor	m	35								
20.4	25 x 6 GS Flat	m	140								
20.5	50 x 10 GS Flat	m	100								
20.6	40 x 6 Copper Flat	m	10								
20.7	1500 mm x 1500 mm grid with gap 300mm, conductor 50x10GS flat, for below Disconnector candle at 600 mm depth	Nos.	5								
20.8	65mm DIA×4000mm Long Pipe earth electrodes (GS) treated earth pit	Nos.	2								
20.9	40mm DIA×4000mm Long solid earth electrodes (MS) Non-treated earth pit	Nos.	20								
20.10	Electronic Earth pit (treated earth pit)	No.	1								
20.11	Soil resistivity test & report (No. of test locations 3)	No,	1								
21.0	Supply, installation, testing and commissioning of following equipment for lightning protection system along the buildings, structures, etc including excavation & backfilling work, support insulators, clamps, welding at joints, providing anti-corrosive paint or bitumen for welded portion, clamping and necessary hardware for fixing/ connecting, etc., including all labour and materials, as per specification of this tender and directions of Engineer-in-Charge.										
21.1	Test Link box (FRP)	Nos.	6								
21.2	25 x 6 GS Flat	m	180								
21.3	25mm dia, 1m long Cu rod	Nos.	4								
21.4	40mm DIA × 4000mm Long solid earth electrodes (MS) Non-treated earth pit	Nos.	6								
22.0	Supply, installation, testing and commissioning of following Safety Equipment as per specification & direction of Engineer-Incharge										
22.1	First Aid Box	Nos.	2								
22.2	Safety chart with stand	Nos.	2								

SPEC.NO. TCE.13376D-EL-4028-4004	Tata Power Company Limited (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F1 SHEET 9 of 10
	TITLE PRICE SCHEDULE	

Item No	Brief Item Description	Unit	Qty	Supply (Rs)				ETC (Rs)			
				Unit Rate	Total	GST Rate	GST Amount	Unit Rate	Total	GST Rate	GST Amount
22.3	Caution board as per IS-2551 (200x150)	Nos.	10								
22.4	Sand Buckets with stand (Each with at least 3 sand buckets)	Nos.	2								
22.5	Fire extinguishers										
	a) CARBON DIOXIDE - 5 kg (As per IS 2878, TAC Guide Lines)	Nos.	2								
23.0	Supply and laying of 1000mm wide safety insulation mats for maintenance of electrical equipment in substation, including cutting to required shape as per IS										
	a) Suitable for 415 V system. (1 kV Grade)	m	6								
	a) Suitable for 22 kV system (24 kV Grade)	m	15								
24.0	Obtaining approval from local statutory authorities including Electrical Inspector, wherever applicable, as stated in Specification	No.	1								
25.0	Commissioning and Start-up spares as per specification	Lot	1								
26.0	Mandatory spares as per specification	Lot	1								
	TOTAL AMOUNT										

SPEC.NO. TCE.13376D-EL-4028-4004	Tata Power Company Limited (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F1 SHEET 10 of 10
	TITLE PRICE SCHEDULE	

SCHEDULE-2: RATES AND PRICES FOR UNLOADING & SHIFTING OF THE ITEMS IN OWNERS SCOPE

Bidders shall include in their scope the unloading of the following items and the shifting of the unloaded items to the designated store under OEM supervision.

Item No	Brief Item Description	Quantity	Unloading (Rs)			
			Unit Rate	Total	GST Rate	GST Amount
1.0	MV SWITCHGEARS					
1.1	SS-2: 22kV HT Meter Box	1 No.				
1.2	SS-3: 22 kV switchgear panel	1 Set				
1.3	SS-4 22 kV ICOG panel	1 No				
1.4	Spares	1 Lot				
2.0	TRANSFORMERS					
2.1	Auxiliary Transformer-1 (AT-1) 500 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=5%, OCTC ±5% in steps of 2.5% Service Transformer for Labour colony	1 No.				
2.2	Auxiliary Transformer-2&3 (AT-2&3) 2000 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=7.15%, OCTC ±5% in steps of 2.5% Service Transformer at Powerhouse area	2 No.				
2.3	Auxiliary Transformer-4 (AT-4) 1250 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=6%, OCTC ±5% in steps of 2.5% Service Transformer at Powerhouse area	1 No.				
2.4	Auxiliary Transformer-5 (AT-5) 2000 kVA, Outdoor, ONAN type, 3-phase, 50Hz, two winding, 22 /0.433 kV, Dyn11, Z=7.15%, OCTC ±5% in steps of 2.5% Service Transformer at Upper reservoir	1 No.				
2.5	Spares	1 Lot				
3.0	MV CABLES & ACCESSORIES					
3.1	22kV (E) grade, 3C x 300 sqmm stranded aluminium conductor, XLPE insulated with all the screens, PVC inner sheathed, GS wire armoured, overall FRLS PVC outer sheathed suitable for directly buried in soil and outdoor.	6800 m				
3.2	Heat shrinkable type joint kit suitable for the 22kV (E) grade, 3C x 300 sq.mm stranded aluminium conductor cables and directly buried in soil and outdoor.	17 Nos.				
4.0	FO CABLES & ACCESSORIES					
4.1	Fibre optic cable (Quantity considered 4 no. 48 Core FO cable per circuit)	25000 m				
4.2	Fiber termination Rack	2 Nos.				
4.3	HDPE pipes for FO cable (dia 40 mm)	25000 m				
4.4	No. of FO joint boxes for 48F cable	24 Nos.				
4.5	No. of termination kits (48F)	10 Nos.				
4.6	Patch Cord for 48F Optic Fiber Cable	50 Nos.				
	TOTAL AMOUNT					

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	TITLE PRICE SCHEDULE	

SCHEDULE-2: GRAND SUMMARY

Item	Description	Total Price ¹	
		Foreign	Local
1	Total Schedule 1. Rates and prices – supply, Statutory Approval & Supervision		
2	Total Schedule-2: Rates and prices - Unloading & shifting of the items in owners scope		
	<u>Total (In Figures):</u>		
	TOTAL (IN WORDS:		
¹ Specify currency for Foreign components, Currency for Local component shall be INR (₹)			

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SPEC.NO. TCE.13376D-EL- 4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F INDEX
	TITLE SCHEDULES	

INDEX

<u>Sl. No</u>	<u>DESCRIPTION</u>
1.0	PRICE SCHEDULE: Refer Commercial Volume 1
2.0	TIME SCHEDULE FOR THE PROJECT
3.0	SCHEDULE OF DEVIATIONS FROM TECHNICAL SPECIFICATIONS
4.0	SCHEDULE OF DEVIATIONS FROM GENERAL & SPECIAL CONDITIONS OF CONTRACT
5.0	SCHEDULE OF DRAWINGS & DOCUMENT SUBMISSION
6.0	SCHEDULE OF STARTUP / COMMISSIONING SPARES
7.0	SCHEDULE OF ESSENTIAL/MANDATORY SPARES
8.0	SCHEDULE OF RECOMMENDED SPARES
9.0	SCHEDULE OF SPECIAL ERECTION, MAINTAINACE TOOLS & TACKLES
10.0	SCHEDULE OF PLACES OF MANUFACTURE, TESTS AND INSPECTION
11.0	SCHEDULE OF CONSTRUCTION POWER & WATER REQUIREMENT
12.0	SCHEDULE OF CONSTRUCTION AREA REQUIREMENT
13.0	SCHEDULE OF WEIGHTS & DIMENSIONS
14.0	SCHEDULE OF ELECTRICAL LOAD LIST
15.0	SCHEDULE OF BIDDERS EXPERIENCE
16.0	SCHEDULE OF PERFORMANCE AND EFFICIENCY TEST INSTRUMENTATION
17.0	SCHEDULE OF PEFORMANCE GUARANTEE

SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F2 SHEET 1 OF 1
	TITLE SCHEDULE OF THE PROJECT	

2.0 TIME SCHEDULE OF THE PROJECT

Sl. No.	Work Description	Months from date of Notice to Proceed	
		START	FINISH
1.0	Design, Manufacture and testing		
2.0	Design and Engineering		
3.0	Manufacturing		
4.0	Delivery at Site		
5.0	Completion of Erection	NOT APPLICABLE	NOT APPLICABLE
6.0	Testing and Commissioning	NOT APPLICABLE	NOT APPLICABLE
7.0	Performance testing	NOT APPLICABLE	NOT APPLICABLE

Note: The shipment schedule with details of equipment covered in each shipment with shipping dimensions and weights shall be furnished.

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F3 SHEET 1 OF 1
	TITLE SCHEDULE OF DEVIATIONS FROM TECHNICAL REQUIREMENTS	

3.0 SCHEDULE OF DEVIATIONS FROM TECHNICAL REQUIREMENTS

All deviations from the technical requirements shall be filled in by the BIDDER clause by clause in this schedule.

SECTION	SPECIFICATION NO	CLAUSE NO	DEVIATION	COST OF WITHDRAWAL OF DEVIATION

The BIDDER hereby certifies that the above mentioned are the only deviations from the PURCHASER's Technical requirement. The BIDDER further confirms that in the event any other data and information presented in the BIDDER's proposal and accompanying documents are at variance with the specific requirements laid out in the PURCHASER's Technical requirements, then the latter shall govern and shall be binding on the BIDDER for the quoted price.

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F4 SHEET 1 OF 1
	TITLE SCHEDULE OF DEVIATIONS FROM GENERAL & SPECIAL CONDITIONS OF CONTRACT	

4.0 SCHEDULE OF DEVIATIONS FROM GENERAL & SPECIAL CONDITIONS OF CONTRACT

All deviations from the General Conditions of Contract and Special Conditions of Contract shall be filled in by the BIDDER clause by clause in this schedule.

SECTION	SPECIFICATION NO	CLAUSE NO	DEVIATION	COST OF WITHDRAWL OF DEVIATION

The BIDDER hereby certifies that the above mentioned are the only deviations from the PURCHASER's General Conditions of Contract and Special Conditions of Contract. The BIDDER further confirms that in the event any other data and information presented in the BIDDER's proposal and accompanying documents are at variance with the specific requirements laid out in the PURCHASER's General Conditions of Contract and Special Conditions of Contract, then the latter shall govern and shall be binding on the BIDDER for the quoted price.

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F5 SHEET 1 OF 1
	TITLE SCHEDULE OF DRAWINGS & DOCUMENT SUBMISSION	

5.0 SCHEDULE OF DRAWINGS & DOCUMENT SUBMISSION

As part of the proposal, the BIDDER shall furnish the schedule of drawing/document submission as follow:

Sr. No.	Title of Drawing/Document	Target Date of submission	For Information/Review/Approval	Remarks
1.0				
1.1				
1.2				
2.0				
2.1				
2.2				
3.0				
3.1				
3.2				
4.0				
4.1				
4.2				
5.0				

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Note: The titles of drawings / documents listed out in the schedule. The bidder shall list out all relevant drawings / documents of the project under master document list which shall be finalised in agreement with owner's engineer. The master document list for the documents /drawings required during detailed engineering shall be decided after finalization of contract at the discretion of owner/ owner's engineering team. The WRENCH system shall be followed for submission of drawings & documents etc. during detailed engineering.

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	TITLE SCHEDULE OF STARTUP / COMMISSIONING SPARES	

6.0 SCHEDULE OF STARTUP / COMMISSIONING SPARES

The BIDDER shall indicate Start-up/Commissioning spares which will be required for successful commissioning of the equipment or system offer by him, as part of their scope.

Item No.	Manufacturer & part No.	Delivery period weeks	Description	Material	Qty.	Unit Price CFR (Indian port)/Ex-works	Total Price 6*7	Remarks
1	2	3	4	5	6	7	8	9

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F8 SHEET 1 OF 1
	TITLE SCHEDULE OF RECOMMENDED SPARES	

8.0 SCHEDULE OF RECOMMENDED SPARES

The BIDDER shall indicate below recommended spares for five (5) years of trouble-free operation of the equipment or system offered by him.

SL. NO.	EQUIPMENT TAG NUMBER	DESCRIPTION OF SPARE	MATERIAL OF CONSTRUCTION	MANUFACTURER AND PART NUMBER	QUANTITY/SET RECOMMENDED PER UNIT EQUIPMENT	UNIT PRICE Rs.	TOTAL PRICE Rs.	DELIVERY PERIOD (WEEKS) FROM DATE OF LOI	REMARKS
RECOMMENDED SPARES AS INDICATED BY THE BIDDER									
1.									
2.									
3.									
4.									
5.									

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F9 SHEET 1 OF 1
	TITLE SCHEDULE OF SPECIAL ERECTION, MAINTAINACE TOOLS & TACKLES	

9.0 SCHEDULE OF SPECIAL ERECTION / MAINTENANCE TOOLS & TACKLES

As part of the proposal, the BIDDER shall indicate below, the list of erection/maintenance tools & tackles offered by him.

Sr. No.	Description of spare	Quantity recommended per unit of equipment	Unit price	Total price	Delivery period from date of LOI	Remarks

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F10 SHEET 1 OF 1
	TITLE SCHEDULE OF PLACES OF MANUFACTURE, TESTS AND INSPECTION	

10.0 SCHEDULE OF PLACES OF MANUFACTURE, TESTS AND INSPECTION

The Bidder shall indicate the item of Equipment supplied, name of the MANUFACTURER or SUBCONTRACTOR and place of test and inspection as shown below:

ITEM OF EQUIPMENT	MANUFACTURER / SUBCONTRACTOR	PLACE OF TESTING & INSPECTION

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F11 SHEET 1 OF 1
	TITLE SCHEDULE OF CONSTRUCTION AREA REQUIREMENT	

11.0 SCHEDULE OF CONSTRUCTION POWER AND WATER REQUIREMENT

The BIDDER shall indicate the total construction power required as shown below for different stages of project execution on chargeable basis.

Sl. No.	Stages of Erection	Period of Construction, Months	kVA max.	kVA Average	kW

The BIDDER shall furnish details of construction water requirement as indicated below, which shall be on chargeable basis.

Item No.	Period of Construction, Months	Water requirement Rate, cu.m/h	Total water requirement, cu.m/day

For potable water during construction, E&C period, bidder to make their own arrangements for potable water using construction water supplied at single point by installing packaged water.

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	TITLE SCHEDULE OF CONSTRUCTION AREA REQUIREMENT PROJECT	

12.0 SCHEDULE OF CONSTRUCTION AREA REQUIREMENT

The BIDDER shall indicate his storage area requirements for the equipment/ materials covered under this specification, type-wise as per the following format.

A	<u>SPECIAL (AIR-CONDITIONED) STORAGE</u>			
	SL.NO.	EQUIPMENT/MATERIALS	AREA	REMARKS
			Sq.m	(Indicate special requirements, if any, such as temperature limits, humidities, etc.)
B	<u>FULLY COVERED HEATED STORAGE</u>			
	SL.NO.	EQUIPMENT/MATERIALS	AREA	REMARKS
			Sq.m	(Indicate special requirements, such as temperature limits, mode of heating, aisle requirements, etc.)
C	<u>FULLY COVERED NON-HEATED STORAGE</u>			
	SL.NO.	EQUIPMENT/MATERIALS	AREA	REMARKS
			Sq.m	(Indicate special requirements, if any, aisle requirements and other particulars)

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		TITLE SCHEDULE OF CONSTRUCTION AREA REQUIREMENT PROJECT				

D	<u>OFFICE AREA</u>				
	SL.NO.	EQUIPMENT/MATERIALS	AREA	REMARKS	
			Sq. m	(Indicate special requirements, if any, access requirements etc.)	
E	<u>MATERIAL STORAGE & ASSEMBLY AREA</u>				
	SL.NO.	EQUIPMENT/MATERIALS	AREA	REMARKS	
			Sq. m	(Indicate special requirements, if any, access requirements etc.)	
F	<u>FABRICATION YARD & SCRAP YARD</u>				
	SL.NO.	EQUIPMENT/MATERIALS	AREA	REMARKS	
			Sq. m	(Indicate special requirements, if any, access requirements etc.)	

SPEC.NO. TCE.13376D-EL-4028-4005	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F13 SHEET 1 OF 1
	TITLE SCHEDULE OF WEIGHTS & DIMENSIONS	

13.0 SCHEDULE OF WEIGHTS & DIMENSIONS

The bidder shall state below the weights and dimensions of various packages for shipment covering the complete scope.

Description of package(s)	Dimensions in (meter)	Weight in (tonnes)

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F14 SHEET 1 OF 1
	TITLE SCHEDULE OF ELECTRICAL LOADS	

14.0 SCHEDULE OF ELECTRICAL LOAD LIST

BIDDER shall furnish the information called for in this Schedule for all the electrical equipment in the scope of bidder for this package:

Sl. No.	Equipment	Qty.		Voltage	RPM	kW

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SPEC.NO. TCE.13376D-EL-4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F15 SHEET 1 OF 1
	TITLE SCHEDULE OF BIDDERS EXPERIENCE	

15.0 SCHEDULE OF BIDDERS EXPERIENCE

The BIDDER shall furnish hereunder a list of similar jobs executed by him to whom a reference may be made by the PURCHASER in case the PURCHASER considers such a reference necessary.

Sl. No..	Name & description of work	Scheduled completion period.	Actual completion period.	Value of work.	Year of start and completion.	Client.	Persons to whom ref. May be made.
1	2	3	4	5	6	7	8

Bidder shall submit Project Specific Organization Structure along with key members details.

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SPEC.NO. TCE.13376D-EL- 4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F16 SHEET 1 OF 1
	TITLE SCHEDULE OF PERFORMANCE AND EFFICIENCY TEST INSTRUMENTATION	

16.0 SCHEDULE OF PERFORMANCE AND EFFICIENCY TEST
INSTRUMENTATION

The BIDDER should indicate all necessary instruments to be loaned by him as part of their scope to the PURCHASER for performance tests on returnable basis.

MEASUREMENT POINT	MEASURED VARIABLE	METHOD OF MEASUREMENT/ INSTRUMENT REQUIRED	QTY. REQD.	DURATION OF LOAN (WEEKS)
1				
2				
3				
4				
5				

Note: All the instruments which will be used for Performance and Efficiency test shall have valid calibration certificate, which shall be submitted for Owner's review/approval, 15 days prior of dispatch of instruments to project site.

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SPEC.NO. TCE.13376D-EL- 4028-4004	TATA POWER COMPANY LIMITED (TPCL) Enabling Infrastructure For Shirawta Pumped Storage Project (1800MW)	VOLUME II SECTION: F17 SHEET 1 OF 1
	TITLE SCHEDULE OF PERFORMANCE GUARANTEE	

17.0 SCHEDULE OF PEFORMANCE GUARANTEE

BIDDER shall furnish performance guarantee for the items listed in the specification as applicable. Only the values indicated in the Table will be considered for evaluation.

Also the values indicated in Table and the guaranteed performance will be the basis for evaluation of the performance tests by the OWNER.

TABLE

Sl. no	Particulars	Unit	Guaranteed value
1.			
2.			

Notes :-

- (a) No negative tolerance on items.
- (b) Items are not subjected to any tolerance except the instrument tolerances as indicated in the specification.

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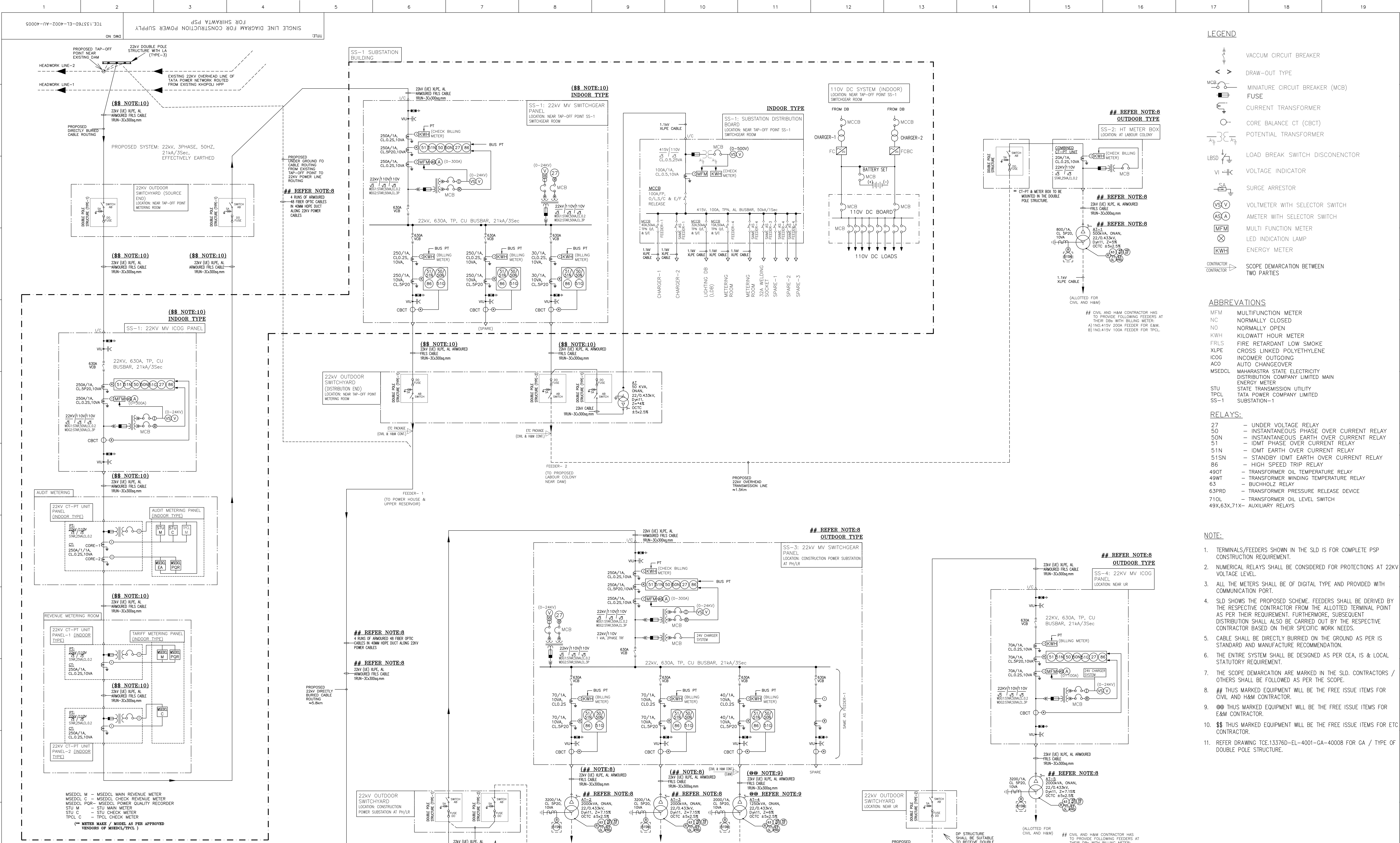
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LEGEND

- VACUUM CIRCUIT BREAKER
- DRAW-OUT TYPE
- MINIATURE CIRCUIT BREAKER (MCB)
- FUSE
- CURRENT TRANSFORMER
- CORE BALANCE CT (CBCT)
- POTENTIAL TRANSFORMER
- LOAD BREAK SWITCH DISCONNECTOR
- VOLTAGE INDICATOR
- SURGE ARRESTOR
- VOLTMETER WITH SELECTOR SWITCH
- AMETER WITH SELECTOR SWITCH
- MULTI FUNCTION METER
- LED INDICATION LAMP
- ENERGY METER
- SCOPE DEMARCATION BETWEEN TWO PARTIES

ABBREVIATIONS

- MFM - MULTIFUNCTION METER
- NC - NORMALLY CLOSED
- NO - NORMALLY OPEN
- KWH - KILOWATT HOUR METER
- FRLS - FIRE RETARDANT LOW SMOKE
- XLPE - CROSS LINKED POLYETHYLENE
- ICOG - INCOMER OUTGOING
- ACO - AUTO CHANGEOVER
- MSEDCL - MAHARASTRA STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED MAIN ENERGY METER
- STU - STATE TRANSMISSION UTILITY
- TPCL - TATA POWER COMPANY LIMITED SUBSTATION-1

RELAYS:

- 27 - UNDER VOLTAGE RELAY
- 50 - INSTANTANEOUS PHASE OVER CURRENT RELAY
- 50N - INSTANTANEOUS EARTH OVER CURRENT RELAY
- 51 - IDMT PHASE OVER CURRENT RELAY
- 51N - IDMT EARTH OVER CURRENT RELAY
- 51SN - STANDBY IDMT EARTH OVER CURRENT RELAY
- 86 - HIGH SPEED TRIP RELAY
- 49DT - TRANSFORMER OIL TEMPERATURE RELAY
- 49WT - TRANSFORMER WINDING TEMPERATURE RELAY
- 63 - BUCHHOLZ RELAY
- 63PRD - TRANSFORMER PRESSURE RELEASE DEVICE
- 710L - TRANSFORMER OIL LEVEL SWITCH
- 49X,63X,71X - AUXILIARY RELAYS

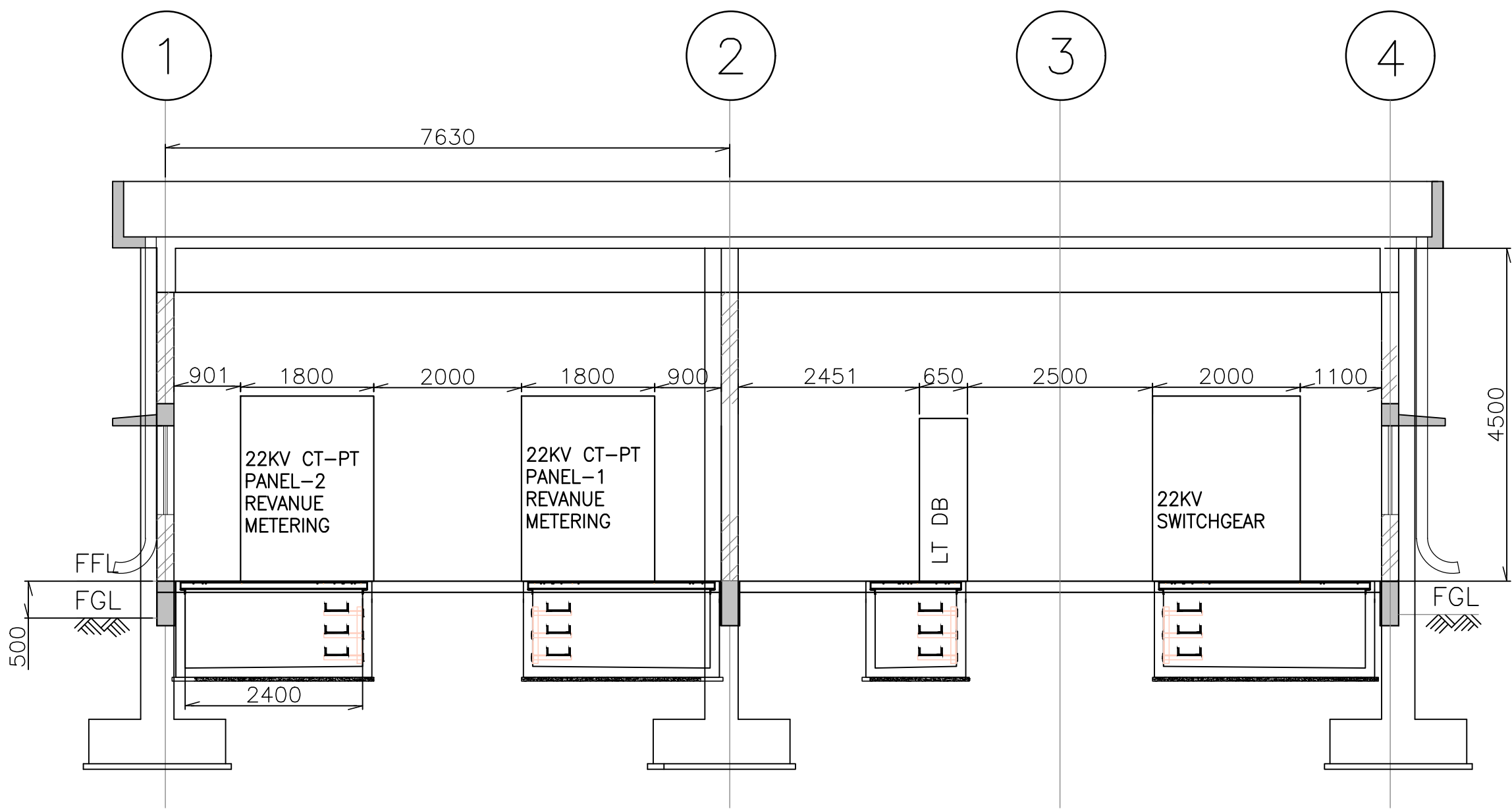
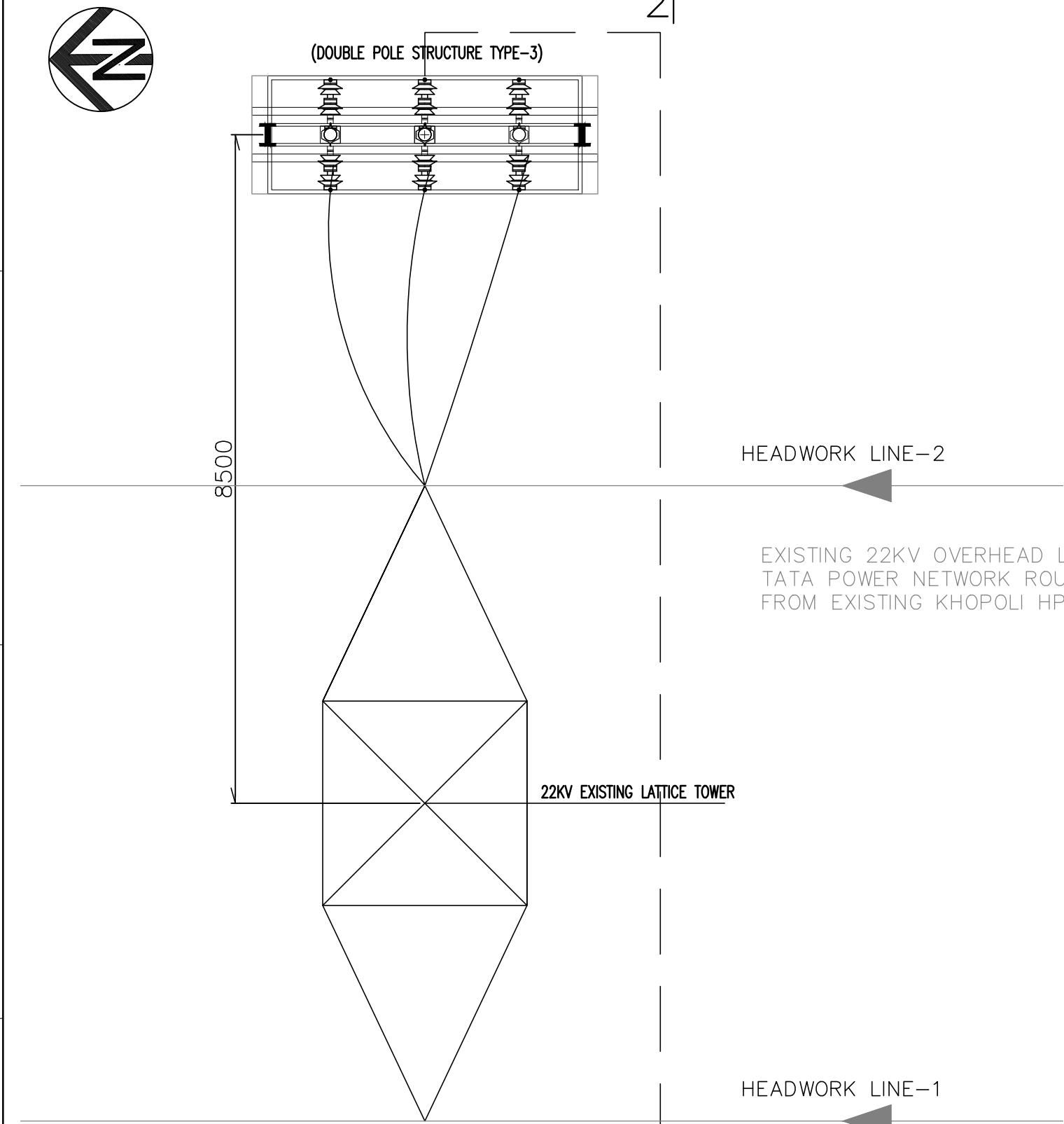
NOTE:

- TERMINALS/FEEDERS SHOWN IN THE SLD IS FOR COMPLETE PSP CONSTRUCTION REQUIREMENT.
- NUMERICAL RELAYS SHALL BE CONSIDERED FOR PROTECTIONS AT 22KV VOLTAGE LEVEL.
- ALL THE METERS SHALL BE OF DIGITAL TYPE AND PROVIDED WITH COMMUNICATION PORT.
- SLD SHOWS THE PROPOSED SCHEME. FEEDERS SHALL BE DERIVED BY THE RESPECTIVE CONTRACTOR FROM THE ALLOTTED TERMINAL POINT AS PER THEIR REQUIREMENT. FURTHERMORE, SUBSEQUENT DISTRIBUTION SHALL ALSO BE CARRIED OUT BY THE RESPECTIVE CONTRACTOR BASED ON THEIR SPECIFIC WORK NEEDS.
- CABLE SHALL BE DIRECTLY BURIED ON THE GROUND AS PER IS STANDARD AND MANUFACTURE RECOMMENDATION.
- THE ENTIRE SYSTEM SHALL BE DESIGNED AS PER CEA, IS & LOCAL STATUTORY REQUIREMENT.
- THE SCOPE DEMARCATION ARE MARKED IN THE SLD. CONTRACTORS / OTHERS SHALL BE FOLLOWED AS PER THE SCOPE.
- ## THUS MARKED EQUIPMENT WILL BE THE FREE ISSUE ITEMS FOR CIVIL AND H&M CONTRACTOR.
- ## THUS MARKED EQUIPMENT WILL BE THE FREE ISSUE ITEMS FOR E&M CONTRACTOR.
- ## THUS MARKED EQUIPMENT WILL BE THE FREE ISSUE ITEMS FOR ETC CONTRACTOR.
- REFER DRAWING TCE.133760-EL-4001-GA-40008 FOR GA / TYPE OF DOUBLE POLE STRUCTURE.

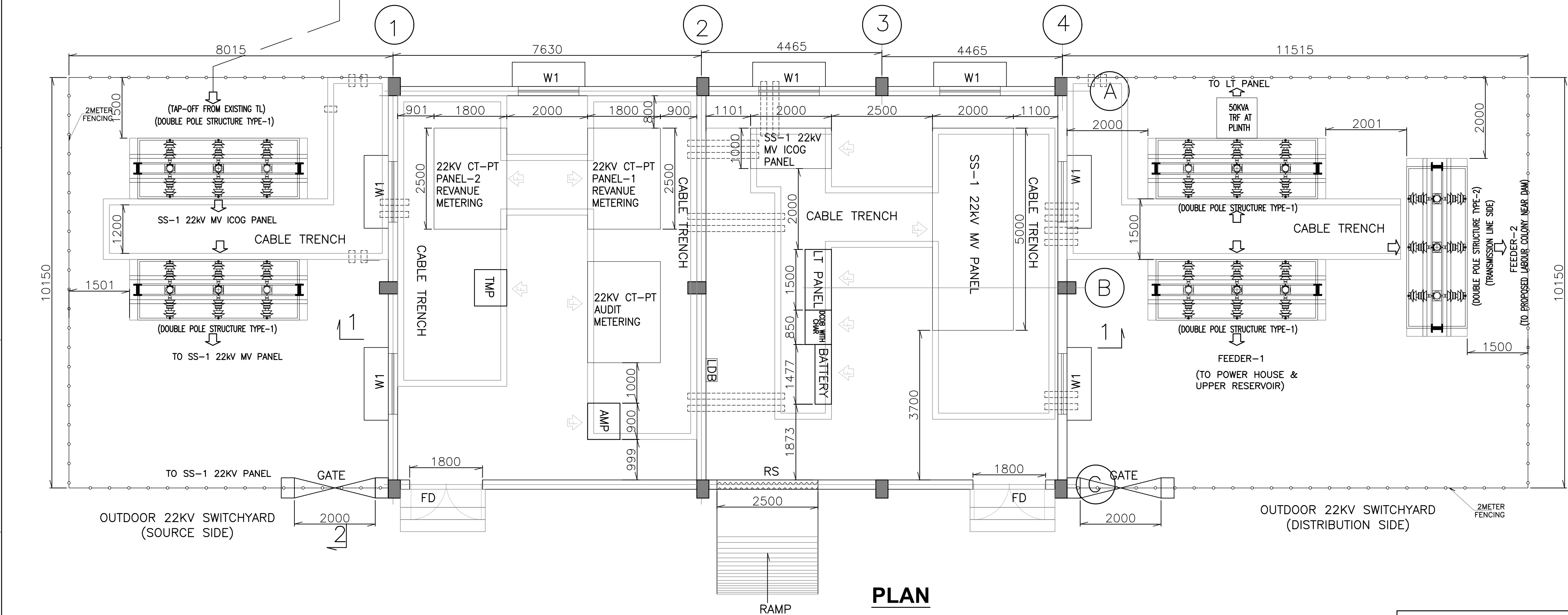
POWER ALLOCATION

	AT TAP/PT AT UR HOUSE	AT LABOUR COLONY
CIVIL, H&M	1500 KVA	1800 KVA
E&M	1000 KVA	120 KVA
TPCL	100 KVA	15 KVA
TOTAL	4500 KVA	2000 KVA

FOR RO ISSUE ONLY			ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED						APPD	DATE	ISSUE	REVISIONS			DRN	CLEARED					
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SECT 1-1



PLAN



KEY PLAN

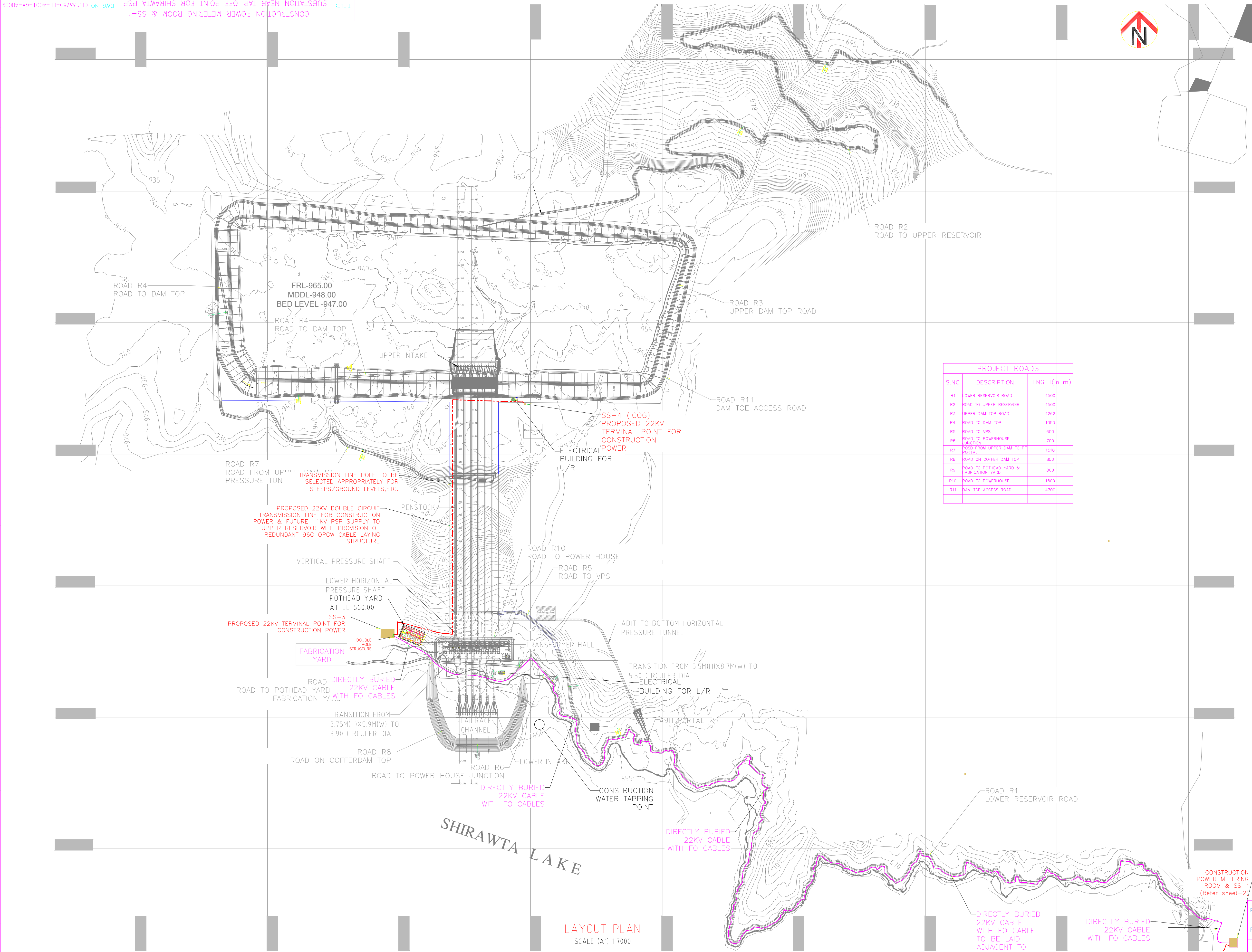
LEGENDS

- TMP - TARIFF METERING PANEL
- AMP - AUDIT METERING PANEL
- CHAR - DC CHARGER PANEL
- DCDB - DC DISTRIBUTION BOARD
- ⬅ - FRONT

NOTES

- ALL DIMENSIONS ARE IN MILLIMETERS & ELEVATIONS ARE METERS.
- ALL DOORS IN THE PASSAGE SHALL BE FIRE DOORS.
- ALL DOORS SHOWN SHALL BE OF 2.1M HIGH.
- SWITCHYARD SHOULD BE UNIFORMLY LEVELED AND SPREAD WITH 40MM BLUE GRANITE JELLY OF 150mm DEPTH.
- EQUIPMENT DIMENSIONS AND QUANTITY SHOWN ARE PRELIMINARY. EXACT DIMENSION AND QUANTITY SHALL BE BASED ON VENDOR INPUTS.
- FOUNDATION DETAILS FOR DOUBLE POLE STRUCTURE / OTHER EQUIPMENT SHALL BE GIVEN BY VENDOR.
- THIS DRAWING IS INDICATIVE PURPOSE. AS PER ELECTRICITY BOARD REQUIREMENT, ANY MODIFICATION/ADDITIONAL ITEMS, IF NECESSARY TO BE PROVIDED BY THE CONTRACTOR WITHOUT ANY ADDITIONAL COST.
- ALL CLEARANCES (PH-PH, PH-E, SECTIONAL, ETC) SHALL NOT BE LESS THAN LATEST CEA REGULATIONS/RELEVANT IS STANDARD / CEIG / LOCAL STATUTORY AUTHORITY REQUIREMENTS.

CLEARED		ISSUE	
DEPT	SIGNATURE		DATE
CHEM			
CIVIL			
ELEC			
I&C			
MECH			



- NOTES**
- ALL DIMENSIONS ARE IN mm & ELEVATION ARE IN METERS. UNLESS OTHERWISE SPECIFIED.
 - THE DETAILS PROVIDED IN THE DRAWING ARE TENTATIVE AND SAME WILL BE FINALIZED DURING DETAIL ENGINEERING.
 - DIMENSIONS SHALL NOT BE OBTAINED BY SCALING THE DRAWINGS. ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.

1. FRL UPPER RESERVOIR	-	965.00m
2. MDDL AT UPPER RESERVOIR	-	948.00m
3. TOP OF DAM UPPER RESERVOIR	-	969.00m
4. FRL LOWER RESERVOIR	-	656.84m
5. MDDL AT LOWER RESERVOIR	-	638.00m

- LEGEND:-**
- DAM TOP
 - CONTOUR
 - FRL BOUNDARY
 - PROPOSED PROJECT ROAD
 - EXISTING ROAD
 - CONSTRUCTION ADIT

S.NO	DESCRIPTION	LENGTH(m m)
R1	LOWER RESERVOIR ROAD	4500
R2	ROAD TO UPPER RESERVOIR	4500
R3	UPPER DAM TOP ROAD	4282
R4	ROAD TO DAM TOP	1050
R5	ROAD TO VPS	600
R6	ROAD TO POWERHOUSE JUNCTION	700
R7	ROAD FROM UPPER DAM TO PT	1510
R8	ROAD ON COFFER DAM TOP	850
R9	ROAD TO POTHEAD YARD & FABRICATION YARD	800
R10	ROAD TO POWERHOUSE	1500
R11	DAM TOE ACCESS ROAD	4700

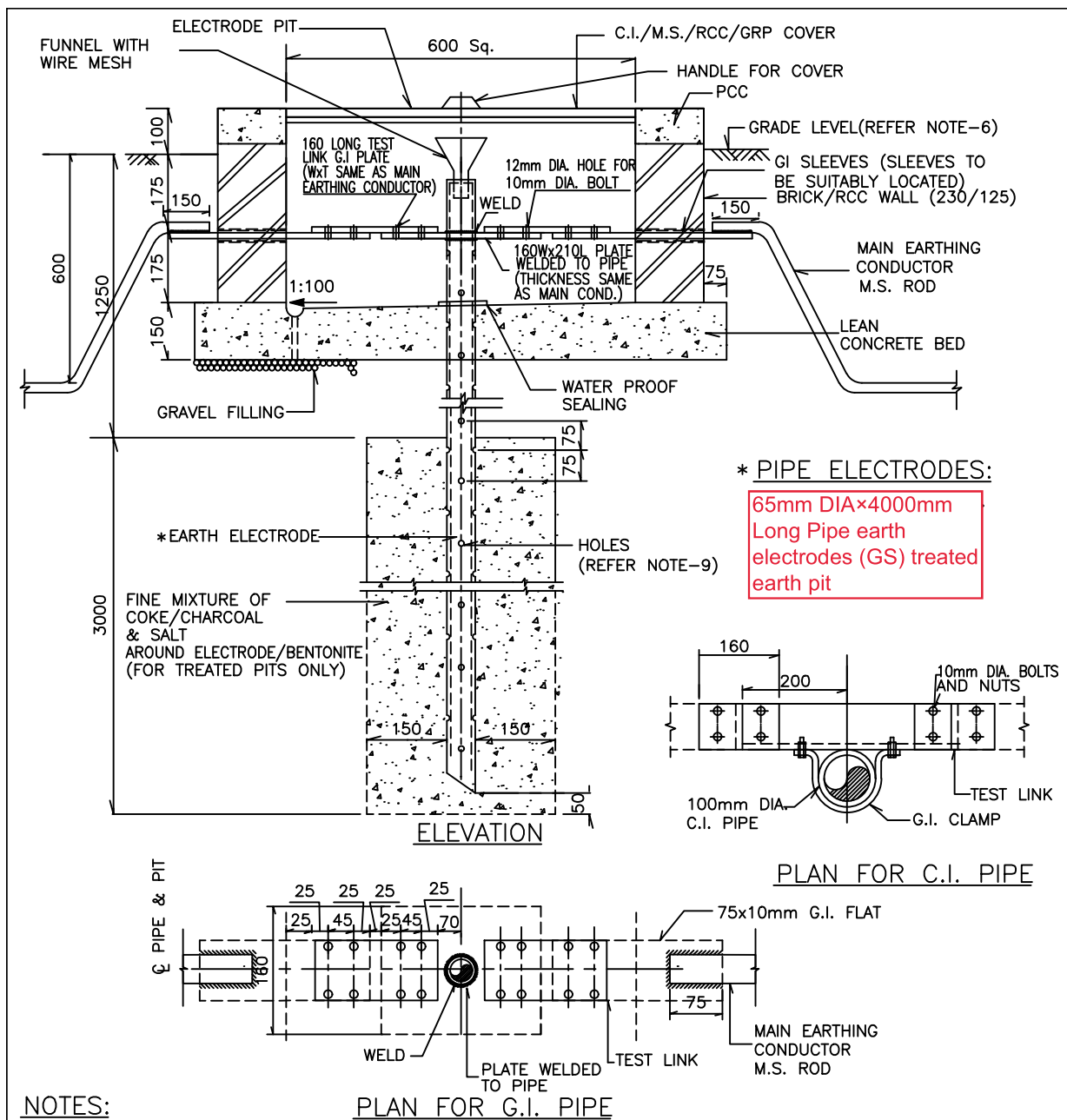
LAYOUT PLAN
SCALE (A1) 1:7000

CLEARED			ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN	CLEARED					APPD	DATE	ISSUE	REVISIONS					DRN
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TCE DWG NO.: TCE.13176D-EL-4001-CA-40009						FILE NAME: TCE.13176D-40009	
DWRN	CLEARED					APPD	DATE
	CHEM	CIVIL	ELEC	I&C	MECH		

		FOR PLANNING	
PROJECT:- SHIRAWTA PUMPED STORAGE PROJECT (1800MW)			
PACKAGE:-ENABLING INFRASTRUCTURE WORKS FOR SHIRAWTA PSP			
		OWNER :- THE TATA POWER COMPANY LIMITED	
		OWNER'S CONSULTANT:- TATA CONSULTING ENGINEERS LIMITED	
DESIGNED	SRN	DWG TITLE PROPOSED CONSTRUCTION POWER SUBSTATION LOCATION, CABLE & TRANSMISSION LINE ROUTING	
DRAWN	DS		
CHECKED	ASK		
APPROVED	VSK		
SCALE		DATE	DWG NO.
—		02-12-2025	TCE.13376D-EL-4001-CA-40009
		SH-	REV.
		02	P1



NOTES:

- ALL DIMENSIONS ARE IN mm.
-
- WALL OPENINGS AND SLEEVES SHALL BE SEALED AFTER CONDUCTOR LAYING.
- EXPOSED PORTION OF THE PIPE IN THE PIT TO BE COATED WITH ZINC-RICH PAINT.
-
- IN CASE OF PAVED AREA, PIT SHALL BE FLUSHED OR PROJECTED 50mm ABOVE THE PAVED AREA, AS PER PROJECT REQUIREMENT.
- SPECIFIC REQUIREMENTS, IF ANY, OF LOCAL EBs/CEIG SHALL BE CONSIDERED BEFORE SELECTING THE TYPE AND SIZE OF ELECTRODE.
-
- ALTERNATIVELY IN CASE OF ELECTRODE PIPE WITHOUT HOLES, WATERING ARRANGEMENT CAN BE PROVIDED WITH 25mm DIA HDPE PIPE WITH HOLES.

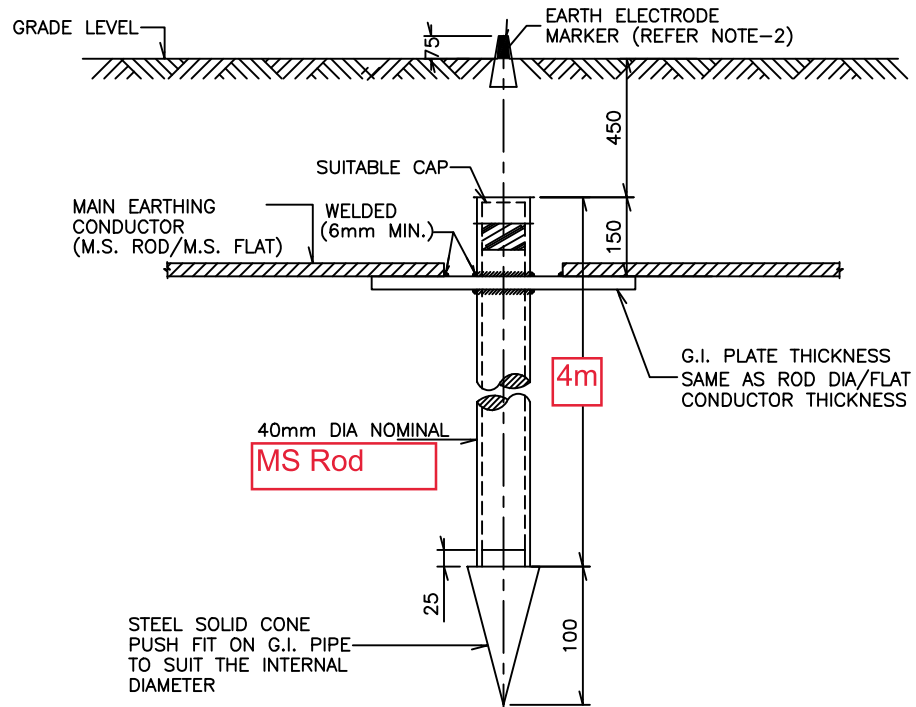
R7	TITLE BLOCK REVISED & GENERALLY REVISED	SRK		AVD		BSY					VVB	19.03.21
R6	TITLE BLOCK, PIT & ELECTRODE DIMENSION REVISED	NDD		AVD		BSY					VVB	13.03.18
R0		VVK				SF/DG					NP	26.07.76
ISSUE	REVISIONS	DRN	DSN	CHD	CV	EL	IC	ME		PE/PM	APPD	DATE

DO NOT SCALE		STANDARD DRAWING										
FILE NAME : M2-EL-2353-Rev-R7												
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		EARTHING DETAILS PIPE ELECTRODE PIT (WITH MS FLAT EARTHING CONDUCTOR) TATA CONSULTING ENGINEERS LIMITED MUMBAI										
SCALE : NTS		DWG. NO.		TCE.M2-EL-GL-S-2353				ISSUE		R7		
DC & DISC: DM-EL												

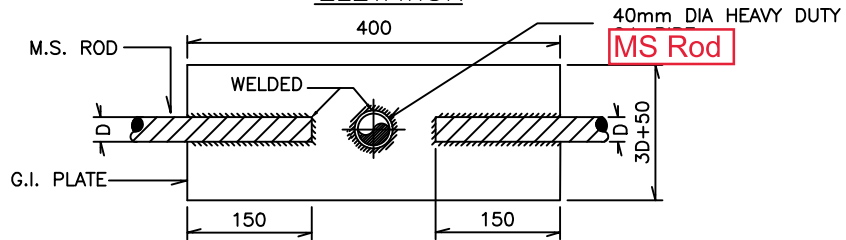
FILE NAME: F-094-Rev-R1.DWG

TCE FORM NO. 094 R1

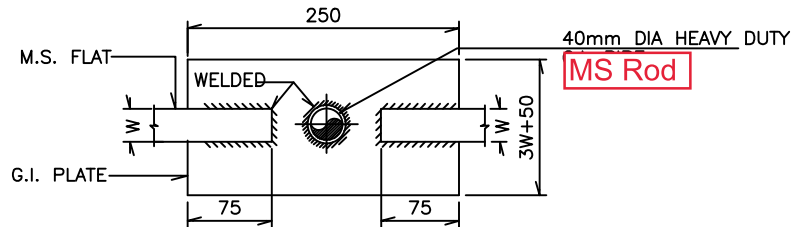
SIZE-A4



ELEVATION



PLAN FOR MS ROD



PLAN FOR MS FLAT

NOTES:

- ALL DIMENSIONS ARE IN mm.
- MARKER FOR EARTH ELECTRODE AS SHOWN SHALL BE PROVIDED. -
-
- THE ARRANGEMENT IS TYPICAL FOR CONNECTING 2 NOS. CONDUCTORS ON THE ELECTRODE. ACTUAL NO. OF CONDUCTORS TO BE DECIDED AT SITE AND RELEVANT DIMENSIONS FOR FLAT / ROD CONDUCTORS TO BE FOLLOWED.

R7	TITLE BLOCK CHANGED & GENERALLY REVISED	SRK		AVD		BSY					VVB	19.03.21	
R6	TITLE BLOCK CHANGED & GENERALLY REVISED	NDD		AVD		BSY					VVB	13.03.18	
R0		VVK				DGL					NP	21.09.76	
ISSUE	REVISIONS	DRN	DSN	CHD	CV	EL	IC	ME			PE/PM	APPD	DATE
					CLEARED								

DO NOT SCALE

STANDARD DRAWING

FILE NAME : M2-EL-2354-Rev-R7

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EARTHING DETAILS
DIRECTLY BURIED **MS Rod** ELECTRODE (WELDED CONNECTIONS)



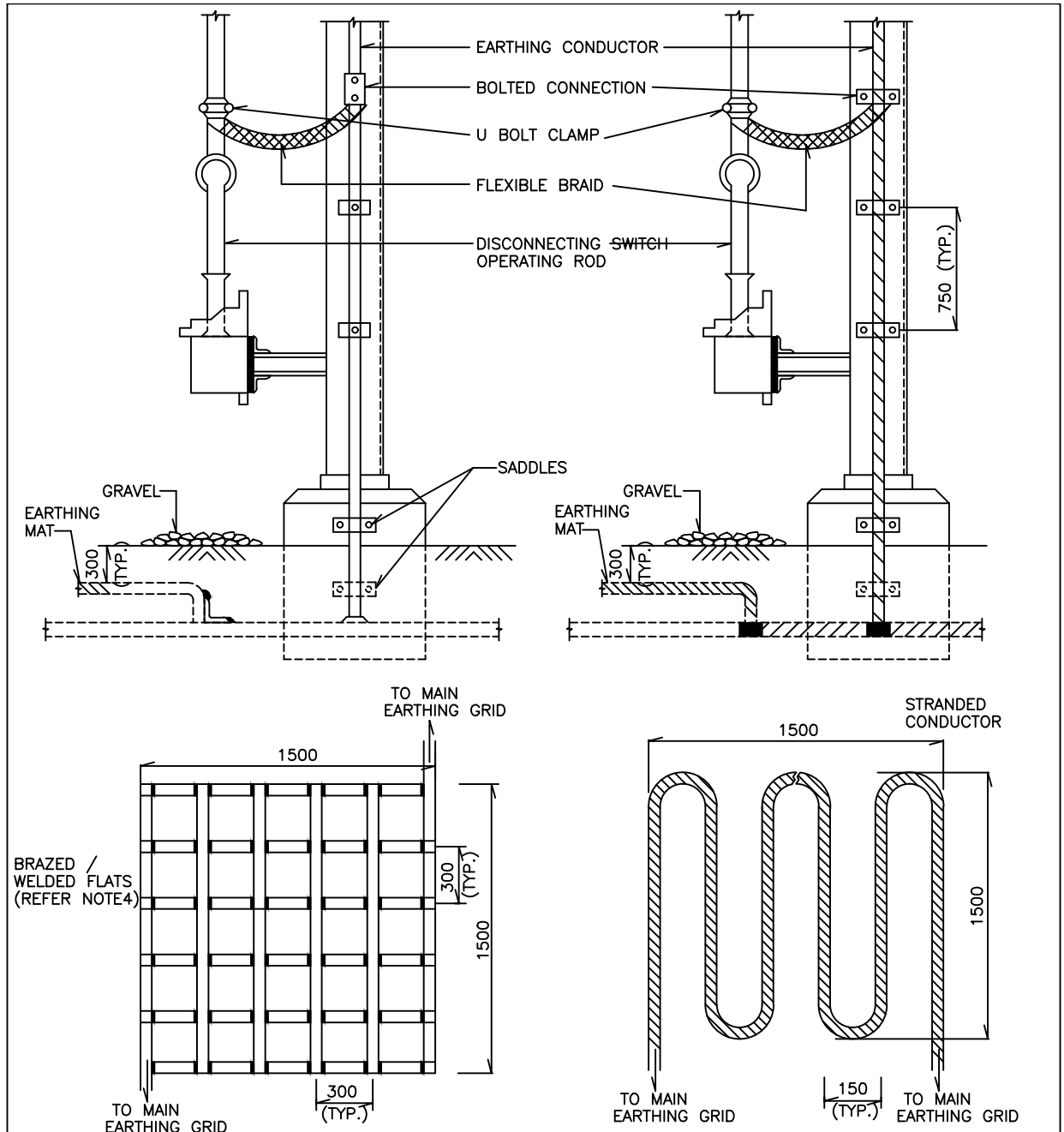
TATA CONSULTING ENGINEERS LIMITED
MUMBAI

SCALE : NTS	DWG. NO. TCE.M2-EL-GL-S-2354	ISSUE R7
DC & DISC: DM-EL		

FILE NAME: F-094-Rev-R1.DWG

TCE FORM NO. 094 R1

SIZE-A4

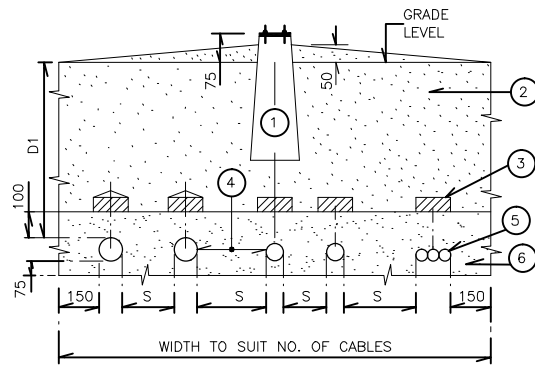


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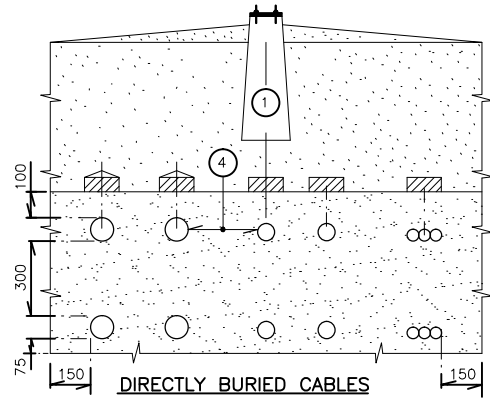
1. ALL DIMENSIONS ARE IN mm.
2. EARTH MAT DETAILS, TYPICAL FOR DISCONNECTING SWITCHES / ISOLATORS AS WELL AS FOR CIRCUIT BREAKERS.
3. FOR EARTHING AND LIGHTNING PROTECTION SYSTEMS INSTALLATION NOTES REFER TCE.M2-EL-GL-S-2350/ENCLOSED SPECIFICATIONS.
4. WELDED CONNECTIONS ARE FOR STEEL & BRAZED CONNECTIONS ARE FOR COPPER.

TYPICAL EARTHING MAT

R7	TITLE BLOCK CHANGED & GENERALLY REVISED				SRK		AVD		BSY				VVB	31.08.20	
R6	TITLE BLOCK CHANGED & GENERALLY REVISED				NDD		AVD		BSY				VVB	31.08.17	
R0					VVK				DGL				NP	26.07.76	
ISSUE	REVISIONS				DRN	DSN	CHD	CV	EL	IC	ME		PE/PM	APPD	DATE
								CLEARED							
DO NOT SCALE					STANDARD DRAWING										
FILE NAME : M2-EL-2367-Rev-R7					EARTHING DETAILS DISCONNECTING SWITCHES (WELDED/BRAZED/BOLTED CONNECTIONS)										
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					 TATA CONSULTING ENGINEERS LIMITED MUMBAI										
					SCALE : NTS				DWG. NO.				ISSUE		
					DC & DISC: MUM-EL				TCE.M2-EL-GL-S-2367				R7		
FILE NAME: F-094-Rev-R1.DWG					TCE FORM NO. 094 R1										



**DIRECTLY BURIED CABLES
IN SINGLE LAYER**



**DIRECTLY BURIED CABLES
IN TWO LAYERS**

DIMENSION (MIN.)	FOR 1.1kV GRADE CABLES	FOR 3.3kV & 11kV CABLES	FOR 22kV & 33kV CABLES
D1	750	900	1050
S	⊗ D — BETWEEN CABLES OF SAME VOLTAGE GRADE * 300MM — BETWEEN CABLES OF DIFFERENT VOLTAGE GRADE * 400MM — BETWEEN SINGLE CORE POWER CABLE AND COMMUNICATION CABLE * 300MM — BETWEEN MULTICORE POWER CABLE AND COMMUNICATION CABLE		

⊗ D — OVERALL DIAMETER OF THE BIGGER OF THE TWO CABLES

* — SPACING SHALL BE KEPT BOTH HORIZONTALLY AND VERTICALLY

LEGEND

- ① — CABLE ROUTE MARKER
- ② — EARTH BACK FILLED & RAMMED
- ③ — PROTECTIVE COVERS
 - a) EARTHENWARE FOR LOW VOLTAGE CABLES
 - b) RCC FOR HIGH VOLTAGE CABLES, WITH HOLE AT EACH END TO TIE THEM TO EACH OTHER WITH NYLON WIRE
- ④ — ARMoured POWER CABLE
- ⑤ — ARMoured CONTROL CABLE
- ⑥ — FINE SAND / RIDDLED SOIL COMPACTED

NOTES

- ALL DIMENSIONS ARE IN MM.
- ALL DIMENSIONS INDICATED ARE THE MINIMUM VALUES.
- FOR GENERAL NOTES REFER DRG. No. TCE.M2-EL-CT-S-2040 & 2041.
- SINGLE CORE CABLES SHALL BE RUN IN TREFOIL FORMATION AND SHALL BE BOUND BY PLASTIC TAPES OR 3MM DIA NYLON CORD EVERY 750MM.
- FOR CABLE ROUTE MARKER/JOINT MARKER, REFER SHEET 2 OF 2.
- CABLE IDENTIFICATION TAG SHALL BE TIED AT BOTH ENDS OF THE CABLE AND ALSO AT AN INTERVAL OF 15 METERS. FOR DETAILS OF TAG REFER DRG. NO. TCE.M2-EL-CT-S-2058.
- IF THE MINIMUM CLEARANCE AS INDICATED IN THE ABOVE TABLE FOR CABLES OF DIFFERENT VOLTAGE GRADE ARE NOT FEASIBLE, BRICK BARRIERS SHALL BE USED BETWEEN ADJACENT CABLES.
- RCC PIPE (NP2/NP3)/DWC PIPE SHALL BE PROVIDED FOR ROAD CROSSING AT A MINIMUM DEPTH OF 1000MM FROM THE GRADE LEVEL UNLESS OTHERWISE SPECIFIED.

R7	GENERALLY REVISED	AMS	SPK	GVC		GVC					SVS	10.09.2015
R6	GENERALLY REVISED	VBS	MVA	TSG		VVB					BSY	02.11.2015
R5	NOTE REVISED	M.J.I				A.R.					SR	03.01.2011
R4		MR				UGK					UGK	20.03.2002
R0												22.04.1985
ISSUE	REVISIONS	DRN	DSN	CHD	CV	EL	IC	ME		PE/PM	APPD	DATE

DO NOT SCALE

FILE NAME : M2-EL-2045-REV-R7.DWG

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INSTALLATION PRACTICE FOR DIRECTLY BURIED CABLES (SHEET 1 OF 2)



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MUMBAI

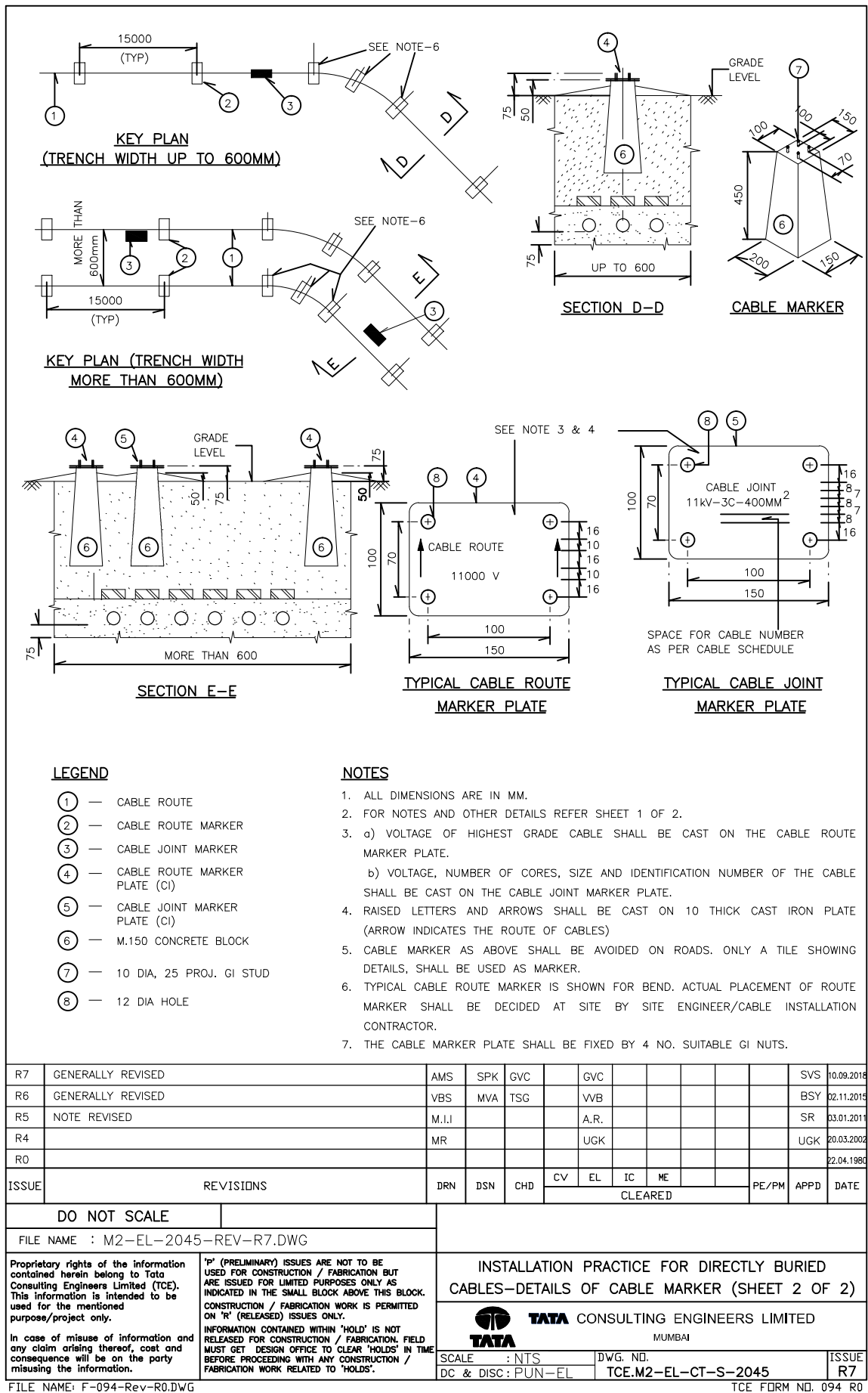
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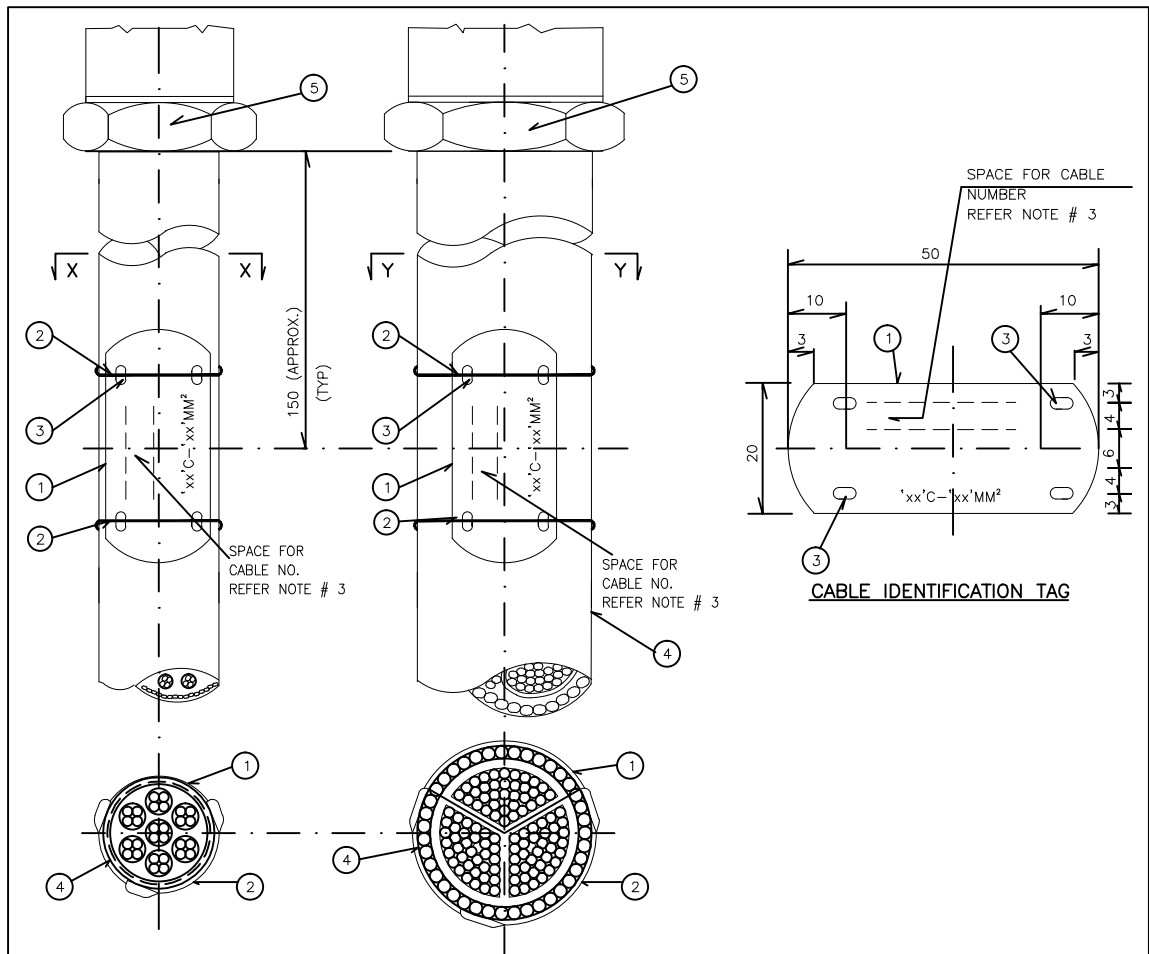
ISSUE R7

FILE NAME: F-094-Rev-R0.DWG

TCE FORM NO. 094 R0

SIZE-A4





TYPE-A (SECTION X-X)

TYPE-B (SECTION Y-Y)

**TYPICAL METHOD OF TYING THE TAG
FOR CABLES**

LEGEND

- ① — CABLE IDENTIFICATION TAG FABRICATED FROM 12 GAUGE ALUMINIUM (IS GRADE HP30WP OR EQUIVALENT) SHEET
- ② — 16 GAUGE GI BINDING WIRE/NYLON CORD
- ③ — 3MM DIA. HOLE
- ④ — CABLE
- ⑤ — CABLE GLAND

NOTES

- 1. ALL DIMENSIONS ARE IN MM.
- 2. FOR GENERAL NOTES REFER DWG. NO. TCE.M2-EL-CT-S-2040 & 2041
- 3. THE CABLE IDENTIFICATION NUMBER, NUMBER OF CORES AND SIZE SHALL BE EMBOSSED ON THE TAG, AS PER CABLE SCHEDULE.
- 4. THE TAG SHALL BE SUITABLY TIED APPROXIMATELY 150MM AWAY FROM THE CABLE GLAND AT BOTH ENDS OF THE CABLE.
- 5. THE TAG SHALL BE FREE FROM SHARP EDGES.

R5	GENERALLY REVISED	AMS	SPK	GVC		GVC					SVS	10-09-2018
R4	GENERALLY REVISED	MVK	PK	TSG		VVB					BSY	07-11-2019
R3	LEGEND NO.4 CHANGED	M.I.I				AR						27-01-2011
R0												08-08-1980
ISSUE	REVISIONS	DRN	DSN	CHD	CV	EL	IC	ME		PE/PM	APPD	DATE
										CLEARED		
DO NOT SCALE												
FILE NAME : M2-EL-2058-REV-R5.DWG												
Proprietary rights of the information contained herein belong to Tata Consulting Engineers Limited (TCE). This information is intended to be used for the mentioned purpose/project only. In case of misuse of information and any claim arising thereof, cost and consequence will be on the party misusing the information.		"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK ABOVE THIS BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLDS' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLDS'.										
		CABLE IDENTIFICATION TAG TATA CONSULTING ENGINEERS LIMITED MUMBAI SCALE : NTS DWG. NO. TCE.M2-EL-CT-S-2058 DC & DISC: PUN-EL										
FILE NAME: F-094-Rev-R0.DWG		TCE FORM NO. 094 RO										

FILE NAME: F-094-Rev-R0.DWG

TCE FORM NO. 094 R0

SIZE-A4

ANNEXURES -1
TECHNICAL SPECIFICATION FOR STU METERS
(131 SHEETS)

MATERIAL SPECIFICATIONS CELL

TECHNICAL SPECIFICATION

THREE PHASE FOUR WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER AS PER CATEGORY “B” OF IS: 15959/2011 WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

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TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

1.00 SCOPE:

This specification covers design; manufacture, testing, supply and delivery of ISI mark HT three phase four wire CT / PT operated 1 Amps or 5 Amps fully Static & AMR compatible Four Quadrant TOD Tri - vector Energy Meter as per Category B of IS: 15959 / 2011 and with latest amendments with ABT feature. The meters shall be suitable for measurement of import & export energies and demand as per Power and ABT tariff requirement for AC balanced / unbalanced loads.

The meter shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to purchaser, who will interpret the meaning of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered material shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in these specifications and / or the commercial order or not.

2.00 APPLICATION

HT Consumer's Installations (For open access consumer) / CPP / IPP / Co – Generation / Wind Mill/ Solar Generation or as an Interface Meter

SERVICE CONDITIONS

The meters to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Environmental Conditions:

(a) Maximum ambient temperature	55 ⁰ C
(b) Maximum ambient temperature in shade	50 ⁰ C
(c) Minimum temperature of air in shade	5 ⁰ C
(d) Maximum daily average temperature	40 ⁰ C
(e) Maximum yearly weighted average temperature	32 ⁰ C
(f) Relative Humidity	10 to 95 %
(g) Maximum Annual rainfall	1450 mm
(h) Maximum wind pressure	150 Kg/m ²

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

- | | |
|---|--------------|
| (i) Maximum altitude above mean sea level | 1000 mtrs |
| (j) Isoceraunic level | 50 days/year |
| (k) Seismic level (Horizontal acceleration) | 0.3 g |
| (l) Climate: Moderately hot and humid tropical climate conducive to rust and fungus growth. | |

3.00 STANDARD TO WHICH METER SHALL COMPLY:

IS: 15959 / 2011 (amended upto date) – Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification for Category – “B” Meters;

IS: 14697 / 2021 (amended up to date) – AC Static Transformer operated Watt-hour and VAR-hour Meters, Class 0.2S – Specification;

Amended CBIP Tech Report 325 for AC Static Transformer operated Watt Hour & VAR-Hour Meters (class 0.2S);

IS: 15707 / 2006 Specification for Testing, evaluation, installation & maintenance of AC Electricity Meters-Code of Practice;

CEA regulations and MERC guidelines with latest amendments.

The specifications given in this document supersedes the relevant clauses of IS: 14697 / 2021 (amended up to date) wherever applicable.

The equipment meeting with the requirements of other authoritative standards, which ensures equal or better quality than the standards mentioned above, also shall be considered.

In case the bidder wishes to offer material conforming to the other authoritative standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule.

Copy of such standards with authentic English Translations, shall be furnished along with the offer.

In case of conflict related with communication protocol, the IS: 15959 / 2011 – Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification shall prevail upon.

For conflict related with other parts of the specification, the order of priority shall be – (i) this technical specification, (ii) IS: 14697 / 2021 (Amended up to date), (iii) IEC, (iv) other authoritative standards

In case of any difference between provisions of these standards, the provisions of this specification shall prevail.

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

4.00 GENERAL TECHNICAL REQUIREMENT:

1)	TYPE	Three Phase, Four wire CT / PT operated 1 Amps or 5 Amps fully Static & AMR compatible Four Quadrant TOD Tri - vector Energy Meter as per Category B of IS: 15959 / 2011 and with latest amendments with ABT feature
2)	FREQUENCY	50 Hz $\pm$ 5%
3)	ACCURACY CLASS	0.2S (for Active Energy 0.2S and for Reactive Energy 0.2S)
4)	PT SECONDARY VOLTAGE	63.5 V Ph-N
5)	RATED VOLTAGE	110 V Ph-Ph or 63.5 V Ph-N
6)	VOLTAGE RANGE	+15% TO – 30% of rated voltage
7)	PT RATIO	$\frac{11 \text{ kV}}{\sqrt{3}}$ / $\frac{110 \text{ V}}{\sqrt{3}}$
8)	CT RATIO	1 / 1 Amps; 5 / 5 Amps
9)	BASIC CURRENT (I _b)	1 Amp; 5 Amps.
10)	MAXIMUM CONTINUOUS CURRENT (I _{max})	2 times (200 %) of I _b .
11)	SHORT TIME CURRENT	As per IS: 14697 / 2021.
12)	STARTING CURRENT	0.1% of I _b .
13)	POWER CONSUMPTION	The active and apparent power consumption, in each voltage circuit, at reference voltage, reference temperature and reference frequency shall not exceed 1.5W and 10 VA The apparent power taken by each current circuit, at basic current I_b, reference frequency and reference temperature shall not exceed 1 VA.
14)	POWER FACTOR	Power Factor range: Zero Lag to unity to Zero Lead to unity

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

		$\text{Avg. P.F} = \frac{\text{Total (kWh)}}{\text{Total (kVAh)}}$ For both Import & Export mode, $\text{kVAh} = \sqrt{(\text{Kwh})^2 + (\text{RKVAhlag} + \text{RKVAhlead})^2}$ PF shall be up to 3 decimal.
15)	DESIGN	Meter shall be designed with application specific integrated circuit (ASIC) or micro controller; shall have no moving parts; electronic components shall be assembled on printed circuit board using surface mounting technology; factory calibration using high accuracy (0.02 class) software based test bench.
16)	POWER SUPPLY	SMPS
17)	ISI MARK	The meter shall bear ISI Mark
18)	TEMPERATURE	The standard reference temperature for performance shall be 27° C. The mean temperature co-efficient shall not exceed 0.03%.
19)	POWER SOURCE	Meter shall be self powered.

5.00 CONSTRUCTION:

5.01 The meter shall be projection type suitable for mounting on plane vertical surface, dust and moisture proof.

The meter base shall be opaque & meter top cover shall be transparent/translucent/opaque. Meter base and cover shall be made out of unbreakable, high grade, fire resistant Polycarbonate material so as to give it tough and non-breakable qualities. The meter body shall be type tested for IP51 degree of protection as per IS: 12063 against ingress of dust, moisture & vermin. The meter cover shall be secured to base by means of sealable unidirectional/bidirectional captive screws.

NOTE: The meter shall be strictly wall mounted type with front side connections. Panel type meters having rear side connections shall not be accepted.

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

- 5.02 The poly carbonate body of the meter shall conform to IS: 11731 (FV-2 category) besides meeting the test requirement of heat deflection test as per ISO 75, glow wire test as per the IS: 11000 (part 2/SEC-1) 1984 OR IEC PUB 60695-2-12, Ball pressure test as per IEC-60695-10-2 and Flammability Test as per UL 94 or as per IS 11731(Part-2) 1986.
- 5.03 To meet the requirement of terminal connection arrangement, the moulded single terminal block for current & voltage connections shall be provided as per IS: 14697 / 2021 (amended up to date). The termination arrangement shall be provided with an extended type transparent terminal cover, sealable independently at the bottom of meter approachable from front side to prevent unauthorized tampering.
- 5.04 All insulating materials used in the construction of the meter shall be substantially non-hygroscopic, non aging and of tested quality.
- 5.05 All parts that are likely to develop corrosion under normal working condition shall be effectively protected against corrosion by suitable method to achieve durable results.
- 5.06 Independent sealing provision shall be made against opening of the terminal cover and meter body cover. It is necessary to provide unidirectional screws for meter body cover and bidirectional screws for terminal cover with two holes for sealing purpose.
- 5.07 The thickness of material for meter cover and base shall be 2 mm (minimum).
- 5.08 The terminal block, the terminal cover and the meter case shall ensure reasonable safety against the spread of fire. They shall not be ignited by thermal over load of live parts in contact with them.
- 5.09 The meter shall be completely factory sealed by providing minimum two (stickers / polycarbonate) seals at diagonally opposite positions except the terminal block cover. The provision shall be made on the meter for at least two (sticker / polycarbonate) seals to be provided diagonally by utility. The terminal cover shall be transparent with one side hinge/top hinge & sealing arrangement on both sides. Also transparent terminal cover without hinge with sealing arrangement on both sides shall be accepted.
- 5.10 The Push button facility shall be provided for following functions, as brought out elsewhere in this specification.
- (a) For TEST MODE (high resolution reading of display)
- (b) For ON DEMAND MODE (UP & DOWN Scrolling): Separate two buttons must be provided.

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

- (c) For INTERNAL BATTERY BACKUP (to read meter in case of Power failure)
 - (d) For MD RESET (with sealing arrangement): Separate independent button to be provided.
 - (e) One button for menu selection.
- 5.11 The meter shall have test output accessible from the front and be capable of being monitored with suitable testing equipment while in operation at site. The operation indicator must be visible from front. The test output device shall be provided only in the form of blinking LED. Resolution of the test output device shall be sufficient to enable the starting current test in less than 10 minutes. The pulse rate of output device (separate blinking LED must be provided for each parameter) which is Pulse / kWh and Pulse / kVAh (meter constant) shall be programmed according to primary values of voltage & current & shall be indelibly provided on the nameplate.
- 5.12 The meter accuracy shall not be affected by AC / DC magnetic field on all the sides of meter i.e. front, sides, top and bottom of the meter as per CBIP publication No. 325 with latest amendments. If the accuracy of the meter gets affected, then the same shall be recorded as magnetic tamper event with date & time stamping. The energy recorded during such tamper shall be registered in a separate register in addition to main register.
- 5.13 The meter shall also be capable to withstand and shall not get damaged if phase-to-phase voltage is applied between phases & neutral for five minutes without affecting the accuracy.
- 5.14 In meter, power supply unit shall be micro control type instead of providing transformer and then conversion to avoid magnetic influence.
- 5.15 Non specified display parameters in the meter shall be blocked and it shall not be accessible for reprogramming at site.
- 5.16 Complete metering system shall not be affected by the external electromagnetic interference such as electrical discharge of cables and capacitors, harmonics, electrostatic discharges, external magnetic fields and DC current in AC supply etc. The Meter shall meet the requirement of CBIP publication No. 325 with latest amendments.
- 5.17 Internal CTs, (if provided) are to be provided with magnetic shielding and they shall be tested separately prior to assembly by the meter manufacturer.
- 5.18 PCB used in meter shall be made by Surface Mounting Technology.

5.19 REAL TIME INTERNAL CLOCK (RTC)

The real time quartz clock shall be used in the meter for maintaining time (IST) and calendar. The RTC shall be non - rechargeable and shall be pre-programmed for 30 Years Day / date without any necessity for correction. The maximum drift shall not exceed +/- 300 seconds per year.

5.20 The clock day / date setting and synchronization shall only be possible through password / key code command from one of the following:

- a) Hand Held Unit (HHU), Laptop Computer or Meter Testing Work Bench and this shall need password enabling for meter;
- b) From remote server (MDAS) through suitable communication network or Sub-station data logger 'PC'.

The RTC battery & the battery for display in case of power failure shall be separate.

5.21 SELF DIAGNOSTIC FEATURES:

5.21.1 The meter shall keep log in its memory for unsatisfactory functioning or non-functioning of Real Time Clock battery, also it shall be recorded and indicated in reading file at base computer software.

5.21.2 All display segments: "LCD Test" display shall be provided for this purpose.

5.22 METERING PROTOCOL:

The meter protocol shall be as per Annex E - Category B meters of IS: 15959 / 2011.

5.23 COMMUNICATION CAPABILITY:

The meter shall be provided with three ports for communication of the measured / collected data as per IS: 15959 / 2011 as mentioned below.

- i) Hardware port compatible with RS-232 specifications of RJ - 11 or RJ-45 type
- ii) Hardware port compatible with RS-485 specifications of RJ - 11 or RJ-45type
- iii) Optical port complying with hardware specifications detailed in IEC - 62056 - 21.

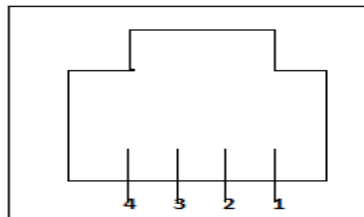
RS-232 and RS-485 ports of RJ - 11 or RJ-45 type shall be used for remote access through suitable Modem (4G/GPRS / GSM / and SCADA). Optical port shall be used for local data downloading through a DLMS compliant CMRI. Sealing arrangement for Optical, RS 232 port & RS-485 port as required shall be provided.

All the ports shall be able to communicate simultaneously.

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

The minimum requirements for RS-232 based systems are described below:

- i. The interface shall meet all the requirements of RS-232 specifications in terms of Physical media, Network topologies, maximum devices, maximum distance, mode of operation, etc.
- ii. RJ 11 type connectors have to be provided to easily terminate the twisted pair.



PIN DESCRIPTION

Pin No	Signal
1	RTS (Ready To Send)
2	Ground (GND)
3	Transmit Data (Tx)
4	Receive Data (Rx)

All ports shall support the default and minimum baud rate of 9,600 bps. Necessary chord for Optical Port of minimum length of 2 metres per meter shall be provided free of cost.

- 5.24 The meter shall have facility to read the default display parameters during Power supply failure. For this purpose an internal or external battery may be provided.

The internal battery shall be Ni-mh or Li-ion or NI CD or AA Lithium thionyl chloride maintenance free battery of long life of 10 years. A suitable Push Button arrangement for activation of this battery shall be provided.

- 5.25 Wire / Cable less design:

The meter PCB shall be wireless to avoid improper and loose connections/ contacts.

- 5.26 The data stored in the meter shall not be lost in the event of power failure. The meter shall have Non Volatile Memory (NVM), which does

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

not need any battery backup. The NVM shall have a minimum retention period of 10 years.

5.27 Meter energy measure, record & display

- i) The meter shall measure, record and display total kWh energy in Import mode.
- ii) The meter shall measure, record and display total kVAh energy in Import mode.
- iii) The meter shall measure, record and display total kWh energy in Export mode.
- iv) The meter shall measure, record and display total kVAh energy in Export mode.
- v) In addition to above, fundamental kWh, kVArh & kVAh energy shall be recorded and available at BCS end.

6.00 TOD TIMINGS:

There shall be provision for at least 8 (EIGHT) TOD time zones for energy and demand. The number and timings of these TOD time Zones shall be programmable by manufacturer only at site / factory.

At present the time zones shall be programmed as below:

- TIME ZONE "A" ... 00.00 to 06.00 hrs and 22.00 to 24.00 hrs.
TIME ZONE "B" ... 06.00 to 09.00 hrs and 12.00 to 18.00 hrs.
TIME ZONE "C" ... 09.00 to 12.00 hrs.
TIME ZONE "D" ... 18.00 to 22.00 hrs.

7.00 DEMAND INTEGRATION PERIOD:

MD integration period shall be programmable upto 15 min with sub-integration period of 5 min with sliding window method. Also it shall be possible to reprogram MD integration period from sliding window method to block window method if required in future.

8.00 MD RESET:

The meter shall have following MD resetting options.

- i) Communication driven reset;
- ii) Manual resetting arrangement with sealing facility;
- iii) Automatic reset at the end of certain predefined period (say, start of the month (on first day at 00:00:00 Hrs) or end of the month (on

last day at 24:00:00 Hrs)).

9.00 ANTI TAMPER FEATURES:

The meter shall detect and correctly register energy under following tamper conditions:

- (a) The meter accuracy shall not be affected by change of phase sequence. It shall maintain the desired accuracy in case of reversal of phase sequence.
- (b) The meter shall continue to work even without neutral.
- (c) The meter shall work in absence of any two phases, i.e. it shall work on any one phase wire and neutral, to record relevant energy.
- (d) The meter accuracy shall not be affected by AC / DC magnetic field on all the sides of meter i.e. front, sides, top and bottom of the meter as per CBIP publication No. 325 with latest amendments. If the accuracy of the meter gets affected, then the same shall be recorded as magnetic tamper event with date & time stamping.

The meter should have features to detect the occurrence and restoration of the following abnormal events:

Missing potential:

The meter shall be capable of detecting and recording occurrence and restoration with date and time the case of potential failure and low potential, which could happen due to disconnection of potential leads (one or two). If any of the three line to neutral voltages fall below 70% of reference voltage for continuous 5 minutes, the event shall be recorded with phase identification.

Potential Unbalance:

Meter shall also detect and log cases of voltage unbalance (10% or more for 5 Minutes.) with date & time. Higher of the 3 phase voltages shall be considered as reference for this purpose.

Current unbalance:

The meter shall be capable of detecting and recording occurrence and restoration with date and time of current unbalance. (30% or more for 15 minutes) Higher of the 3 phase currents shall be considered as reference for this purpose.

Current Reversal:

The meter shall be capable of detecting and recording occurrence and

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

restoration with date and time of reversal of current in one phase w.r.t. two other phases. The meter shall record resultant energy in the respective registers (Import if resultant is Import & vice versa) in the case of CT reversal detected. It shall also possess a current reversal counter.

Current Missing:

The meter shall be capable of detecting and recording occurrences and restoration of current below starting current value as a current missing event with phase identification for persistence time of 15 minutes. It shall also possess a current missing counter.

Power ON/OFF:

The meter shall be capable to record power ON/OFF events in the meter memory. All potential failure shall record as power off event. All power OFF events shall be recorded separately. This event shall not have any persistence time for occurrence, recovery & event persistence.

Low Power Factor:

The meter shall be capable of detecting and recording occurrences and restoration of LOW PF of 0.5 & below for lag / lead in import as well as export mode.

Neutral Injection:

Under influence due to injection of High frequency, High Voltage or High DC Voltage through neutral, if the accuracy of meter gets affected, then the meter shall record the same as tamper event with date & time.

Cover opening:

In the event the meter is forcibly opened, even by 2 to 4 mm variation of the meter cover, same shall be recorded as tamper event with date & time stamping and the meter shall continuously display that the cover has been tampered.

For above abnormal conditions, the recording of events shall be on FIFO basis. It shall be possible to retrieve the abnormal event data along with all related snap shots data by authorized personnel through the meter optical port with the help of CMRI or remote access through suitable communication network & downloaded the same to the base computer. All the information shall be made available in simple & easy to understand format.

9.01 TAMPER EVENTS

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

- 9.01.1 The meter shall work satisfactorily under presence of various influencing conditions like External Magnetic Field, Electromagnetic Field, Radio Frequency Interference, Harmonic Distortion, Voltage / Frequency Fluctuations and Electromagnetic High Frequency Fields, etc. as per relevant IS
- 9.01.2 The meter shall record the occurrence and restoration of tamper events of current, voltages, kWh, kVAh power factor, event code, date & time etc. listed in Table 32 to 37 of IS: 15959 / 2011
- 9.01.3 In the event the meter is forcibly opened, even by 2 to 4 mm variation of the meter cover, same shall be recorded as tamper event with date & time stamping as per table 37 of IS: 15959 / 2011 and the meter shall continuously display that the cover has been tampered
- 9.01.4 The detection of the tamper event shall be registered in the tamper event register. The no. of times the tampering has been done shall also be registered in the meter
- 9.01.5 Tamper details shall be retrieved by authorized personnel through either of the following

- i) CMRI
- ii) Remote access through suitable communication network

Minimum 200 numbers of events (occurrences & restoration with date & time) shall be available in the meter memory.

The recording of abnormal events shall be as per IS 15959. The recording of abnormal events shall be on FIFO basis. The un-restored events shall be recorded and shall not be deleted till they get recovered (permissible upto 3 months)

All the information of data shall be made available in simple & easy to understand format.

- 9.02 The threshold values for various tampers are as below.

Sr. No.	Description	Occurrence (With Occ. Time 5 min.)	Restoration (With Rest. Time 5 min.)
1.	PT link Missing (Missing potential)	< 70% of Vref and current in that phase is > 5% Ib	>70 % of Vref

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

2.	Over voltage in any phase	> 115 % of Vref	< 115 % of Vref
3.	Low voltage in any phase	< 70 % of Vref	> 70 % of Vref
4.	Voltage Unbalance	Vmax - Vmin > 10 % Vmax	Vmax - Vmin < 10 % Vmax
5.	CT Open.	Zero Amps in one or two phases and current in at least 1 phase is > 5% Ib for 15 minutes.	> 5 % Ib for 15 min in the tampered phase for 15 min.
6.	Current Unbalance. (Diff. of phase currents)	> 30 % Iref* for 15 min	< 30 % Iref* for 15 min
7.	Current Bypass	Bypass Current > 50 % Iref* for 15 min	Bypass Current < 30 % Iref* for 15 min
8.	Current Reversal	Immediate in case of reverse of any one phase w.r.t. two phases	Direction of all the currents are same.
9.	Over Current in any Phase	> 120 % Ib	< 120 % Ib
10.	Influence of permanent magnet or AC / DC electromagnet / permanent magnet	Immediate	1 minute after removal
11.	Neutral Disturbance	--	--
12.	Power failure	Immediate	Immediate
13.	Very Low PF	--	--

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

14.	Meter Cover Opening	(2 to 4 mm) Immediate (Occurrence only)
* Higher of 3 phase currents shall be taken as reference for this purpose.		

*The energy meter shall capable to record & display all tamper with date and time stamping.

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

10.00 QUANTITIES TO BE MEASURED & DISPLAYED

The meter shall be capable of measuring and displaying the following electrical quantities within specified accuracy limits for polyphase balanced or unbalanced loads:

- a) Instantaneous Parameters such as phase and line voltages, currents, power factors, overall kVA, kW, kVAr, frequency etc as per details given in the table below and IS: 15959 / 2011[AMENDED UP TO DATE].
- b) Block Load Profile Parameters such as kVAh / kWh / kVArh (lag / lead) / Maximum Demand (MD) in kW / kVA / power factor / phase and line voltages / currents etc. as per details given in the table below and IS: 15959 / 2011 [AMENDED UP TO DATE].
- c) BillingProfile Parameters such as cumulative energy kWh / cumulative kVAh / cumulative energy kVArh, etc. as per details given in the table below and IS: 15959 / 2011 [AMENDED UP TO DATE].

In addition to above the meter shall also record the Name plate details, programmable parameters (readable as profile), occurrence and restoration of tamper events along with the parameters (Table 30, 31 32, 33, 34, 35, 36, 37 & 39 respectively) of IS: 15959 / 2011 [AMENDED UP TO DATE].

Detail of category wise parameters requirement suitable for HT (CT / PT) boundary energy metering is given in following tables of IS: 15959 / 2011[AMENDED UP TO DATE].

Category B	Parameter group	Annexure Table No.
HT (CT / PT) ABT Energy Meters	Instantaneous parameters	24
	Block Load Profile parameters	25
	Billing Profile Parameters	26
	Name Plate details	30
	Programmable Parameters	31
	Event Conditions	32 to 37

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All logging parameters for each of the event condition for 3 Φ / 4W	Capture parameters for event (Event Log Profile)	39
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11.00 DISPLAY OF MEASURED VALUES:

11.01 DISPLAY INDICATORS

The supply indication shall be displayed permanently by LCD as a minimum and shall be visible from the front of the meter. In case of non available of voltage to any phase(s), the LCDs of that particular phase shall stop glowing or those particular indicator(s) shall start blinking on the LCD display of meter

- 11.02 Permanently backlit LCD panel shall show the relevant information about the parameters to be displayed. The corresponding non-volatile memory shall have a minimum retention time of 10 years.

In the case of multiple values presented by a single display it shall be possible to display the content of all relevant memories. When displaying the memory, the identification of each parameter applied shall be possible.

The principal unit for the measured values shall be the kilowatt-hour kWh for active energy and kVARh for reactive energy

- 11.03 The meter shall have minimum 6 digits (with +/- indication), parameter identifier, permanently backlit LCD with wide viewing angle. The size of digit shall be minimum 8x5 mm. The decimal units shall not be displayed in auto scroll mode and push button mode or alternate mode. However it shall be displayed in for high resolution display for testing. Auto display cycling push button is required with persistence time of 10 Seconds. LCD shall be suitable for temperature withstand of 70^o C; adequate back up arrangement for storing of energy registered at the time of power interruption shall be provided.

11.04 DISPLAY OF MEASURED VALUES:

11.05 DISPLAY PARAMETERS

S.N.	Default Display Mode
A	NORMAL DISPLAY (DEFAULT DISPLAY)
1.	LCD Test
2.	Meter Sr. No.
3.	Real Time Clock – Date & Time

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4.	Cumulative Energy – kWh (Import)
5.	Cumulative Energy – kWh - TOD Zone A (TZ1) (Import)
6.	Cumulative Energy – kWh - TOD Zone B (TZ2) (Import)
7.	Cumulative Energy – kWh - TOD Zone C (TZ3) (Import)
8.	Cumulative Energy – kWh - TOD Zone D (TZ4) (Import)
9.	Cumulative Energy – kVArh - Lag (Import)
10.	Cumulative Energy –kVArh - Lead (Import)
11.	Cumulative Energy – kVAh (Import)
12.	Cumulative Energy – kVAh - TOD Zone A (TZ1) (Import)
13.	Cumulative Energy – kVAh - TOD Zone B (TZ2) (Import)
14.	Cumulative Energy – kVAh - TOD Zone C (TZ3) (Import)
15.	Cumulative Energy – kVAh – TOD Zone D (TZ4) (Import)
16.	MD – kVA with occurrence date & time (Import)
17.	MD - kVA – TOD Zone A (TZ1) with occurrence date & time (Import)
18.	MD - kVA – TOD Zone B (TZ2) with occurrence date & time (Import)
19.	MD - kVA – TOD Zone C (TZ3) with occurrence date & time (Import)
20.	MD - kVA – TOD Zone D (TZ4) with occurrence date & time (Import)
21.	Cumulative Energy – kWh (Export)
22.	Cumulative Energy – kWh - TOD Zone A (TZ1) (Export)
23.	Cumulative Energy – kWh - TOD Zone B (TZ2) (Export)
24.	Cumulative Energy – kWh - TOD Zone C (TZ3) (Export)
25.	Cumulative Energy – kWh - TOD Zone D (TZ4) (Export)
26.	Cumulative Energy – kVArh - Lag (Export)
27.	Cumulative Energy –kVArh - Lead (Export)
28.	Cumulative Energy – kVAh (Export)
29.	Cumulative Energy – kVAh - TOD Zone A (TZ1) (Export)
30.	Cumulative Energy – kVAh - TOD Zone B (TZ2) (Export)
31.	Cumulative Energy – kVAh - TOD Zone C (TZ3) (Export)
32.	Cumulative Energy – kVAh – TOD Zone D (TZ4) (Export)
33.	MD – kVA with occurrence date & time (Export)
34.	MD - kVA – TOD Zone A (TZ1) with occurrence date & time (Export)
35.	MD - kVA – TOD Zone B (TZ2) with occurrence date & time (Export)
36.	MD - kVA – TOD Zone C (TZ3) with occurrence date & time (Export)
37.	MD - kVA – TOD Zone D (TZ4) with occurrence date & time (Export)
38.	Number of MD – kVA reset
39.	Voltage – V_R
40.	Voltage – V_Y
41.	Voltage – V_B
42.	Current – I_R
43.	Current – I_Y
44.	Current – I_B
45.	Instantaneous Signed Power Factor – R Phase
46.	Instantaneous Signed Power Factor – Y Phase
47.	Instantaneous Signed Power Factor – B Phase
48.	Three Phase Power Factor (Instantaneous)
49.	Frequency
50.	Cumulative Billing Count- MD Reset count

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51.	Billing Date
52.	Cumulative Programming Count
53.	Cumulative Tamper Count
54.	Number of power failures.
55.	Cumulative power failure duration.
56.	Meter Cover Opening – Occurrence with date and time.
B	ON DEMAND DISPLAY (ALTERNATE MODE)
1.	LCD Test
2.	Meter Sr. No.
3.	Real Time Clock – Date & Time
4.	The % THD for Import shall have +ve sign and for Export –ve sign. a. Voltage % THD (Instantaneous) b. Current % THD (Instantaneous)
5.	MD – kVA reset count
6.	Last date & time of MD - kVA reset
7.	Current – I_R
8.	Current – I_Y
9.	Current – I_B
10.	Voltage – V_R
11.	Voltage – V_Y
12.	Voltage – V_B
13.	Cumulative Energy – kVArh – Lag TOD Zone A (TZ1) (Import)
14.	Cumulative Energy – kVArh – Lag TOD Zone B (TZ2) (Import)
15.	Cumulative Energy – kVArh – Lag TOD Zone C (TZ3) (Import)
16.	Cumulative Energy – kVArh – Lag TOD Zone D (TZ4) (Import)
17.	Cumulative Energy – kVArh – Lead TOD Zone A (TZ1) (Import)
18.	Cumulative Energy – kVArh – Lead TOD Zone B (TZ2) (Import)
19.	Cumulative Energy – kVArh – Lead TOD Zone C (TZ3) (Import)
20.	Cumulative Energy – kVArh – Lead TOD Zone D (TZ4) (Import)
21.	Cumulative Energy – kVArh – Lag TOD Zone A (TZ1) (Export)
22.	Cumulative Energy – kVArh – Lag TOD Zone B (TZ2) (Export)
23.	Cumulative Energy – kVArh – Lag TOD Zone C (TZ3) (Export)
24.	Cumulative Energy – kVArh – Lag TOD Zone D (TZ4) (Export)
25.	Cumulative Energy – kVArh – Lead TOD Zone A (TZ1) (Export)
26.	Cumulative Energy – kVArh – Lead TOD Zone B (TZ2) (Export)
27.	Cumulative Energy – kVArh – Lead TOD Zone C (TZ3) (Export)
28.	Cumulative Energy – kVArh – Lead TOD Zone D (TZ4) (Export)
29.	Instantaneous Signed Power Factor – R Phase (Import/Export)
30.	Instantaneous Signed Power Factor – Y Phase (Import/Export)
31.	Instantaneous Signed Power Factor – B Phase (Import/Export)
32.	Three Phase Power Factor (Instantaneous)
33.	Frequency
34.	Average frequency for previous 15 min block (00 to 99 for frequency form 49.5 to 50.5 Hz)
35.	Net kWh transmittal during previous 15 min block up to second decimal with plus / minus sign

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	(PLUS sign when there is net kWh and kVAh IMPORT to the beneficiary and NEGATIVE sign when there is net kWh and kVAh EXPORT from the beneficiary)
36.	Cumulative kVArh transmitted for Voltage HIGH condition at each midnight in eight digits including two decimals
37.	Cumulative kVArh transmitted for Voltage LOW condition at each midnight in eight digits including two decimals
38.	Cumulative Programming Count
39.	Cumulative Tamper Count
40.	Meter Cover Opening – Occurrence with date and time.
41.	Apparent Power kVA
42.	Number of power failures.
43.	Cumulative power failure duration.
44.	Signed Active Power kW (with sign " Import" for Import and " Export" for Export)
45.	Signed Reactive Power kVA (with sign " Import" for Import and " Export" for Export)
46.	Last Tamper Event with date and time.
47.	Last Block Net kWh Energy = (Imp – Exp)
48.	Last Block Average frequency
C) Test mode display:	
49.	High Resolution total kWh Import (For calibration)
50.	High Resolution total kVAh Import (For calibration)
51.	High Resolution total kVArh Import Lag (For calibration)
52.	High Resolution total kVArh Import Lead (For calibration)
53.	High Resolution total kWh Export (For calibration)
54.	High Resolution total kVAh Export (For calibration)
55.	High Resolution total kVArh Export Lag (For calibration)
56.	High Resolution total kVArh Export Lead (For calibration)
57.	High Resolution total High kVArh (V> 103%)
58.	High Resolution total Low kVArh (V< 97%)
59.	Rising Demand Import kVA with remaining time up to EOI
60.	Rising Demand Export kVA with remaining time up to EOI

NOTE:

(1) It shall be possible to scroll through the parameters (up & down) manually in on demand display mode and test display mode.

(2) In addition to above parameters, phasor diagram shall be plotted invariably at the time of data retrieval

11.06 The meters shall be pre-programmed for following details.

- i) PT Ratio: $11000/\sqrt{3} / 110/\sqrt{3} \text{ V}$,
- ii) CT Ratio: 5/5 Amps or 1/1 Amp as the case may be.

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- iii) Scale MF shall be One (1) invariably.
- iv) MD RESET:
MD resetting shall be auto as per clause no. 8.00 (iii).
- v) MD integration period shall be programmable upto 15 min with sub-integration period of 5 min with sliding window method.
- vi) The display of various parameters in Normal Mode & Alternate mode shall be as per table 24 (except 2) & 26 (except 4 & 5) of Annex D of IS: 15959 / 2011 AMENDED UP TO DATE in the sequence as below. Display other than specified below shall be blocked. The scroll period for auto scroll shall be 10 seconds
- vii) Average power factor for current billing period (since last reset) shall be calculated as ratio of kWh & kVAh since last reset for respective mode. It shall be displayed with 3 decimal digits.

Instantaneous PF shall be calculated as ratio of instantaneous kW and kVA.

12.00 BILLING DATA, BILLING HISTORY DATA, ABT BILLING DATA & BLOCK LOAD SURVEY

12.01 BILLING DATA

The billing data parameters shall be as per table 26 (except 4 & 5) of Annex D of IS: 15959 / 2011 AMENDED UP TO DATE for category B and is summarized as below.

Sr. No.	Parameters
1.	Real Time Clock – Date & Time
2.	Cumulative kWh Energy (Import)
3.	Cumulative Energy – kWh - TOD Zone A (TZ1) (Import)
4.	Cumulative Energy – kWh - TOD Zone B (TZ2) (Import)
5.	Cumulative Energy – kWh - TOD Zone C (TZ3) (Import)
6.	Cumulative Energy – kWh - TOD Zone D (TZ4) (Import)
7.	Cumulative kWh Energy (Export)
8.	Cumulative Energy – kWh - TOD Zone A (TZ1) (Export)
9.	Cumulative Energy – kWh - TOD Zone B (TZ2) (Export)

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10.	Cumulative Energy – kWh - TOD Zone C (TZ3) (Export)
11.	Cumulative Energy – kWh - TOD Zone D (TZ4) (Export)
12.	Cumulative Energy – kVarh – Lag (Import)
13.	Cumulative Energy – kVarh – Lag TOD Zone A (TZ1) (Import)
14.	Cumulative Energy – kVarh – Lag TOD Zone B (TZ2) (Import)
15.	Cumulative Energy – kVarh – Lag TOD Zone C (TZ3) (Import)
16.	Cumulative Energy – kVarh – Lag TOD Zone D (TZ4) (Import)
17.	Cumulative Energy – kVarh – Lead (Import)
18.	Cumulative Energy – kVarh – Lead TOD Zone A (TZ1) (Import)
19.	Cumulative Energy – kVarh – Lead TOD Zone B (TZ2) (Import)
20.	Cumulative Energy – kVarh – Lead TOD Zone C (TZ3) (Import)
21.	Cumulative Energy – kVarh – Lead TOD Zone D (TZ4) (Import)
22.	Cumulative Energy – kVarh – Lag (Export)
23.	Cumulative Energy – kVarh – Lag TOD Zone A (TZ1) (Export)
24.	Cumulative Energy – kVarh – Lag TOD Zone B (TZ2) (Export)
25.	Cumulative Energy – kVarh – Lag TOD Zone C (TZ3) (Export)
26.	Cumulative Energy – kVarh – Lag TOD Zone D (TZ4) (Export)
27.	Cumulative Energy – kVarh – Lead (Export)
28.	Cumulative Energy – kVarh – Lead TOD Zone A (TZ1) (Export)
29.	Cumulative Energy – kVarh – Lead TOD Zone B (TZ2) (Export)
30.	Cumulative Energy – kVarh – Lead TOD Zone C (TZ3) (Export)
31.	Cumulative Energy – kVarh – Lead TOD Zone D (TZ4) (Export)
32.	Cumulative Energy – kVAh (Import)
33.	Cumulative Energy – kVAh - TOD Zone A (TZ1) (Import)
34.	Cumulative Energy – kVAh – TOD Zone B (TZ2) (Import)

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35.	Cumulative Energy – kVAh – TOD Zone C (TZ3) (Import)
36.	Cumulative Energy – kVAh – TOD Zone D (TZ4) (Import)
37.	Cumulative Energy – kVAh (Export)
38.	Cumulative Energy – kVAh - TOD Zone A (TZ1) (Export)
39.	Cumulative Energy – kVAh – TOD Zone B (TZ2) (Export)
40.	Cumulative Energy – kVAh – TOD Zone C (TZ3) (Export)
41.	Cumulative Energy – kVAh – TOD Zone D (TZ4) (Export)
42.	MD – kVA with occurrence date & time (Import)
43.	MD – kVA – TOD Zone A (TZ1) with occurrence date & time (Import)
44.	MD – kVA – TOD Zone B (TZ2) with occurrence date & time (Import)
45.	MD – kVA – TOD Zone C (TZ3) with occurrence date & time (Import)
46.	MD – kVA – TOD Zone D (TZ4) with occurrence date & time (Import)
47.	MD – kVA with occurrence date & time (Export)
48.	MD – kVA – TOD Zone A (TZ1) with occurrence date & time (Export)
49.	MD – kVA – TOD Zone B (TZ2) with occurrence date & time (Export)
50.	MD – kVA – TOD Zone C (TZ3) with occurrence date & time (Export)
51.	MD – kVA – TOD Zone D (TZ4) with occurrence date & time (Export)
52.	Cumulative kVA MD (Import)
53.	Cumulative kVA MD (Import)
54.	Reactive Energy high (V>103 per cent)
55.	Reactive Energy low (V< 97 per cent)

12.02 BILLING HISTORY:

The meter shall have sufficient non-volatile memory for recording history of billing parameters for last 13 months.

12.03 ABT BILLING DATA:

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Following parameters shall be stored in non volatile memory automatically as ABT DATA.

1. Average frequency for each successive 15 min block (00 to 99 for frequency form 49.5 to 50.5 Hz).
2. Net kWh transmittal during each successive 15 min block up to second decimal with plus / minus sign.
(PLUS sign when there is net kWh IMPORT by the beneficiary and NEGATIVE sign when there is net kWh EXPORT from the beneficiary.)
3. Cumulative kWh transmitted at each midnight in eight digits including two decimals.
4. Cumulative kVarh transmitted for Voltage HIGH condition at each midnight in eight digits including two decimals.
5. Cumulative kVarh transmitted for Voltage LOW condition at each midnight in eight digits including two decimals.
6. The date time blocks of failure of VT supply on any phase as a (*) (Star) mark.

The meter shall store all these (1 to 8 above) data in their memory for a period of 10 days. The data older than 10 days shall get erased automatically on FIFO basis.

NOTE:

- Net Reactive Energy HIGH =
$$= [(\text{Export Lag} + \text{Import Lead}) - (\text{Import Lag} + \text{Export Lead})]$$
- Net Reactive Energy LOW
$$= [(\text{Import Lag} + \text{Export Lead}) - (\text{Export Lag} + \text{Import Lead})]$$

12.04 LOAD SURVEY DATA:

The meter shall have sufficient non-volatile memory for logging load survey data. Interval for load survey shall be 15 minutes or configurable for 5 minutes if required in future. Load survey data shall be logged for last 60 days or more on non-time based basis, i.e. if there is no power for more than 24 hours, the day shall not be recorded. Whenever meter is taken out and brought to laboratory, the load survey data shall be retained for the period of actual use of meter. This load survey data can be retrieved as and when desired and load profiles shall be viewed graphically / analytically with the help of meter application software. The meter application software shall be capable of exporting / transmitting these data for analysis to

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other user software in spreadsheet format. The load survey data shall be on first in first out basis (FIFO).

The Block Load survey data shall be for specified parameters as per table 25 (except 5 & 6) for 3 Φ /4W system of measurement with NEUTRAL as reference point of Annex D of IS: 15959 / 2011 AMENDED UP TO DATE. The specified parameters are as below.

Load survey parameters: (for 15 min block or 5 min block if required in future) (As per recent CEA& SAMAST guidelines)

Sr. No.	Parameters
1.	Real Time Clock – Date and Time
2.	Current - I_R
3.	Current – I_Y
4.	Current – I_B
5.	Voltage – V_{RN}
6.	Voltage – V_{YN}
7.	Voltage – V_{BN}
8.	Block Energy – kWh Import mode
9.	Block Energy – kVArh – Lag Import mode
10.	Block Energy – kVArh – Lead Import mode
11.	Block Energy – kVAh Import mode
12.	Block Energy – kWh Export mode
13.	Block Energy – kVArh – Lag Export mode
14.	Block Energy – kVArh – Lead Export mode
15.	Block Energy – kVAh Export mode
16.	kVA demand (Import).
17.	kVA demand (Export).
18.	kW demand (Import).
19.	kW demand (Export).
20.	kVA demand (Import).
21.	kVA demand (Export).
22.	PF (Import)
23.	PF (Export)
24.	Frequency

12.05 METER DATA AVAILABLE AT BCS END:

The programme data shall store & display the programming details of the meter such as four quadrants, programmed CT Ratio & PT Ratio, TOD zone timings, demand reset type & integration and sub-integration period, Load survey parameters with integration period, etc.

12.06 TAMPER DATA:

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It shall be possible to retrieve the abnormal event data along with all related snap shots data (mentioned at Cl. No. 10.00) through the meter optical port with the help of CMRI/Laptop computer/remote access through suitable communication network& download the same to the base computer. All the information shall be made available event wise (occurrence & restoration) in simple & easy to understand format.

It shall be possible to retrieve the abnormal event data along with all related snap shots data (mentioned at Cl. No. 10.00) through the meter optical port with the help of CMRI and Laptop computer and remote access through suitable communication network& download the same to the base computer. For downloading abnormal data at site in laptop, communication cord having optical reader & USB port with supporting tools & software should be provided with a lot of 100 meters each. All the information shall be made available event wise (occurrence & restoration) in simple& easy to understand format.

The meter shall keep records for the minimum 200 events excluding power off events (Occurrence + Restoration). For above abnormal conditions the recording of events shall be on FIFO basis; however the unrestored events stored separately shall not be erased till restoration.

13.00 DEMONSTRATION:

The purchaser reserves the right to ask to give the demonstration of the equipment offered at the purchaser's place.

14.00 COMMON METER READING INSTRUMENT (CMRI)

- 14.01 To enable local reading of meters data, a DLMS compliant CMRI shall be provided.
- 14.02 The CMRI shall be as per specification given in Annex J of IS: 15959 / 2011 AMENDED UP TO DATE.
- 14.03 It shall be compatible to the DLMS compliant energy meters that are to be procured / supplied on the basis of this specification.
- 14.04 The CMRI shall be supplied by the meter manufacturer along with the meter free of cost in the ratio of one for each 50 Nos. meters supplied including user manual and a set of direct communication cords for data downloading to the Laptop or PC for each CMRI.
- 14.05 There shall be a provision for auto power save on CMRI, which shall force the instrument in the power saving mode in case of no-activity within 5 minutes. The data shall not be lost in the event the batteries are drained or removed from the CMRI.

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- 14.06 The CMRI shall have a memory capacity of 8 GB with USB SRAM (Static RAM) with battery backup & upgradeable and BIOS / OS on FLASH / EEPROM Memory of 512 MB.
- 14.07 The manufacturer / supplier shall modify the compatibility of CMRI with the meter and the base computer system due to any change in language or any other reasons at their own cost within guarantee period.
- 14.08 The CMRI shall be type tested for (a) Tests of Mechanical requirement such as Free fall test, Shock Test, Vibration test, (b) Tests of Climatic influences such as Tests of Protection against Penetration of Dust and Water (IP 6X), Dry Heat test, Cold Test, Damp Heat Cyclic Test, (c) Tests for Electromagnetic Compatibility (EMC), (d) Test of Immunity to Electromagnetic HF Fields and (e) Radio Interference Measurement.
- 14.09 The equipments offered shall be fully type tested at approved laboratory by National Accreditation Board for Testing and Calibration Laboratories (NABL) as per relevant standards within last 5 years from the date of opening of tender & the type test reports shall be enclosed with the offer.

15.00 COMPUTER SOFTWARE:

- 15.01 For efficient and speedy recovery of data downloaded through CMRI on base computer, licensed copies of base computer software shall have to be supplied free of cost. This software will be used at number of places up to Division level. As many copies of base computer software as required up to Division level shall be provided by Supplier free of cost even after upgradation of software.
- 15.02 The meter shall be capable to communicate directly with laptop computer. Base Computer Software shall be suitable for all types of printers such as dot matrix, inkjet, deskjet and laser printers.
- 15.03 The Base Computer Software shall be "Windows" based & user friendly. The data transfer shall be highly reliable and fraud proof (No editing shall be possible on base computer as well as CMRI by any means). The software shall have capability to convert all the data into ASCII format/XML format as per MIOS. The BCS shall function properly and support Windows 10 new version.
- 15.04 The Base Computer Software should be password protected.

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- 15.05 The total time taken for downloading Billing, Tamper and Load Survey Data for 60 days shall be less than or equal to 15 minutes.
- 15.06 Downloading time of only Billing data shall be less than or equal to 60 secs.
- 15.07 The BCS software shall create one single file for the uploaded data, e.g. if CMRI contains the meter readings of, say, 2,000 consumer meters including with meter reading of boundary energy meters and the said data is uploaded to BCS, then the BCS shall create a single file containing separate records for each consumer meter reading and boundary energy meter reading in ASCII format or XML file as per MIOS for individual meter reading.
- 15.08 Meter manufacturers should also need to submit Convert API (API3) as per MIOS universal standard along with Base Computer System free of cost. This API should capable of converting both data i.e. AMR data collected from Read API (API1) and MRI data collected from CMRI.
- 15.09 Also there shall be a provision to give filenames while creating the file. Alternatively, the file to be downloaded shall be automatically saved with a file number comprising of Real date, time & downloading activity for respective date. For ex., 170817120501 where, 170817 will denote the date, 1205 will denote the time & 01 will indicate the first downloading activity on that date. this will completely overrule the possibility of file to be overwritten.
- 15.10 As and when the meter manufacturer releases new or latest or advanced versions of meter hardware / firmware / software (such as Base Computer System, API3 etc), the same shall be made available to purchaser immediately on the release date free of cost. The latest version shall support all existing hardware / meters in the field. The meter manufacturer should also provide support for changes and integration of Base Computer System and API3.
- 15.11 The meter samples shall be tested by our IT Department for the time required for downloading the data as per specifications and as confirmed by the bidder.
- 15.12 Downloading software shall also be provided so as to install on our Laptop for downloading data directly on Laptop from meter without the use of CMRI.
- 15.13 The software provided on laptop or PC shall be compatible to read the data from USB drive and for that purpose a sample cable (1

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No.) shall be provided with USB termination. USB being the de-facto standard, this is the requirement.

- 15.14 MSEDCL is procuring large quantity of meters. As such manufacturer have to depute Hardware Engineers and Software Engineers on call basis, who shall have thorough knowledge of meter hardware / software used for downloading and converting so as to discuss the problems, if any, or new development in the hardware / software with Chief Engineer, Testing & Quality Control / Chief General Manager (IT), MSEDCL, Prakashgad, Bandra (E), Mumbai – 400051 without any additional charge.

16.00 CONNECTION DIAGRAM AND TERMINAL MARKINGS:

The connection diagram of the meter shall be clearly shown on inside portion of the terminal cover and shall be of permanent nature. Meter terminals shall also be marked and this marking shall appear in the above diagram. The diagram and terminal marking on sticker will not be allowed.

17.00 NAME PLATE AND MARKING:

Meter shall have a name plate clearly visible, effectively secured against removal and indelibly and distinctly marked with all essential particulars as per relevant standards. Meter Serial Number shall be Bar Coded along with numeric number. The size of bar code number shall not be less than 35x5 mm. The manufacturer's meter constant shall be marked on the name plate. Meter serial number & bar code on sticker will not be allowed.

The meter shall also store name plate details as given in the table 30 of Annex F of IS: 15959 / 2011 AMENDED UP TO DATE. These shall be readable as a profile as and when required.

In addition to the requirement as per IS, following shall be marked on the name plate.

- (i) Purchase order no. & date
- (ii) Month and Year of manufacture
- (iii) Name of purchaser, i.e. MSEDCL
- (iv) Guarantee Five Years
- (v) ISI mark
- (vi) Category of Meter: **Category B – HT (PT / CT) ABT Energy Meter**. The lettering shall be bold in 3 mm font.

A sticker label containing warning notice in Marathi language which is to be stick up on meters front cover or printed on meter name plate with easily readable font size not less than 10 in red colour, which reads as

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“सावधान ! मीटरला फेरफार करण्याचा प्रयत्न केल्यास अधिकतम वेगाने वीज नोंदणी होणार.”

18.00 TESTS:**18.01 TYPE TESTS:**

The meter offered shall have successfully passed all the type tests described in IS: 14697 / 2021 (amended upto date), external AC / DC / permanent magnetic influence tests as per CBIP Tech Report 325 with latest amendments and this specification and the meter Data Transfer and Communication capability as per IS: 15959 / 2011 AMENDED UP TO DATE.

The type test reports shall clearly indicate the constructional features of the type tested meter. Separate type test reports for each offered type of meter shall be submitted.

The type test certificates as per IS: 14697 / 2021 (amended upto date) shall be submitted along with the offer. The type test certificate carried out during last three years from the date of opening the tender shall be valid. The Type test certificate of metering protocol as per IS: 15959 / 2011 AMENDED UP TO DATE shall be submitted along with the offer, and the same shall not be more than 36 months old at the time of submission.

The Type test certificate of metering protocol as per - Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification may also be acceptable along with offer for evaluation purpose only.

All the type test including Additional acceptance test as per cl. no. 18.04 & Metering protocol report as per IS 15959 : 2011 shall be got approved from the Chief Engineer, MSEDCL, Testing & Quality Control, Prakashgad, Mumbai before commencement of supply.

All the Type Tests specified in the technical specifications shall be carried out at laboratories which are accredited by the National Board of Testing and Calibration Laboratories (NABL) of Govt. of India such as ERDA, ERTL, CPRI, etc. Type Test Reports conducted in manufacturers own laboratory and certified by testing institute shall not be acceptable.

Further Purchaser shall reserve the right to pick up energy meters at random from the lots offered and get the meter tested at third party lab i.e. CPRI / agencies listed at Appendix - C of Latest – standardization of AC static electrical energy meters – CBIP publication No. 325 / NPL / CQAL / ERTL / ERDA at the sole discretion of the purchaser at the purchaser's cost. The supplier shall

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have no right to contest the test results of the third party lab or for additional test and has to replace / take corrective action at the cost of the supplier. For this purpose, the tenderer shall quote unit rates for carrying out each type test. However, such unit rates will not be considered for evaluation of the offer.

Make & type of major components used in the type-tested meter shall be indicated in the QAP.

18.02 ACCEPTANCE TESTS:

Criteria for selection for such tests and performance requirements shall be as per IS: 14697 / 2021 .

ALL acceptance tests as per IS: 14697 / 2021 shall be carried out on the meter.

All acceptance tests as per IS: 11731 (Part-2)/ 1986 shall be carried out on the meter body, heat deflection test as per ISO:75, glow wire test as per the IS:11000 (part 2/SEC-1) 1984 OR IEC PUB 60695-2-12, Ball pressure test as per IEC--60695-10-2 and Flammability Test as per UL 94 or as per IS: 11731 (Part-2)/ 1986

18.03 ROUTINE TESTS:

All routine tests as per IS: 14697/2021 shall be carried out on all the meters.

18.04 ADDITIONAL ACCEPTANCE TESTS:

The following additional tests shall be carried out in addition to the acceptance tests specified in IS: 14697 / 2021 (amended up to date)

(a) OTHER ACCEPTANCE TESTS:

- (i) Meters shall be tested for tamper conditions as stated in this specification.
- (ii) Glow wire testing for poly-carbonate body.
- (iii) Power consumption tests shall be carried out.
- (iv) The meter shall comply all the tests for external AC / DC magnetic field as per CBIP publication No. 325 with latest amendments. Moreover, the magnetic influence test for permanent magnet of 0.5 T for minimum period of 15 minutes shall be carried out by putting the magnet on the meter body. If, during the test, the accuracy of the meter gets affected, then the same shall be recorded as magnetic tamper event with date & time stamping. The energy recorded during such tamper shall be registered in a separate register in addition to main

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register. After removal of magnet, meter shall be subjected to accuracy test as per IS: 14697 / 2021 (amended up to date). No deviation in error is allowed in the accuracy as per specification.

(v) The meter shall withstand impulse voltage at 6 kV.

The tests 18.04 (a), (i) to (iii) shall be carried out at factory for each inspected lot at the time of pre-dispatch inspections.

The tests 18.04 (a) (iv) & (v) shall be carried out on one sample from first lot as per procedure laid down in IS: 14697 / 2021 (amended up to date) and CBIP publication No. 325 (with latest amendments) in NABL LAB. The test report shall be got approved from Chief Engineer, MSEDCL, Testing & Quality Control, 5th Floor, Prakashgad, Bandra (E), Mumbai - 400051 before commencement of supply.

(b) For influence quantities like voltage variation, frequency variation, voltage unbalance etc. the limits of variation in percentage error will be as per IS: 14697/2021. (amended up to date)

(c) ACCEPTANCE TESTS FOR CONFIRMATION OF ABT FEATURE:

(i) 15 minutes block average frequency registration.

(ii) 15 minutes block net active energy registration.

(iii) Net kVArh High registration in all four quadrants when voltage is above 103% of V_{REF} .

(iv) Net kVArh registration in all four quadrants when voltage is at V_{REF} .

(v) Net kVArh Low registration in all four quadrants when voltage is below 97% of V_{REF} .

(vi) Test for confirmation of midnight energy banking in power ON & power OFF conditions.

19.00 GUARANTEED TECHNICAL PARTICULARS:

The tenderer shall furnish the particulars giving specific required details of Meters in schedule 'A' attached. The offers without the details in Schedule 'A' stand rejected.

20.00 PRE-DESPATCH INSPECTIONS:

All Acceptance tests and inspection shall be carried out at the place of manufacturer unless otherwise specially agreed upon by the manufacturer and purchaser at the time of purchases.

The manufacturer shall offer to the inspector representing the purchaser all the reasonable facilities, free of charge, for inspection

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and testing, to satisfy him that the material is being supplied in accordance with this specification. The Company's representative / Engineer attending the above testing will carry out testing as per IS: 14697/2021 (amended upto date) & this specification and issue test certificate approval to the manufacturer and give clearance for dispatch. The first lot of meter may be jointly inspected by the Executive Engineer, Testing Division and the Executive Engineer Inspection Wing.

21.00 JOINT INSPECTION AFTER RECEIPT AT STORES (Random Sample Testing):

From each lot (lot means the total number of meters received in a Store out of inspected and approved lot by Executive Engineer, Inspection Wing or purchaser's representative under one approval letter) of meters received at Stores, 5 sample meters shall be drawn and these meters will be tested by our Testing Engineer in presence of Supplier's representative jointly for (i) no load condition, (ii) limits of error test (iii) starting & (iv) repeatability of error test and (v) tamper conditions as per this specification. The 5 days advance intimation will be given to the supplier and if the suppliers fail to attend the joint inspection on the date informed, the Testing will be carried out by our Testing Engineer in absence of supplier's representative. If the meters failed in above random sample testing, the lot will be rejected.

22.00 SAMPLE SUBMISSION & DEMONSTRATION:

One sample of Three phase ABT meter along with operating manual, BCS software & all necessary accessories as per technical specification shall be submitted free of cost to S.E.(TQA), Pune OFFICE & Demonstration shall be carried out within 10 days from the date of Tender opening. Those bidders who will failed to submit the sample & Live demonstration of their offer shall be liable for rejection against the tender

23.00 GUARANTEE:

The meter & CMRI supplied shall be guaranteed for a period of 66 months from the date of supply or 60 months from the date of commissioning, whichever is earlier. Bidders shall guarantee to replace free of cost the meters which are found defective / inoperative at the time of installation, or become inoperative / defective during guarantee period. Replacements shall be effected within one month from the date of intimation. If the defective meters are not replaced within the specified period above, MSEDCL shall recover an equivalent amount plus 15% supervision charges from any of the bills of the

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supplier.

24.00 PACKING:

24.01 The meters & CMRIs shall be suitably packed in order to avoid damage or disturbance during transit or handling. Each meter & CMRI may be suitably packed in the first instance to prevent ingress of moisture and dust and then placed in a cushioned carton of a suitable material to prevent damage due to shocks during transit. The lid of the carton may be suitably sealed. A suitable number of sealed cartons may be packed in a case of adequate strength with extra cushioning, if considered necessary. The cases may then be properly sealed against accidental opening in transit. The packing cases may be marked to indicate the fragile nature of the contents.

24.02 The following information shall be furnished with the consignment:

- Name of the consignee.
- Details of consignment
- Destination
- Total weight of consignment
- Sign showing upper/lower side of the crate
- Sign showing fragility of the material.
- Handling and unpacking instructions.
- Bill of Material indicating contents of each package & spare materials.

25.00 QUALITY CONTROL:

The purchaser shall send a team of experienced engineers for assessing the capability of the firm for manufacturing of meters as per this specification. The team shall be given all assistance and co-operation for inspection and testing at the bidder's works. The tenderer has to give all facilities for carrying out the testing of samples.

26.00 MINIMUM TESTING FACILITIES:

26.01 Manufacturer shall possess fully computerized Meter Test Bench System for carrying out routine and acceptance Tests as per IS: 14697 / 2021 (amended up to date). In addition, this facility shall produce Test Reports for each and every meter. The bidder shall have fully automatic Test Bench having in-built constant voltage, current and frequency source with facility to select various loads automatically and print the errors directly. The list of testing equipments shall be

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enclosed. The manufacturer shall have the necessary minimum testing facilities for carrying out the following tests:

Sr. No.	Name of Test
(1)	A.C. Voltage test
(2)	Insulation Resistance Test
(3)	Test of Accuracy Requirement
(4)	Test on limits of errors
(5)	Test on meter constant
(6)	Test of starting condition
(7)	Test of no-load condition
(8)	Repeatability of error test
(9)	Test of power Consumption
(10)	Vibration test
(11)	Shock Test
(12)	Tamper conditions - as per MSEDCL specification
(13)	Glow Wire Test
(14)	Long duration test
(15)	Flammability Test
(16)	The manufacturer shall have duly calibrated RSS meter of class 0.01 accuracy

26.02 METER SOFTWARE:

The Bidders will have to get appraised & obtain CMMI – Level III within one year from date of letter of award

26.03 Notwithstanding anything stated herein under, the Purchaser reserves the right to assess the capacity and capability of the bidder to execute the work, shall the circumstances warrant such assessment in the overall interest of the Purchaser

27.00 MANUFACTURING PROCESS, ASSEMBLY, TESTING:

Meters shall be manufactured using latest and 'state of the art' technology and methods prevalent in electronics industry.

The meter shall be made from high accuracy and reliable surface mount technology (SMT) components.

All inward flow of major components and sub assembly parts (CT, PT, RTCs / Crystal, LCDs, LEDs, power circuit electronic components, etc.) shall have batch and source identification. Multilayer 'PCB' assembly with 'PTH' (Plated through Hole) using surface mounted component shall have adequate track clearance for power circuits. SMT component shall be assembled using automatic 'pick-and-place' machines, Reflow Soldering oven, for stabilized setting of the components on 'PCB'. For soldered PCBs, cleaning and washing of cards, after wave soldering process is to be carried out as a standard practice.

Assembly line of the manufacturing system shall have provision for testing of sub-assembled cards.

Manual placing of components and soldering, to be minimized to items, which cannot be handled by automatic machine.

Handling of 'PCB' with ICs / C-MOS components, to be restricted to bare minimum and precautions to prevent 'ESD' failure to be provided.

Complete assembled and soldered PCB shall undergo functional testing using computerized Automatic Test Equipment.

Test points shall be provided to check the performance of each block / stage of the meter circuitry. RTC shall be synchronized with NPL time at the time of manufacture.

Meters testing at intermediate and final stage shall be carried out with testing instruments, duly calibrated with reference standard, with traceability of source and date.

The manufacturer shall submit the list of plant and machinery along with the offer.

28.00 MANUFACTURING ACTIVITIES:

a) Quality shall be ensured at the following stages:

- (i) At PCB manufacturing stage each board shall be subjected to computerized bare board testing.

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- (ii) At insertion stage all components should under go computerized testing for conforming to design parameters and orientation.
- (iii) Complete assembled and soldered PCB should under go functional testing using Automatic Test Equipments (ATEs)
- (iv) The calibration of meters shall be done in-house.
- (v) The bidders shall submit the list of all imported & indigenous components separately used in meter along with the offer.
- (vi) Bought out items:

A detailed list of bought out items which are used in the manufacture of the meter shall be furnished indicating the name of firms from whom these items are procured.

The bidder shall also give the details of quality assurance procedures followed by him in respect of the bought out items.

- (vii) List of Plant and Machinery:

Sr. No.	List of Plant and Machinery used for Energy meter Production	
1	Fully automatic testing Bench with ICT for testing link less meters	Routine Testing and Calibration of Meters
2	Semi automatic testing Bench with MSVT	Routine Testing and Calibration of Meters
3	IR Tester	Insulation testing
4	HV Tester	Insulation testing
5	Error calculators	Error testing
6	Long duration Running test set ups	Reliability Testing
7	Reference Meters Class 0.02 accuracy	Error calculation
8	Ultrasonic welding Machines	Welding of meters
9	Automatic Pick and Place Machines	Automatic placing of SMT components
10	Solder Paste Printing Machine	SMT soldering
11	Soldering Furnace IR reflow	SMT soldering

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12	PCB Scanner	For testing of PCBs
13	ATE functional tester	For testing of Components
14	Programmings and Program Loaders	Chip Programming Tools
15	CAD PCB designing setups	PCB designing
16	Furnace IR type for Hybrid Micro Circuits	resistance network and HMC manufacturing
17	Laser Trimming Machines	trimming of resistances for higher accuracy measurement
18	Wave Soldering Machines	Wave soldering of PCBs
19	Humidity Chamber	Accelerated testing for Life cycle
20	Dry Heat Test Chamber	Accelerated testing for Life cycle
21	Thermal Shock Chamber	Accelerated testing for Life cycle
22	PRO - E Mechanical Design Stations	Mechanical CAD stations
23	Spark Erosion Tool fabricating Machine	Tool fabrication and Die manufacturing
24	CNC wire Cut Tool Fabrication machine	Tool fabrication and Die manufacturing
25	CNC Milling Machine for composite tool fabrication	Tool fabrication and Die manufacturing
26	Injection Moulding Machine	Moulding of plastic parts
27	Vibration testing Machine	Vibration testing of Meters
28	Glow Wire Test machine	Testing of Plastic Material
29	Fast transient burst testing setup	Type testing of Meters
30	Short term over Current testing setup	Type testing of Meters

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31	Magnetic and other tamper testing setups	Tamper Testing
32	Impulse Voltage Testing Setup	Type testing of Meters
33	Composite Environmental testing chambers	Type testing of Meters

29.00 QUALITY ASSURANCE PLAN:

- 29.01 The tenderer shall invariably furnish QAP as specified in Annexure I along with his offer. The QAP shall be adopted by him in the process of manufacturing.
- 29.02 Precautions taken for ensuring usage of quality raw material and sub component shall be stated in QAP.

30.00 COMPONENT SPECIFICATION:

As per Annexure II enclosed.

31.00 SCHEDULES:

The tenderer shall fill in the following schedules, which are part and partial of the tender specification and offer. If the schedules are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule - 'A' ... Guaranteed and technical particulars. (As per GTP uploaded on e -tendering site)

The discrepancies if any between the specification and the catalogs and / or literatures submitted as part of the offer by the bidders, the same shall not be considered and representations in this regard shall not be entertained. If it is observed that there are deviations in the offer in Guaranteed Technical Particulars, then, such deviations shall be treated as deviations.

ANNEXURE I

QUALITY ASSURANCE PLAN

- A)** The bidder shall invariably furnish the following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of material offered.
- i) Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested. List of test normally carried out on raw materials in presence of Bidder's representative, copies of test certificates:
 - ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
 - iii) List of manufacturing facilities available.
 - iv) Level of automation achieved and list of areas where manual processing exists.
 - v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
 - vi) List of testing equipment available with the bidder for final testing of equipment specified and test plan limitation. If any, vis-a-vis the type, special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly bought out in schedule of deviation from specified test requirements.
- B)** The successful bidder shall within 30 days of placement of order, submit following information to the purchaser.
- i) List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offers.
 - ii) Type test certificates of the raw materials and bought out accessories if required by the purchaser.
 - iii) Quality assurance plan (QAP) with hold points for purchaser's inspection.
 - iv) The quality assurance plan and purchasers hold points shall be discussed between the purchaser and bidder before the QAP is finalized.
- C)** The contractor shall operate systems which implement the following:

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- i) Hold point: A stage in the material procurement or workmanship process beyond which work shall not proceed without the documental approval of designated individuals organizations. The purchaser's written approval is required to authorise work to progress beyond the hold points indicated in quality assurance plans.
- ii) Notification point: A stage in the material procurement or workmanship process for which advance notice of the activity is required to facilitate witness. If the purchaser does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice then work may proceed.
- D)** The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing if required by the purchaser and ensure that Quality Assurance program of the contractor shall consist of the quality systems and quality plans with the following details.
- i) The structure of the organization.
- The duties and responsibilities assigned to staff ensuring quality of work.
 - The system for purchasing taking delivery and verification of material.
 - The system for ensuring quality workmanship.
 - The system for retention of records.
 - The arrangements for contractor's internal auditing.
- A list of administration and work procedures required to achieve and verify contract's quality requirements these procedures shall be made readily available to the project manager for inspection on request.
- ii) Quality Plans:
- An outline of the proposed work and programme sequence. The structure of the contractor's organization for the contract.
 - The duties and responsibilities assigned to staff ensuring quality of work.
 - Hold and notification points.
 - Submission of engineering documents required by the specification.
 - The inspection of materials and components on receipt. Reference to the contractor's work procedures appropriate to each activity.
 - Inspection during fabrication/ construction.
 - Final inspection and test

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ANNEXURE II
COMPONENT SPECIFICATION

The make/grade and the range of the components should be equivalent reputed makes only.

Sr. No.	Component function	Requirement
1	Current Transformers	The Meters shall be with the current transformers as measuring elements. The current transformer shall withstand for the clauses under 5 & 9 of IS: 14697 / 2021
2	Measurement or computing chips	The measurement or computing chips used in the Meter shall be with the Surface mount type along with the ASICs.
3	Memory chips	The memory chips shall not be affected by external parameters like sparking, high voltage spikes or electrostatic discharges. There shall be security isolation between metering circuit, communication circuit, and power circuit.
4	Display modules	a) The display modules shall be well protected from the external UV radiations. b) The display visibility shall be sufficient to read the Meter mounted at height of 0.5 meter as well as at the height of 2 meters. c) The construction of the modules shall be such that the displayed quantity shall not disturbed with the life of display (PIN Type). d) It shall be trans-reflective HTN (Hyper Twisted Nematic (120°)) or STN (Super Twisted Nematic (160°)) type industrial grade with extended temperature range.
5	Communication Modules	Communication modules shall be compatible for the three ports (a hardware port compatible with RS-232 and 485 specifications of RJ-11 or RJ-45 type & optical port)
6	Optical port	Optical port shall be used to transfer the meter data to meter reading instrument. The mechanical construction of the port shall be such

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		to facilitate the data transfer easily.
7	Power supply	The power supply shall be with the Capabilities as per the relevant standards. The power supply unit of the meter shall not be affected in case the maximum voltage of the system appears to the terminals due to faults or due to wrong connections. The power supply shall be SMPS Type
8	Electronic components	The active & passive components shall be of the surface mount type & are to be handled & soldered by the state of art assembly processes.
9	Mechanical parts	(i) The internal electrical components shall be of electrolytic copper & shall be protected from corrosion, rust etc. (ii) The other mechanical components shall be protected from rust, corrosion etc. by suitable plating / painting methods.
10	Battery	Chargeable maintenance free guaranteed life of 10 years.
11	RTC & Micro controller.	The accuracy of RTC shall be as per relevant IEC / IS standards.
12	P.C.B.	Glass Epoxy, fire resistance grade FR4, with minimum thickness 1.6 mm.

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SCHEDULE 'A'

GUARANTEED TECHNICAL PARTICULARS (TO BE FILLED ONLINE)

ITEM NAME	THREE PHASE FOUR WIRE CT / PT OPERATED 1 AMP OR 5 AMPS ENERGY METER AS PER IS: 15959/2011 WITH AVAILABILITY BASED TARIFF (ABT) FEATURE	
SR. NO.	GTP PARAMETERS	GTP VALUES
1.	MANUFACTURER'S / SUPPLIER'S NAME AND ADDRESS WITH WORKS ADDRESS	TO BE FILLED BY MANUFACTURER
2.	MAKE AND TYPE OF METER	TO BE FILLED BY MANUFACTURER
3.	APPLICABLE STANDARD IS AS PER IS: 14697 / 2021 (AMENDED UPTO DATE), IS: 15959 / 2011 AMENDED UP TO DATE, CBIP TECH REPORT 325 AMENDED UP TO DATE, IS: 15707 / 2006	YES
4.	METER BEARS ISI MARK	YES
5.	ACCURACY CLASS OF METER	0.2S (FOR ACTIVE AND REACTIVE ENERGY)
6.	RATED VOLTAGE	110 V PH-PH OR 3 X 63.5 V PH-N
7.	VOLTAGE RANGE	+15% TO – 30% OF RATED VOLTAGE
8.	BASIC CURRENT (IB) OF METER	1 AMP; 5 AMPS.
9.	MAXIMUM CONTINUOUS CURRENT (IMAX)	2 TIMES (200 %) OF IB.
10.	STARTING CURRENT OF METER	0.1% OF IB.
11.	SHORT TIME OVER CURRENT	AS PER IS: 14697 / 2021.
12.	CT RATIO OF METER	1 / 1 AMPS; 5 / 5 AMPS

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13.	PT RATIO OF METER	$\frac{11 \text{ kV}}{\sqrt{3}} / \frac{110 \text{ V}}{\sqrt{3}}$
14.	STANDARD REFERENCE TEMPERATURE OF METER	27° C
15.	MEAN TEMPERATURE CO-EFFICIENT	SHALL NOT EXCEED 0.03%.
16.	FREQUENCY	50 HZ ±5%
17.	POWER FACTOR	ZERO LAG TO UNITY TO ZERO LEAD TO UNITY
18.	AVERAGE POWER FACTOR & INSTANTANEOUS POWER FACTOR IS CALCULATED AS PER CLAUSE NO. 4.00 (14) OF THE SPECIFICATION.	YES
19.	KVAH CALCULATIONS AS PER SPECIFICATION.	YES
20.	POWER CONSUMPTION IN EACH VOLTAGE CIRCUIT	SHALL NOT EXCEED 1.0 W AND 4 VA
21.	POWER CONSUMPTION IN EACH CURRENT CIRCUIT	SHALL NOT EXCEED 1 VA
22.	POWER SUPPLY IS SMPS & MICRO CONTROL TYPE	YES
23.	KVA MD PROVIDED	YES
24.	METER IS PROJECTION TYPE, DUST AND MOISTURE PROOF & SUITABLE FOR MOUNTING ON PLANE VERTICAL SURFACE.	YES
25.	THE METER BASE SHALL BE OPAQUE & METER TOP COVER SHALL BE TRANSPARENT/TRANSLUCENT/OPAQUE	YES
26.	POLY CARBONATE CONFORMS TO IS: 11731 / 1986 (PART-2) (FV-2 CATEGORY)	YES
27.	POLY CARBONATE BODY MEETS TEST REQUIREMENT OF	YES

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	(A) HEAT DEFLECTION TEST AS PER ISO 75 > 1500C	
28.	(b) GLOW WIRE TEST AS PER IS: 11000 (PART 2/SEC-1) 1984 OR IEC PUB 60695-2-12 AT 900°C	YES
29.	(c) BALL PRESSURE TEST AS PER IEC--60695-10-2	YES
30.	(d) BALL PRESSURE TEST AS PER IEC--60695-10-2	YES
31.	(e) FLAMMABILITY TEST AS PER UL 94 OR IS 11731 (PART-2) 1986	YES
32.	METER BODY TYPE TESTED FOR IP51 DEGREE OF PROTECTION AS PER IS: 12063 AGAINST INGRESS OF DUST, MOISTURE & VERMIN.	YES
33.	WHETHER TYPE TEST REPORT FOR IP51 DEGREE OF PROTECTION IS ENCLOSED	YES
34.	TYPE TEST REPORT NO. OF IP51 & DATE	TO BE FILLED BY MANUFACTURER
35.	METER COVER SECURED TO BASE BY SEALABLE UNIDIRECTIONAL/BIDIRECTIONAL CAPTIVE SCREWS.	YES
36.	PHYSICAL WATER ABSORPTION VALUE OF METER BODY	TO BE FILLED BY MANUFACTURER
37.	THERMAL HDDT VALUE OF METER BODY	TO BE FILLED BY MANUFACTURER
38.	TENSILE STRENGTH OF METER BODY	TO BE FILLED BY MANUFACTURER
39.	FLEXURE STRENGTH OF METER BODY	TO BE FILLED BY MANUFACTURER
40.	MODULUS OF ELASTICITY OF METER BODY	TO BE FILLED BY MANUFACTURER
41.	IZOD IMPACT STRENGTH OF METER BODY NOTCHED AT 23°C	TO BE FILLED BY MANUFACTURER
42.	MOULDED SINGLE TERMINAL BLOCK FOR CURRENT & VOLTAGE CONNECTIONS IS	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

	PROVIDED AS PER IS: 14697 / 2021 (AMENDED UP TO DATE)	
43.	TERMINAL COVER OF METER IS EXTENDED TYPE & PROVIDED WITH HINGES AND IS SEALABLE INDEPENDENTLY	TO BE FILLED BY MANUFACTURER
44.	INDEPENDENT SEALING PROVISION IS MADE AGAINST OPENING OF TERMINAL COVER AND FRONT COVER	TO BE FILLED BY MANUFACTURER
45.	UNIDIRECTIONAL SCREWS WITH TWO HOLES FOR SEALING PURPOSE ARE PROVIDED ON METER BODY	TO BE FILLED BY MANUFACTURER
46.	THICKNESS OF MATERIAL FOR METER COVER & BASE	2 MM MINIMUM
47.	PROVISION TO PUT AT LEAST TWO SEALS BY UTILITY	YES
48.	PUSH BUTTONS ARE PROVIDED AS PER SPECIFICATION	YES
49.	OUTPUT DEVICE FOR TESTING OF METER IS BLINKING LED OR OTHER SIMILAR DEVICE WITH CONSTANT PULSE RATE	YES
50.	METER CONSTANT IS INDELIBLY PRINTED ON THE NAME PLATE OF THE METER	YES
51.	METER ACCURACY NOT AFFECTED BY AC / DC MAGNETIC FIELD AS PER CBIP 325	YES
52.	UNDER INFLUENCE OF ANY MAGNETIC FIELD, IF THE ACCURACY OF THE METER GETS AFFECTED, THE SAME IS RECORDED AS MAGNETIC TAMPER EVENT WITH DATE & TIME STAMPING &. THE ENERGY RECORDED DURING SUCH TAMPER IS REGISTERED IN A SEPARATE REGISTER IN ADDITION TO MAIN REGISTER.	YES
53.	METER IS CAPABLE TO WITHSTAND AND DOES NOT GET DAMAGED IF PHASE-TO-	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

	PHASE VOLTAGE IS APPLIED BETWEEN PHASES & NEUTRAL FOR FIVE MINUTES WITHOUT AFFECTING ACCURACY.	
54.	POWER SUPPLY UNIT IS MICRO CONTROL TYPE	YES
55.	NON SPECIFIED DISPLAY PARAMETERS ARE BLOCKED AND SHALL NOT BE ACCESSIBLE FOR REPROGRAMMING AT SITE.	YES
56.	COMPLETE METERING SYSTEM DOES NOT AFFECTED BY EXTERNAL ELECTROMAFNETIC INTERFERENCE	YES
57.	CTS ARE PROVIDED WITH MAGNETIC SHIELDING AND ARE TESTED SEPARATELY PRIOR TO ASSEMBLY	YES
58.	PCB USED IN METER IS MADE BY SURFACE MOUNTING TECHNOLOGY & IS WIRELESS	YES
59.	NON - RECHARGEABLE & PRE-PROGRAMMED FOR 30 YEARS DAY / DATE WITHOUT ANY NECESSITY FOR CORRECTION REAL TIME QUARTZ CLOCK (RTC) IS USED IN METER FOR MAINTAINING TIME (IST) AND CALENDAR.	YES
60.	MAXIMUM DRIFT OF RTC	SHALL NOT EXCEED +/- 300 SECONDS PER YEAR
61.	CLOCK DAY / DATE SETTING AND SYNCHRONIZATION IN RTC ARE POSSIBLE THROUGH PASSWORD / KEY CODE COMMAND FROM HAND HELD UNIT (HHU), LAPTOP COMPUTER OR METER TESTING WORK BENCH OR FROM REMOTE SERVER THROUGH SUITABLE COMMUNICATION NETWORK OR SUB-STATION DATA LOGGER 'PC'.	YES
62.	RTC BATTERY & BATTERY FOR DISPLAY IN	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

	CASE OF POWER FAILURE IS SEPARATE.	
63.	METER WITHSTANDS HIGH VOLTAGE & HIGH FREQUENCY SURGES WHICH ARE SIMILAR TO THE SURGES PRODUCED BY INDUCTION COIL TYPE INSTRUMENTS WITHOUT AFFECTING THE ACCURACY OF THE METER	YES
64.	METER LOGS UNSATISFACTORY OR NON FUNCTIONING OF RTC BATTERY	YES
65.	METERING PROTOCOL AS PER ANNEX E - CATEGORY B METERS OF IS: 15959 / 2011 AMENDED UP TO DATE	YES
66.	DEFAULT & MINIMUM BAUD RATE OF RS 232 & OPTICAL PORTS IS 9600 BPS	YES
67.	METER PROVIDED WITH 3 THREE PORTS FOR COMMUNICATION	YES
68.	SEALING ARRANGEMENT IS PROVIDED TO COMMUNICATION PORTS	YES
69.	NECESSARY CHORD FOR OPTICAL PORT OF MINIMUM LENGTH OF 2 METRES PER METER IS PROVIDED.	YES
70.	INTERNAL NI-MH OR LI-ION OR NI CD MAINTENANCE FREE BATTERY OF LONG LIFE OF 10 YEARS WITH PUSH BUTTON ARRANGEMENT FOR ACTIVATION OF BATTERY IN THE RATIO OF 1 BATTERY PACK PER METER IS PROVIDED.	YES
71.	NON VOLATILE MEMORY (NVM) WITH MINIMUM RETENTION PERIOD OF 10 YEARS IS PROVIDED	BOOLEAN
72.	8 (EIGHT) TOD TIME ZONES FOR ENERGY AND DEMAND ARE PROVIDED	BOOLEAN
73.	PROVISION OF MAXIMUM DEMAND INTEGRATION PERIOD SHALL BE PROGRAMMABLE UPTO 15 MINUTES WITH SLIDING WINDOW METHOD.	SHALL BE PROGRAMMABLE UPTO 15 MINUTES WITH SLIDING WINDOW METHOD

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

		WITH 5 MIN SUB INTEGRATION PERIOD
74.	PROVISION FOR AUTO RESET OF MD AT CERTAIN PREDEFINED PERIOD IS PROVIDED	YES
75.	METER STORES NAME PLATE DETAILS AS GIVEN IN THE TABLE 30 OF ANNEX F OF IS: 15959 / 2011 AMENDED UP TO DATE & ARE READABLE AS A PROFILE AS AND WHEN REQUIRED	YES
76.	A DLMS COMPLIANT CMRI AS PER ANNEX J OF IS: 15959 / 2011 AMENDED UP TO DATE IS PROVIDED	YES
77.	PROVISION FOR AUTO POWER SAVE IS MADE ON CMRI	YES
78.	CMRI HAS A MEMORY CAPACITY OF 8 MB SRAM (STATIC RAM) WITH BATTERY BACKUP & UPGRADEABLE AND BIOS / OS ON FLASH / EEPROM MEMORY OF 256 KB	YES
79.	CMRI OFFERED IS FULLY TYPE TESTED AT APPROVED NABL LABORATORY FOR (a) TESTS OF MECHANICAL REQUIREMENT SUCH AS FREE FALL TEST, SHOCK TEST, VIBRATION TEST	YES
80.	(b) TESTS OF CLIMATIC INFLUENCES SUCH AS TESTS OF PROTECTION AGAINST PENETRATION OF DUST AND WATER (IP 6X), DRY HEAT TEST, COLD TEST, DAMP HEAT CYCLIC TEST	YES
81.	(c) TESTS FOR ELECTROMAGNETIC COMPATIBILITY (EMC)	YES
82.	(d) TEST OF IMMUNITY TO ELECTROMAGNETIC HF FIELDS	YES
83.	(e) RADIO INTERFERENCE MEASUREMENT	YES
84.	TYPE TEST REPORT NOS. & DATE OF CMRI	TO BE FILLED BY MANUFACTURER
85.	BASE COMPUTER SOFTWARE IS "WINDOWS" BASED & USER FRIENDLY	YES
86.	LICENSED COPIES OF BASE COMPUTER SOFTWARE ARE SUPPLIED FREE OF COST.	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

87.	NO EDITING IN TRANSFERRED DATA IS POSSIBLE ON BASE COMPUTER AS WELL AS CMRI BY ANY MEANS .	YES
88.	DOWNLOADING SOFTWARE IS SUBMITTED TO INSTALL ON OUR LAPTOP / PC FOR DIRECTLY DOWNLOADING DATA FROM METER WITHOUT THE USE OF CMRI	YES
89.	SOFTWARE PROVIDED ON LAPTOP/PC IS COMPATIBLE TO READ DATA FROM USB DRIVE	YES
90.	PROVISION TO RESET MD THROUGH HAND HELD TERMINAL (CMRI) CAPABLE OF COMMUNICATING WITH THE METER OR COMMUNICATION DRIVEN RESET IS PROVIDED	YES
91.	PROVISION TO RESET MD THROUGH LOCAL PUSH BUTTON IS PROVIDED	YES
92.	ALL ANTI TAMPER FEATURES ARE INCORPORATED IN METER AS PER SPECIFICATION	YES
93.	METER LOGS TAMPER EVENTS AS PER SPECIFICATION	YES
94.	TAMPER DETAILS ARE STORED IN INTERNAL MEMORY & REGISTERED IN TAMPER EVENT REGISTER	YES
95.	PERMANENT BACKLIT LIQUID CRYSTAL DISPLAY (LCD) OF 8 DIGITS (WITH +/- INDICATION) AND MINIMUM 8 MM HEIGHT AND WIDE VIEWING ANGLE IS PROVIDED	YES
96.	AUTO DISPLAY CYCLING PUSH BUTTON WITH PERSISTENCE TIME OF 10 SECONDS IS PROVIDED	YES
97.	BACKLIT LIQUID CRYSTAL DISPLAY (LCD) IS SUITABLE FOR TEMPERATURE WITHSTAND OF 70° C	YES
98.	DISPLAY PARAMETERS AS PER SPECIFICATIONS	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

99.	IT IS POSSIBLE TO SCROLL THROUGH PARAMETERS (UP & DOWN) MANUALLY ON DEMAND DISPLAY MODE AND TEST DISPLAY MODE	YES
100.	METER SHALL BE SELF POWERED	YES
101.	SCALE MF IS ONE (1)	YES
102.	MD INTEGRATION PERIOD SHALL BE PROGRAMMABLE UPTO 15 MINUTES WITH SUB INTEGRATION PERIOD OF 5 MINUTES WITH SLIDING WINDOW METHOD	YES
103.	AVERAGE POWER FACTOR WITH 3 DECIMAL DIGITS FOR CURRENT BILLING PERIOD (SINCE LAST RESET) IS CALCULATED AS RATIO OF KWH & KVAH SINCE LAST RESET FOR RESPECTIVE MODE.	YES
104.	INSTANTANEOUS PF IS CALCULATED AS RATIO OF INSTANTANEOUS KW AND KVA.	YES
105.	BILLING PARAMETERS AS PER SPECIFICATION	YES
106.	BILLING HISTORY DATA IS STORED IN METER MEMORY FOR LATEST 12 NO. OF RESETS AS WELL AS FOR THE INSTANT OF DATA RETRIEVAL.	YES
107.	RESET TO RESET CONSUMPTION OF ENERGIES & MAXIMUM DEMANDS IS MADE AVAILABLE	YES
108.	ABT BILLING DATA PARAMETERS ARE STORED IN NON VOLATILE MEMORY AUTOMATICALLY AS ABT DATA FOR A PERIOD OF 10 DAYS ON FIFO BASIS	YES
109.	PROVISION FOR LOAD SURVEY DATA FOR EVERY 15 MINUTES (OR CONFIGURABLE FOR 5 MINUTES IF REQUIRED IN FUTURE) AND FOR PREVIOUS 60 DAYS OR MORE FOR SPECIFIED PARAMETERS ON NON-TIME BASED BASIS ON FIRST IN FIRST OUT BASIS	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

	(FIFO)	
110.	IT IS POSSIBLE TO RETRIEVE ABNORMAL EVENT DATA ALONG WITH ALL RELATED SNAP SHOTS DATA THROUGH METER OPTICAL PORT WITH CMRI AND LAPTOP COMPUTER AND REMOTE ACCESS THROUGH SUITABLE COMMUNICATION NETWORK & DOWNLOAD THE SAME TO THE BASE COMPUTER ON FIFO BASIS.	YES
111.	METER KEEPS RECORDS FOR THE MINIMUM 200 (OCCURRENCE + RESTORATION) EVENTS EXCLUDING POWER OFF EVENTS ON FIFO BASIS.	YES
112.	ALL THE COMPUTER SOFTWARE IS PROVIDED	YES
113.	MAXIMUM DOWNLOADING TIME FOR COMPLETE DATA FROM CMRI TO PC IS NOT MORE THAN 5 MIN	YES
114.	SEPARATE COMMUNICATION CABLE OF 2 METER LENGTH EACH FOR DATA COMMUNICATION BETWEEN METER & CMRI, METER & LAPTOP COMPUTER AND BETWEEN METER & PC IS PROVIDED.	YES
115.	1 CABLE OF 2 MTR LONG IS PROVIDED WITH USB TERMINATION	YES
116.	METER IS CAPABLE TO COMMUNICATE DIRECTLY WITH LAPTOP COMPUTER.	YES
117.	BASE COMPUTER SOFTWARE IS SUITABLE FOR ALL TYPES OF DOT MATRIX, INKJET & LASERJET PRINTERS	YES
118.	MANUFACTURER AGREES TO PROVIDE API (BASED UPON MIOS STANDARD) WITH PROPER DOCUMENTATION & DEMONSTRATION FOR EXISTING METERS AS WELL AS TO BE SUPPLIED WITH THIS SPECIFICATION.	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

119.	METER STORES NAME PLATE DETAILS AS GIVEN IN THE TABLE 30 OF ANNEX F OF IS: 15959 / 2011 AMENDED UP TO DATE & ARE READABLE AS A PROFILE AS AND WHEN REQUIRED	TO BE FILLED BY MANUFACTURER
120.	METER AS "CATEGORY B- HT (PT / CT) BOUNDARY METER" IN 3 MM BOLD FONT IS MARKED ON NAME PLATE	YES
121.	PERMANENT NATURE METER CONNECTION DIAGRAM IS CLEARLY SHOWN ON INSIDE PORTION OF TERMINAL COVER WITH MARKING ON METER TERMINALS IN THE ABOVE DIAGRAM.	YES
122.	METER HAS CLEARLY VISIBLE, EFFECTIVELY SECURED AGAINST REMOVAL & INDELIBLY & DISTINCTLY MARKED WITH ALL ESSENTIAL PARTICULARS AS PER RELEVANT STANDARDS NAME PLATE WITH SIZE OF BAR CODED METER SERIAL NUMBER NOT LESS THAN 35X5 MM ALONGWITH NUMERIC NUMBER & ADDITIONAL REQUIREMENT AS PER SPECIFICATION.	YES
123.	NAME PLATE WITH SIZE OF BAR CODED METER SERIAL NUMBER NOT LESS THAN 35X5 MM ALONGWITH NUMERIC NUMBER & ADDITIONAL REQUIREMENT AS PER SPECIFICATION	YES
124.	WHETHER METER IS TYPE TESTED	YES
125.	TYPE TEST REPORT NOS. & DATES	TO BE FILLED BY MANUFACTURER
126.	ALL ACCEPTANCE & ROUTINE TESTS, AS PER IS: 14697 / 2021 AMENDED UPTO DATE & THIS SPECIFICATION ARE CARRIED OUT ON METER	YES
127.	METER & CMRI ARE GUARANTEED FOR A PERIOD OF 66 MONTHS FROM THE DATE OF SUPPLY OR 60 MONTHS FROM THE DATE OF COMMISSIONING, WHICHEVER IS EARLIER	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

128.	GUARANTEE TO REPLACE METERS / CMRI FREE OF COST WHICH ARE FOUND DEFECTIVE / INOPERATIVE AT THE TIME OF INSTALLATION OR BECOME INOPERATIVE / DEFECTIVE DURING GUARANTEE PERIOD	YES
129.	FURNISH PRINCIPLE OF OPERATION OF METER OUTLINING THE METHODS AND STAGES OF COMPUTATIONS OF VARIOUS PARAMETERS STARTING FROM INPUT VOLTAGE AND CURRENT SIGNALS INCLUDING SAMPLING RATE IF APPLICABLE	TO BE FILLED BY MANUFACTURER
130.	ALL ACCEPTANCE TESTS FOR CONFIRMATION OF ABT FEATURE ARE CARRIED OUT.	YES
131.	METER IS GUARANTEED FOR A PERIOD OF FIVE YEARS FROM THE DATE OF COMMISSIONING OR FIVE AND HALF YEAR FROM THE DATE OF DISPATCH WHICHEVER IS EARLIER.	YES
132.	IN HOUSE TESTING FACILITY IS AVAILABLE FOR (A) A.C. VOLTAGE TEST	YES
133.	(b) INSULATION RESISTANCE TEST	YES
134.	(c) ACCURACY REQUIREMENT	YES
135.	(d) TEST ON LIMITS OF ERRORS	YES
136.	(e) TEST ON METER CONSTANT	YES
137.	(f) TEST OF STARTING CONDITION	YES
138.	(g) TEST OF NO-LOAD CONDITION	YES
139.	(h) REPEATABILITY OF ERROR TEST	YES
140.	(i) TEST OF POWER CONSUMPTION	YES
141.	(j) VIBRATION TEST	YES
142.	(k) SHOCK TEST	YES
143.	(l) TAMPER CONDITIONS AS PER MSEDCL	YES

TECHNICAL SPECIFICATION OF 3 PHASE 4 WIRE CT / PT OPERATED 1 AMPS OR 5 AMPS ENERGY METER WITH AVAILABILITY BASED TARIFF (ABT) FEATURE

	SPECIFICATION	
144.	(m) FACILITY FOR ACCEPTANCE TESTS OF ABT FEATURES AS PER SPECIFICATION.	YES
145.	(n) GLOW WIRE TEST	YES
146.	(o) LONG DURATION TEST	YES
147.	(p) FLAMMABILITY TEST	YES
148.	(q) MANUFACTURER HAS DULY CALIBRATED RSM OF CLASS 0.02 ACCURACY	YES
149.	MANUFACTURING PROCESS, ASSEMBLY, TESTING & MANUFACTURING ACTIVITIES AS PER TECHNICAL SPECIFICATION	YES
150.	MANUFACTURING ACTIVITIES AS PER TECHNICAL SPECIFICATION	YES
151.	FURNISH PRINCIPLE OF OPERATION OF METER OUTLINING THE METHODS AND STAGES OF COMPUTATIONS OF VARIOUS PARAMETERS STARTING FROM INPUT VOLTAGE AND CURRENT SIGNALS INCLUDING SAMPLING RATE IF APPLICABLE	YES
152.	QUALITY ASSURANCE PLAN AS PER SPECIFICATIONS IS ENCLOSED	YES
153.	COMPONENT SPECIFICATION AS PER SPECIFICATION	YES

MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD.



SRM e-TENDER FOR --

Supply, Installation, Testing & Commissioning of Interface Energy Meters (IEM) along with Automated Meter Reading (AMR) as per SAMAST guidelines at various Substations in MSETCL including Mumbai Utility & Meter data Processing system (MDPS) at SLDC Airoli.

RFX. No. 7000012640

MSETCL/CE/AC&I/AMR/T-01/2019-20

Volume – II

**Section - I
Technical Specification**

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ABBREVIATIONS

Sr. No	Acronym	Definition
1	AMR	Automated Meter Reading
2	ATP	Acceptance Test Plan
3	CDCS	Central Data Collection System
4	CMRI	Common Meter Reading Instrument
5	C&R	Control & Relay
6	STU	State Transmission Utility
7	DCD	Data Collection Device
8	DCU	Data Concentrator Unit
9	DSM	Deviation Settlement Mechanism
10	EA	Energy Accounting
11	EHV	Extra High Voltage
12	FAT	Factory Acceptance Test
13	FTE	Full Time Equivalent
14	GPRS	General Packet Radio Service
15	GSM	Global System of Mobile
16	HHU	Hand Held Unit
17	IEC	International Electro-technical Commission
18	IEEE	Institute of Electrical and Electronics Engineers
19	IEM	Interface Energy Meter
20	IP	Ingress Protection
21	IS	Indian Standard
22	ISTS	Inter State Transmission System
23	LAN	Local Area Network
24	MDP	Meter Data Processing
25	NMS	Network Management System
26	OEM	Original Equipment Manufacturer
27	PCB	Printed Circuit Board
28	RDBMS	Relational Database Management System
29	RMS	Root Mean Square
30	SAT	Site Acceptance Test
31	SEM	Special Energy Meter
32	SRS	Software Requirements Specification
33	TOC	Taking Over Certificate
34	VPN	Virtual Private Network
35	WAN	Wide Area Network
36	RLDC	Regional Load Despatch Centre
37	WRPC	Western Regional Power Committee
38	SLDC	State Load Despatch Centre
39	MSETCL	Maharashtra State Electricity Transmission Company

I. BACKGROUND

Maharashtra State Electricity Transmission Company limited (MSETCL) is the largest state transmission utility in India having a transmission network of 46217 Circuit KM of transmission lines and 660 EHV Substations with 123846 MVA transformation capacity.

The State Load Dispatch Center (SLDC), Mumbai is responsible for the operation, monitoring and control of the power system.

Availability Based Tariff and Deviation Settlement Mechanism were implemented in the state of Maharashtra as per Hon. MERC's order in case 42 of 2006 dtd 17th May 2007 for implementation of Intra-State ABT. The ABT meter data of approximately 3000 interface locations is required by the SLDC for weekly DSM billing throughout the geographical domain of MSETCL. At present all this data is being manually acquired, validated and processed at SLDC. Further the present scheduling and settlement mechanism period is 15 min. This settlement period now needs to be changed to five min as per the new guide lines by Forum of Regulators (FOR).

In this context it is to mention here that The Central Electricity Regulatory Commission (CERC) has adopted the recommendations by Technical committee of the Forum of regulators (FOR) suggested vide the **“Scheduling, Accounting , Metering and settlement of Transactions in Electricity (SAMAST)”** report published in July 16 and has suggested for implementation of the recommendations of this report by State Load dispatch Centers/State Transmission Utilities under the supervision of respective State regulatory commissions.

SAMAST in its report on page 54 article 5.6 has mentioned as below:

“Presently the scheduling and settlement period at interstate level is 15 min. A number of states have adopted the same. However with envisaged high penetration of renewable energy in the grid there would be a need of for high granularity in scheduling and settlement to handle the challenges of high ramp rate and net load flowing. “Further the report has quoted the text on page 55 of one of the report of **“Niti - Ayog “**which is reproduced as below

“Scheduling and dispatch: - Through both practice and theory it has become evident that the grids that operated in a manner where scheduling and dispatches are implemented over a short duration (e. g. As low as five min) have significantly lower overall cost to consumer as need of ancillary resources decreases.”

So MSETCL intends to implement an AMR system for transmission & sub transmission system whose scope of work is supply, installation & commissioning of necessary hardware and software (from 765kV level up to 33/22/11kV feeder level in the respective substations) throughout the geographical domain of MSETCL and in distribution utilities in Mumbai like Tata Power, Adani, BEST in a phased manner for better granularity and ramp monitoring.

II.SCOPE OF THE PROJECT

The details of the Interface Energy Meters required and number of substations considered in the existing MSETCL network & Mumbai utility/zone is enclosed as below. The tentative 6600 Nos. of Main & Check IEM meters spread over at 800 EHV substations in jurisdiction of MSETCL & Mumbai utility along with accessories and services will have to be provided. The number of IEM/ABT meters and other material may vary as per the existing infrastructure and the requirement of SLDC.

Table: Zone wise Substations & Interface locations.

Sr. No.	Zone	No. of Substation	Interface Locations	No. of ABT Meters required
1	Amravati	56	159	318
2	Aurangabad	115	298	596
3	Karad	136	468	936
4	Nagpur	89	312	624
5	Nashik	125	452	904
6	Pune	162	403	806
7	Vashi	87	341	682
8	Mumbai Utility / Zone (TATA/ADANI/BEST)	34	691	1382
TOTAL		804	3124	6248

The final Bill of Quantities shall be developed after site survey.

The present project envisages:

1. Replacing the existing Special Energy Meters (15 min, ABT meters) at all the existing interface points such as Intrastate/Interstate transmission utility, G to T, T to D in jurisdiction of MSETCL & Mumbai utility with Interface Energy Meters (5 min, Interface meters).
2. All IEM meters (5 min, interface meter) having TCP/IP port will be connected to the LAN switches to create a LAN network and terminate to the Gateway/DCU of respective substation. Gateway/DCU will have inbuilt or external 4G/3G/2G/Internet modem which will connect further to the central data centre through 4G/3G/2G/Internet communication network and also to OFC network available at any of the substation, same can be used for data transfer as parallel path/communication. Provision of necessary communication links like OFC/ VSAT/ 2G/3G/ 4G/Internet will be in utility's scope. In case of communication failure, data downloading by MRI and sending to SLDC is the responsibility of MSETCL.
3. DCU/Gateway at each substation will also be installed and connected to the Ethernet switch for increasing the reliability & availability of meter data. DCU/gateway shall have capability of storing the acquired meter data and in case of non-availability of network link; DCU/gateway will store the data and transfer when ever link will be available.
4. The project also envisages putting in place a system of Automated Meter Data Reading (AMR)/Meter Data Processing (MDP) software along with the associated hardware for meter data collection (meter data will be transmitted by the DCU to the server at SLDC using GPRS/VSAT/GSM/Internet or Optical fiber network), validation and processing at State Load Dispatch Centre (SLDC) for energy accounting
5. The successful bidder shall be responsible for supply and installation of hardware and software at respective locations.
6. This project envisages delivering an end to end solution for energy metering at the interstate/intrastate level. It shall involve capital as well as O&M expenditure by the successful bidder.
7. During the warranty and O&M phase, the bidder shall provide web based system for complaint registration, support and maintenance along with one full time equivalent (FTE) competent resident engineer at SLDC to diagnose and address any software related issues in AMR/MDP/reporting system.

8. This project also envisages application server which should be web/browser based as such an Internet Information Server needs to be deployed on a same/separate server as application server. It shall be possible to access the application through a web link from remote (subject to availability of web link) and viewing the data. These clients should be in view mode only they cannot perform any task from there. Access needs to be via secured VPN.

Service Conditions:

All equipment's to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions

a) Maximum ambient temperature	55 ⁰ C
b) Maximum ambient temperature in shade	45 ⁰ C
c) Minimum temperature of air in shade	35 ⁰ C
d) Maximum daily average temperature	40 ⁰ C
e) Maximum yearly weighted average temperature	32 ⁰ C
f) Relative Humidity	10 to 95%
g) Maximum Annual rainfall	5600 mm
h) Maximum wind pressure	150 Kg/m ²
i) Maximum altitude above mean sea level	1000 mtrs
j) Isoceraunic level (days/year)	50
k) Seismic level (Horizontal acceleration)	0.3 g

Climate: - Moderately hot and humid tropical climate conducive to rust and fungus growth.

The technical specifications are broadly in the following chapters

Chapter – I: The first chapter of the specifications covers the design, manufacturing, testing, supply and delivery of AC 3 ph., 4 wire Interface Energy Meter (IEM). The meter shall incorporate suitable communication features to communicate with DCU (Data Concentrator Unit) installed at the substation.

Chapter– II: The second chapter covers the design, manufacturing, testing, supply and delivery of DCU & facility/provision of Communication facility. The DCU shall communicate with Central Data Collection System for data transfer to SLDC, as per the user defined schedule.

Chapter – III: The third chapter covers the design, manufacturing, testing, supply and delivery of Automated Meter Reading system (AMR) / Meter Data Processing (MDP) and report generation at SLDC.

Chapter – IV: The fourth chapter covers the general software & hardware requirement for AMR/MDP at SLDC.

Chapter – V: The fifth chapter covers the Documentation requirement

Chapter – VI: The sixth chapter covers the Acceptance test plan & procedure for SAT & FAT.

Chapter – VII: The seventh chapter covers the training requirement.

Chapter – VIII: The eighth chapter covers the scope of warranty

The installation of the IEM at the interface points shall involve shutdown of transmission elements. This shall be coordinated through the existing outage coordination procedure approved by the WRLDC/SLDC. MSETCL shall coordinate for administrative approvals from the utility in whose premises the IEM/DCU have to be installed. SLDC shall coordinate the shutdown in coordination with WRLDC. The bidder shall keep suitable margins for grid related uncertainties while formulating the meter installation plan.

CHAPTER – I: INTERFACE ENERGY METERS (IEM)

1. Basic Features of Interface Energy Meters

1.1 The energy metering system specified herein shall be used for tariff metering for bulk, inter-utility/intra-utility, G to T, T to D power flows. Static composite meter shall be installed at interface points as a self-contained device for measurement of Voltage (V), Frequency (f), Active (Wh) and Reactive (VARh) energy exchanged in each successive 5 min time block. The meter shall conform to the following standards along with latest amendments, if any.

IS15959	AC static transformer operated Watt-hour and VAR hour meters for class 0.2s category B (ABT compliant) metering
IS: 14697 (1999)	AC static transformer operated Watt-hour and VARh meters for class 0.2S and 0.5S
IEC62056	Detection of Tamper conditions for DLMS compliant meter
IEC-62056-51	For Data security
IEC-62053-22:2003/IEC 62053-23:2003	For meter accuracy

1.2 Each meter shall have a unique identification code, which shall be marked permanently on its front, as well as in its memory. All meters supplied to as per this specification shall have their identification code starting with “MSETCL”, which shall not be used for any other supplies. “MSETCL” shall be followed by an eight digit running serial number. **CT ratio of 1A or 5A shall be user configurable or shall be of single rating.**

This shall be mutually agreed between the buyer and the vendor.

1.3 The meters shall be suitable for communication with external device like modem, DCU, etc. which shall be able to communicate with CDCS for local/remote data transfer. The meter shall compulsorily have at least 1 optical port for taking reading through Hand Held Unit (HHU). The supply of required number of HHU is in scope of bidder. (see price bid)

The meter shall also have following communication ports for local/remote reading:

- i) IEC 1107 optical port
- ii) RS485 port (should be configurable on DLMS)
- iii) TCP/IP Ethernet (should be configurable on DLMS TCP)
- iv) USB

Note: All the ports shall be fixed or modular. If provision of USB port is not possible then RS 232 port with converter for RS 232 to USB should be provided

1.4 **Auxiliary Supply to IEM:** The meters shall normally operate with the power drawn from DC auxiliary power supply (Range 110V to 220V DC) to reduce the Voltage Transformer (VT) burden. In addition, there shall be provision to operate the meter from the Voltage Transformer (VT) secondary circuit having a rated secondary line-to-line voltage of 110V, and current transformers (CTs) having a rated secondary current of 1 A or 5A. Any further transformers/ transactions/ transducers required for their functioning shall be in-built in the meters. Necessary isolation and/or suppression shall also be built- in, for protecting the meters from surges and voltage spikes that occur in the VT and CT circuits of extra high voltage switchyards. The reference frequency shall be 50Hz. Also, the meter shall have suitable of $\pm 15\%$ tolerance for DC supply.

1.5 The meters shall safely withstand the usual fluctuations arising during faults etc. In particular, VT secondary voltages 115% of V_{ref} applied continuously and 190% of V_{ref} for 3.0 seconds, and CT secondary current 150% of I_{ref} applied continuously and 30 times of I_{ref} applied for 0.5 seconds shall not cause any damage to or maloperation of the meters.

1.6 The meters shall continue to function for the remaining healthy phase(s), in case one or two phases of VT supply fails. In case of a complete VT supply failure, the computation of average frequency shall be done only for the period during which the VT supply was available in the 5-minute block. Any time block contraction or elongation for clock correction shall also be duly accounted for.

1.7 The total burden imposed by a meter for measurement and operation shall be defined as per IS 14697. An automatic backup for continued operation of the meter's calendar-clock, and for retaining all data stored in its memory, shall be provided through a long-life battery, which shall be capable of supplying the required power for at least 2 years. The meters shall be supplied duly fitted with the batteries, which shall not require to be changed for at least 10 years, as long as total VT supply interruption does not exceed two years.

1.8 The meters shall fully comply with all stipulations in IS 14697 except those specifically modified by this specification. The reference ambient temperature shall be 27°C.

1.9 Each meter shall have a test output device (visual), as per clause 6.11 of IS 14697.1999, for checking the accuracy of active energy (Wh) measurement. The preferred pulsing rate is twenty (20) per Wh for CT sec-1A and four (4) per Wh for CT sec -5A. However, bidder may decide on their own. It shall be possible to couple this device to suitable testing equipment also.

1.10 **Exception Management** - The three line-to-neutral voltage shall be continuously monitored and in case any of these falls below defined threshold (70% of Vref), meter shall have suitable indication on LED/ LCD. The meter shall also have provision for low voltage event logging in meter memory in case of any phase voltage going below a defined threshold. The time blocks in which such a voltage failure occurs/persists shall also be recorded in the meter's memory with a symbol "*" if 3 Phase RMS voltage applied to the IEM is in between 5% to 70% of Vref and if Voltage is less than 5% of Vref, meter should record Zero voltage symbol "Z". There shall also be a provision to generate an alarm/SMS (to predefined mobile numbers) in the software at CDCS in case of VT supply failure or to generate error log.

1.11 **Time Accuracy** - Each meter shall have a built-in calendar and clock, having an accuracy of 10 seconds per month or better. The calendar and clock shall be correctly set at the manufacturer's works. The date (year-month-day) and time (hour-min.-sec.) shall be displayed on the meter front on demand. Meter shall have the intelligence to synchronize the time with GPS (Local GPS/CDCS GPS) signal and from PC using software. Limited time synchronization through meter communication port shall be possible at site. The meter shall be capable of accepting time synchronizing signal from local BCU, DCU, GPS or remote MDAS (CDCS). When an advance or retard command is given, twelve subsequent time blocks shall be contracted or elongated by five seconds each. Time advance and retard command should be limited to one command/week. All clock corrections shall be registered in the meter's memory and suitably shown on print out of collected data.

1.12 A touch key or push button, backlit LCD display shall be provided on the meter front for switching on the display and for changing from one indication to the next. Preferably the display shall switch off automatically about one minute after the last operation of touch

key/push button. When the display is switched on, the parameter last displayed shall be displayed again, duly updated.

1.13 The whole system shall be such as to provide a print out (both from the local PC, and from remote central computer) of the following format:

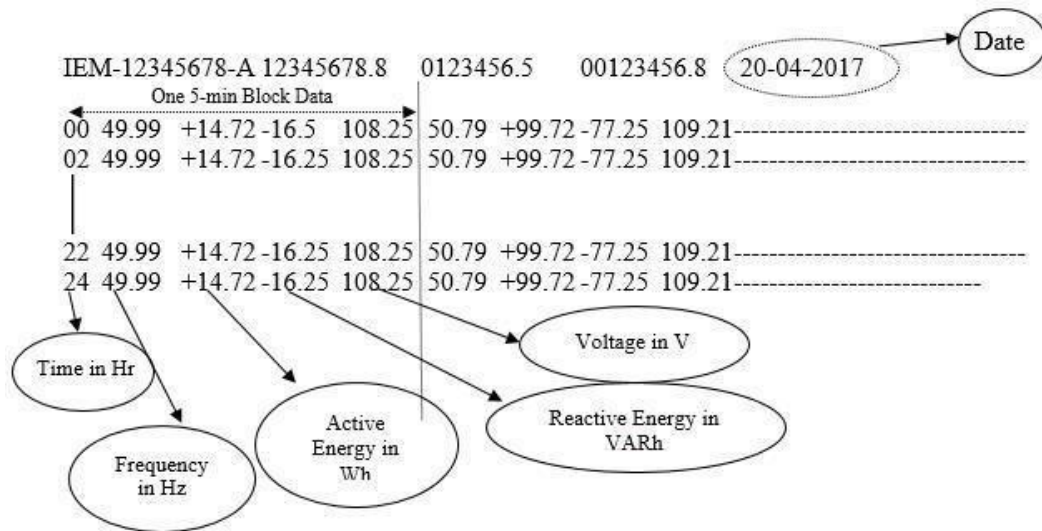


Figure 1 – Standard raw data format for IEM

There are 4 values in one 5 min time block. The first row shall contain the meter data for 2 hours, i.e. 24 time blocks, 00 hrs to 02:00 hrs. Similarly the 2nd row shall contain the data for the next 2 hours and henceforth.

The above data shall be available in text file format (file extension as per IEEE standard/.txt) exportable to Excel. Indication of time retard or advance to be provided without disturbing the proposed format. Each 5-min block data consists of Frequency (in HZ), Active energy (in Wh), Reactive energy (in VARh) and Voltage (in V). All 5 minute Wh and VARh figures in required (.CSV/.NPC/ any other) output report shall be rounded off up to third decimal. Active and Reactive energy High Low to be in the order of 7+1 digits.

1.14 The portable hand held unit (HHU)/ Common meter reading instrument (CMRI)/ Data Collecting Device (DCD) shall be having IS-15959:2011 compatibility for standardized parameters. The optical coupler for tapping data stored in the SEMs memory shall be compatible universally across different make of SEMs.

1.15 Constructional Features:

1.15.1 The meters shall be supplied housed in compact and sturdy, metallic or moulded cases of non-rusting construction and/or finish. The cases shall be designed for simple mounting on a plane, vertical surface such as a control/relay panel front. All terminals for

CT and VT connections shall be arranged in a row along the meter's lower side. Terminals shall have a suitable construction with barriers and cover, to provide a secure and safe connection of CTs and VTs leads through stranded copper conductors of 2.5 sq. mm. sizes.

1.15.2 All meters of the same model shall be totally identical in all respects except for their unique identification codes. They shall also be properly sealed and tamper evident, with no possibility of any adjustment at site, except for transactions allowed in IS 15959.

1.15.3 The meters shall safely withstand, without any damage or mal operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. in accordance with IS-14697. They shall have an IP51 category (But without suction in meter) dust tight construction, and shall be capable of satisfactory operation in an indoor, non-air conditioned installation & outdoor installation in a panel.

1.15.4 Either the meters shall have built-in facility (e.g. test links in their terminals) for in-situ testing, or a separate test block shall be provided for each meter. However, in case of new metering panel separate TTB will be the part of panel.

1.15.5 The sealing arrangement should be suitable for application of polycarbonate seals.

2. Measurement

2.1 The active energy (Wh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy as per class 0.2S (IS 14697).

2.2 The meter shall compute the net active energy (Wh) sent out from the substation bus bars during each successive 5 min block, and store it in its memory up to fourth decimal with plus sign if there is net Wh export and with a minus sign if there is net Wh import. Further Wh data in (.CSV/.NPC/ any other) output report shall be rounded upto third decimal.

2.3 The meter shall count the number of cycles in VT output during each successive 5 min block, and divide the same by 300 (60 sec/min x 5min) to arrive at the average frequency. The least count of the frequency data shall be 0.01 Hz. The frequency data shall be stored in the meter's memory in Hertz up to two decimal. Further hz data in (.CSV/.NPC/ any other) output report shall be rounded up to two decimal.

2.4 The meter shall continuously compute the average of the RMS values of the three line-to-neutral VT secondary voltages as a percentage of 63.51 V, and display the same on demand. The accuracy of the voltage measurement/computation shall be at least 0.5%, a better accuracy such as 0.2% in the 95-105% range being desirable. The voltage data

shall be stored in the meter's memory in volts up to third decimal. Further Wh data in (.CSV/.NPC/ any other) output report shall be rounded upto second decimal.

2.5 The Reactive energy (VARh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy of 0.2S as specified in IS 14697. The meter shall compute the net Reactive energy ($\text{Net VARh} = (\text{VARh Export} - \text{VARh Import})$) sent out from the substation bus bars during each successive 5 min block, and store it in its memory up to fourth decimal with plus sign if there is net VARh export and with a minus sign if there is net VARh import. It shall also display on demand the net VARh sent out during the previous 5 min block. Further VARh data in (.CSV/.NPC/ any other) output report shall be rounded up to third decimal.

2.6 The meter shall also integrate the reactive energy (VARh) algebraically into two separate registers, one for the period for which the average RMS voltage is above 103.0%, and the other for the period for which the average RMS voltage is below 97.0 %. The current reactive power (VAR), with a minus sign if negative, and cumulative reactive energy (VARh) readings of the two registers (>103% and <97%) shall be displayed on demand. The readings of the two registers at each midnight shall also be stored in the meter's memory. When reactive power is being sent out from substation bus bars, VAR display shall have a plus sign or no sign and VARh registers shall move forward. When reactive power flow is in the reverse direction, VAR display shall have negative sign and VARh registers shall move backwards. The meters to be commissioned for secondary voltage i.e. -/110V and primary voltage shall be configurable at site during commissioning. Generally, the standard PT ratios are 132/110V, 220 kV /110V, 400 kV /110 V and 765 kV / 110 V. However, at the time of commissioning the vendor may confirm the same from site and configure the meter accordingly to ensure correct recording of reactive energy. For Reactive High & Low recordings, PT secondary voltage shall be configured in the meter.

2.7 Further, the meter shall continuously integrate and display on demand the net cumulative active energy sent out from the substation bus bars up to that time. The cumulative net Wh reading at each midnight shall be stored in the meter's memory. The register shall move backwards when active power flows back to substation bus bars.

2.8 Errors for different power factors shall be as defined in IS14697.

2.9 For reactive power (VAR) and reactive energy (VARh) measurements, IS14697 shall be complied with. The accuracy of measurement of reactive energy shall be as per class 0.2S.

2.10 The harmonics shall be filtered out while measuring Wh, V and VARh, and only fundamental frequency quantities shall be measured/computed.

2.11 The meter shall be capable of measuring total harmonic distortion for current and voltage.

2.12 The meter shall be capable of measuring four quadrant import/ export metering for active, reactive and apparent power.

2.13 Data security shall be ensured as per IS 15959 (three layers of security).

3. Memory/ Storage

3.1 Each meter shall have a non-volatile memory in which the following shall be automatically stored:

3.1.1 Average frequency for each successive 5 min block, in Hertz up to third decimals.

3.1.2 Net Wh transmittal during each successive 5 min block, up to fourth decimal, with plus sign if there is net Wh export and with a minus sign if there is net Wh import.

3.1.3 Net VARh transmittal during each successive 5 min block, up to fourth decimal, with plus sign if there is net VARh export and with a minus sign if there is net Varh import.

3.1.4 Cumulative Wh transmittal at each midnight, in eight digits including one decimal.

3.1.5 Cumulative VARh transmittal for voltage high condition, at each midnight in eight digits including one decimal.

3.1.6 Cumulative VARh transmittal for voltage low condition, at each midnight, in eight digits including one decimal.

3.1.7 Average RMS voltage for each successive 5min block.

3.1.8 Date and time blocks of failure of VT supply on any phase, as a star (*)/ (Z) mark.

3.2 The meters shall store all the above listed data in their memories for a period of minimum fifteen (15) days.

3.3 The software provided at CDCS, i.e. SLDC, will manage all functionalities of collection of data through DCUs, validate the data, store the data in a database, and manage the complete system. Software will also have a scheduler for scheduling the task of collection of data periodically. The periodicity of data collection shall be user defined.

4. Display

4.1 Each meter shall have digital display for indication of the following (one at a time), on demand:

- 4.1.1 Meter serial no. and model: IEM12345678A or IEM12345678B
- 4.1.2 Date (year month day /yyyy mm dd): 20160311 d
- 4.1.3 Time (hour min sec /hh mm ss): 195527 t
- 4.1.4 Cumulative Wh reading: 1234567.8 C
- 4.1.5 Average frequency of the previous block: 49.89 F
- 4.1.6 Net Wh transmittal during the previous block: - 28.75 E
- 4.1.7 Net VARh transmittal during the previous block: - 18.75 R
- 4.1.8 Average % Voltage: 99.2 U
- 4.1.9 Reactive power (VAR): 106.5 r
- 4.1.10 Voltage - high VARh registers reading: 1234567.5 H
- 4.1.11 Voltage - low VARh register reading: 1234567.4 L
- 4.1.12 Low battery indication
- 4.1.13 The three line-to-neutral voltages shall be continuously monitored and in case any of these falls below 70 %, then preferably, the corresponding flashing LED/LCD provided on meter's front shall become steady. They all shall go off if all three voltages fall below 70 %. The LED/LCD shall automatically resume flashing when all VT secondary voltages are healthy again.
- 4.1.14 The two VARh registers (x and xi) shall remain stay-put while VT supply is unhealthy.
- 4.2 Any other better or more informative mechanism to display the above shall be preferred. The above shall be mutually agreed between the meter buyer and vendor.
- 4.3 Navigation keys to be provided at the meter front plate to navigate the display menu.

5. Communication

5.1 Each meter must have an optical port on its front for tapping all data stored in its memory through HHU. In addition to the above each meter shall also be provided with a RS-485, Ethernet and USB port/ optical to USB converter cable on one of its sides, from where all the data stored in the meter's memory can also be transferred to CDCS (through DCU), local computer and external storage. The overall intention is to tap the data stored in the meter's memories at a scheduled time from any of the above mentioned ports or any other means and transmit the same to a remote central computer using suitable means of communication. It shall be possible to securely download the IEM data through an USB port via external storage thereby removing the requirement of a MRI (Meter Reading

Instrument). It shall be ensured that data transfer through USB shall be unidirectional only i.e. from Meter to external storage device in an authentication process. Meter data shall be tamper-proof.(As an alternative RS232 to USB converter can be provided)

5.2 All meters shall be compatible with Optical port, RS-485 port, Ethernet port and USB/optical to USB converter cable all together at a time and communicate using DLMS independently. It shall also be possible to obtain a print out (hard copy) of all data collected from the meters, using the local PC. Data collection from any local laptop/PC shall be possible by installing data collection software.

The meter shall comply with latest prevalent interoperability open data exchange protocols in metering, including DLMS. It shall be capable of transmitting required data either to local DCU or to remote MDAS.

5.3 Entire project has to be based on Optic Fibre/ VSAT/GSM/Internet/4G/3G/2G. Communication between DCU and MDAS shall be OF/GSM(Sim)/VSAT/Internet provided by MSETCL. In case of communication failure data downloading by MRI and sending SLDC is the responsibility of MSETCL.

5.4 The bidder may design appropriate architecture for providing end to end metering solution. He is free to decide upon the best solution out of all the available options to ensure that data from all IEMs are available at the SLDC by the scheduled time. However, the entire responsibility of fully functional end to end metering system shall rest with the bidder in order to meet the performance levels as given in this document. MSETCL may adopt Optical Fibre/ VSAT/GSM/3G/4G/Internet communication technology or a combination of these technologies as per the site requirement adopting best available technology in the proposed area of implementation. The successful bidder shall be responsible for proper data exchange among IEM, DCU, CDCS, MDP and other operational/requisite software as part of fully functional metering system.

5.5 The bidder shall adhere to the appropriate security algorithm for encryption and decryption.

5.6 The bidder shall design a reliable, interference free & robust communication network keeping in view the site conditions. It shall be flexible in terms of providing communication in variable terrain & urban density. The bidder shall design the network architecture keeping in view the existing and planned infrastructure of the utility. During designing, suitable consideration shall be kept for future expansion as per requirement of Utility. The entire infrastructure & associated works required for installation & commissioning of equipment/devices like DCUs, repeaters, routers etc. shall be in the

scope of bidder. The operational testing of all the network elements has to be demonstrated by the bidder to the satisfaction of the utility.

5.7 The Bidder shall provide the necessary software which would enable a local PC/ CDCS to:

5.7.1 Accept the data from the Optical/Ethernet/WAN and store it in its memory in user defined formats (text, csv, xls, etc.) in a user-defined file name (file name format must be dd mm yy substation name-utility name).

5.7.2 Polling feature along with a task scheduler to run the data downloading software at a pre-designated date and time repeatedly or by manually selecting a meter. File naming for such downloaded data should also be in user-defined format. A detailed activity log shall also be available for each downloading operation.

5.7.3 Upload/Import meter data (binary files) in the software for further processing. While uploading, there shall be provision to upload all selected files with single key-stroke.

5.7.4 Convert the binary file(s) to text file(s). There should be provision to select multiple files based on filename, convert all selected files with single key-stroke and store the text files in the same location where binary files are stored.

5.7.5 Display the collected data on PC's screen in text format, with forward / backward rolling.

5.7.6 Print out in text format the data collected from one or more meters, starting from a certain date and time, as per operator's instructions.

5.7.7 Transmit the collected data, in binary format, through an appropriate communication link to the central computer, starting from a certain date and time, as per operator's instructions.

5.7.8 Store the collected data in binary format, on a CD/Pen Device. In addition to above, in general the software shall be able to convert IEMs data to existing format as well as in tabular (.csv) format as applicable.

5.8 The above software shall further ensure that absolutely no tampering (except erasing of complete data with password protection) of the collected metering data is possible during its handling by the PC. The software shall be suitable for the commonly available PCs, (Windows) and shall be supplied to Owner in a compatible form to enable its easy loading into the PCs available (or to be installed by the Owner/others) at the various substations.

5.9 The bidder shall ensure data integrity checks on all metered data received from data collection systems.

5.10 The quality of installation of the various equipment & power supply wiring to all field equipment shall be as per standards/ regulations/prevaling practices of the utility. The supply of electricity needed for operation and maintenance of entire Metering system shall be provided free of cost by the respective owners of the premises.

6. Quality Assurance

The quality control procedure to be adopted during manufacturing of the specified equipment shall be mutually discussed and finalized in due course, generally based on the established and proven practices of the manufacturer. The software shall be user friendly which can be easily installed in any PC / Laptop irrespective of operating system of the PC / Laptop, and shall be certified for ensuring data handling capabilities. The same shall be demonstrated by the party during technical evaluation.

7. Testing

7.1 All equipment, after final assembly and before dispatch from manufacturer's works, shall be duly tested to verify that is suitable for supply to the Owner. Routine and acceptance tests shall be carried out on the meters in line with IS 14697.

7.2 Any meter which fails to fully comply with the specification requirements shall be liable to be rejected by the Owner.

7.3 Acceptance Tests for PC Software and data down loading using meter communication ports-

All IEMs after final assembly and before dispatch from Bidder's/Manufacturer's works shall be duly tested to verify that they are suitable for downloading data using meter communication ports shall be subjected to the following acceptance test.

7.3.1 Downloading Meter Data from the Meter(s) to PC via optical port.

7.3.2 Downloading meter data through USB port.

7.3.3 Downloading meter data to DCU/CDCS through Ethernet port.

7.3.4 Compatibility with PC Software.

7.3.5 Functioning of Time synchronization, advance and retard time commands.

7.3.6 Per meter downloading time verification.

7.4 Copy of Test certificate shall be submitted to MSETCL/OWNER.

8. Type Tests

8.1 One (1 Nos.) meters per lot shall be subjected to the complete range of type tests as per IS14697 and IS15959, after final assembly. In case of any failure to pass all specified tests, the bidder shall arrange to carry out the requisite modifications/ replacements in the entire lot of meters at his own cost. After any such modifications and final assembly, One (1) meters selected out of the lot by the Owner's representative shall be subjected to the full range of type tests. The lot shall be accepted by the Owner only after successful type testing.

8.2 The meters used for type testing shall be separately identified, duly marked, and supplied to the Owner in case they are fully functional and as good as other (new) meters, after necessary touching up/refurbishing. In case this is not possible, the bidder shall provide their replacements at no extra cost to Owner.

8.3 The Bidder shall arrange all type testing specified above, and bear all expenses for the same.

8.4 Copy of Test certificate shall be submitted to MSETCL/OWNER.

9. Installation and Commissioning

The static energy meters specified above shall be installed at various EHV substations owned by the Owner, Interstate/Intrastate licensee, Generating Stations, DISCOMs and other agencies, throughout Maharashtra. The tentative list of substations along with the existing number of meters is enclosed as Annexure-1. The exact location for installation shall be provided by the Owner.

9.1 The Bidder shall be responsible for total installation and commissioning of the meters (along with test blocks, if supplied separately) as per Owner's advice, including unpacking and inspection on receipt at site, mounting the meters on existing control and relay panels at suggested height, connection of CT and VT circuits including any required rewiring, functional testing, commissioning and handing over. The Bidder's personnel shall procure/carry the necessary tools, equipment, materials and consumables (including insulated wires, lugs, ferrules, hardware etc.)

9.2 As part of commissioning of DCDs the Bidder shall load the software specified in clause 6 into the PCs at the respective substations, and fully commission the total meter reading scheme. He shall also impart the necessary instructions to substation engineers. At least 2-hour training session shall be arranged for substation staff. This training shall be excluding the training envisaged separately in section – VII. Also, an

operating manual (pdf as well as hard copy) of the meter containing all details of the meter, various data downloading features, etc. shall be made available at site and SLDC.

9.3 Bidders to check the dimensions of the existing SEM's. IEMs shall fit in the same location in the panel, wherever feasible.

9.4 Following technical information shall be furnished by the Bidders in their offers:

9.4.1 Foreseen dimensions of proposed meter.

9.4.2 Expected weight of proposed meter.

9.4.3 Dimensions and weight of the test block, if supplied separately.

9.5 At the time of commissioning, the meters shall be either time synchronized through GPS signal or time set through HHU/BCS (BASE COMPUTER SOFTWARE) before installation in the panel to avoid the large time mismatch. Every meter installed shall be time synchronized.

10. General

10.1 The meter shall be supplied with latest/compatible software. Any new software as required to be installed within warranty period are to be done by party or through remote support to client.

10.2 The total arrangement shall be such that one (1) operation (click on "data down load from meter" button on software) can carry out the whole operation in about five (5) minutes per meter or preferably faster.

10.3 The layout of software front end/user interface has to be approved by SLDC/ ACI during technical evaluation/demonstration.

10.4 Software for windows/office/antivirus to be supplied. Antivirus should not slow down processes and same will be demonstrated during technical demonstration.

10.5 Above specification is minimum only, any higher standard required for the purpose intended (meter data handling) would be assessed by vendor and would be supplied accordingly. The detailed architecture shall be approved during drawing approval stage.

10.6 Meter shall be accommodated in existing C&R panel of standard size (Alstom/ ER/ABB/Siemens) in kiosk or C&R panel with door closed. If IEM cannot be accommodated in the existing C&R panel then a separate panel for IEMs is to be provided. Requirement will be ascertained during final survey. If required before bidding, bidder may collect necessary data.

10.7 Step by Step procedure (on screen shot type and desktop video capture) shall be provided for

10.7.1 Installation/Re-installation of Database handling software in to Laptop / PC

10.7.2 Meter maintenance/site-testing procedure as per relevant IS/IEC standard.

10.7.3 Procedure for data downloading from Meter by HHU/Laptop/Desktop PC.

10.8 As on date of delivery, the supplied meters shall comply with all statutory regulation as required under CERC/MERC/CEA/IEGC as applicable and the same should be declared by the vendor during delivery along with warranty certificate. Delivery schedule shall be extended in case of any modification in specification required by CERC/MERC/CEA/IEGC during the delivery period.

10.9 Dismantling of existing SEMs and handing over the same at nearest owner location, shall also be in the scope of bidder. (format for dismantling and handing over of old meter shall be given at time of order/LOI)

CHAPTER – II: DATA CONCENTRATOR UNIT (DCU), COMMUNICATION & AUTOMATED METER DATA READING (AMR) SYSTEM

This section describes the envisaged system architecture of Automated Meter-data Reading within the Region.

1. Intent of AMR

The intent of AMR scheme proposed in this document is to automate the task of data collection from each meter/location to the Central Data Collection System (CDCS) followed by validation, processing and generation of customized reports. The data shall be stored in ORACLE Enterprise Edition database latest available version with RAC storage to provide 99.9% availability located at State Load Dispatch Centre located at Airoli, Navi Mumbai.

The communication system for data transfer from IEM to SLDC be in the scope of MSETCL. Concept diagram of the envisaged AMR system is given in **Figure-2:**

Concept diagram of the envisaged AMR system

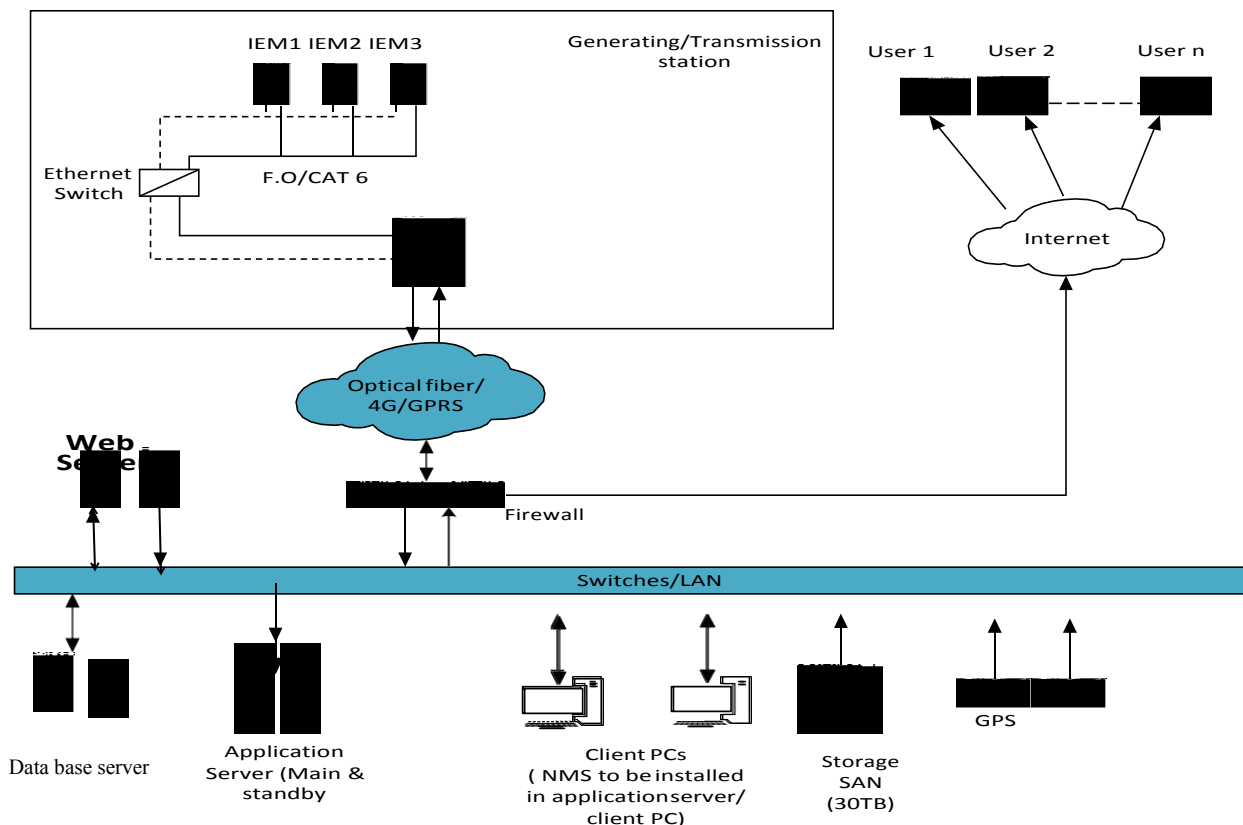


Figure 2

1.1 Energy Meters

Energy Meters to be covered under proposed AMR system are Interface Energy Meters (IEMs) manufactured as per Technical Specification illustrated in this document.

1.2 Data Concentrator Unit

A Data Concentrator Unit (DCU) installed at each location will act as interface between Central Data Collection System (CDCS) at SLDC and IEMs installed at that location. DCU shall collect data from energy meters and sent the same to CDCS at SLDC. DCU shall also report diagnostic information of the energy meters to CDCS. DCU shall have following functions:

1.2.1 Acquiring energy data and status from energy meters.

1.2.2 Providing energy data and status to CDCS.

1.2.3 Intelligence to synchronize IEMs clock with GPS clock located at Station/CDCS. Each meter has a unique identification number and each meter location has unique identification code. DCU shall collect data from a single or group of meters based on meter number or meter location code. DCUs shall collect data from energy meters and transfer the same to CDCS. DCUs should provide a RS-485/LAN/USB port for communication with local personal computer or terminal, if available

1.3 Central Data Collection System

A Central Data Collecting System to be provided at SLDC will manage all functionalities of collection of data through DCUs, validation and verification of the data, storage of the data in ORACLE Enterprise Edition database latest available version with RAC and with HA (High availability provided by remote mirroring of database storage) and management of the complete AMR system. CDCS shall have a scheduler for scheduling the task of collection of data periodically up to the last time block. Provision of extracting data from the database in the text files as per existing format for all or selected meters for further processing by Energy Accounting software is also to be built in data collection software. The responsibility of providing data up to CDCS (including all the hardware in between) shall be the responsibility of the bidder.

1.4 Communication System

Communication system to be used for transfer of data from DCU to CDCS may be Optic Fibre / VSAT/ G S M / Internet/3 G / 4G/2G . Bidder is free to suggest alternative communication media if it is more efficient and cost effective.

2. Scope of Work

This section provides detailed scope of work included in the bidder's scope, excluded from the bidder's scope, facilities to be arranged by bidder and facilities to be provided by station owner.

2.1 Bidder's Scope of Work

The scope of work in complete conformity with subsequent sections of the specification shall include site survey, planning, design, engineering, manufacturing/integration, testing, supply, transportation & insurance, delivery at site, storage, installation, commissioning, demonstration for acceptance, training and documentation of AMR system including:

2.1.1 Design Document for complete AMR System.

2.1.2 Software Requirements Specifications for CDCS and DCU.

2.1.3 Application Server Database System and Central Data Collection System (CDCS) at SLDC.

2.1.4 Making data available up to CDCS system at SLDC.

2.1.5 ORACLE Enterprise Edition database latest available version with RAC and with HA (for storage of data at SLDC).

2.1.6 SAN storage for storage of meter data for 5 years

2.1.7 Data Collection Unit (DCU).

2.1.8 Connection and interfacing of meters with DCU.

2.1.9 Supply and laying of optical fibre at the stations for connection of IEM to DCU.

2.1.10 GSM/GPRS/ Modems, Media converter, Switch

2.1.11 All cabling, wiring, terminations and interconnections of the equipment.

2.1.12 Database development, Displays and Reports.

2.1.13 Archival and retrieval of data through ORACLE Enterprise Edition database latest available version with RAC and with HA (High availability provided by remote mirroring of database storage) database at SLDC.

2.1.14 Decoded text files in existing format at SLDC.

2.1.15 Periphery segregation shall be in line with established cyber security standards.

2.1.16 Training of personnel (Substation, SLDC, ALDC and other utilities).

2.1.17 Warranty and support & maintenance as per Sec-VIII. The intent of the project is that the bidder shall ensure 100% data availability at SLDC within the stipulated time as per IEGC within the warranty period. The successful bidders have to maintain adequate spares during seven years of the warranty period.

2.1.18 To maintain extra 20% quantity of AMR equipment as backup and future requirement.

2.2 Exclusions from Bidder's Scope of Work

Followings are not included in the scope of the bidder and shall be provided by local station without any extra cost to bidder:

2.2.1 Space for installation of IEMs, DCU and CDCS at respective locations.

2.2.2 Auxiliary Power Supply for IEMs, DCU at each location and server system at CDCS.

2.2.3 Provision of static IP and internet connection at SLDC

2.2.4 Building, air conditioning systems and other infrastructures.

2.2.5 Communication channels between DCU and CDCS

2.2.6 Any other work which is not identified in 2.1 & 2.2 or in the specification but is required for completion of the project within the intent of this specification shall also be in the scope of the Bidder without any extra cost.

3. Functional Requirements

Major components of the AMR System to be implemented under the scope of this specification document are Data Concentrator Unit, Central Data Collection System and communication channel. This section enumerates the functional requirements of each component.

3.1 Data Concentrator Unit (DCU)

DCU is to function as a gateway between Central Data Collection System (CDCS) and energy meters installed at DCU location. DCU shall have following functions:

3.1.1 Acquiring energy data and status from energy meters.

3.1.2 Providing energy data and status to CDCS.

3.1.3 Providing energy data and status to local computer, if available.

3.1.4 Time synchronization of IEM's, either through GPS installed at site or through CDCS.

Application Requirement: Data Concentrator Unit (DCU) along with the suitable enclosure shall be placed in the control room in the Substation/ Generating Plant. DCU is functionally requires to acquire the IEM data and transferring the same to Data Control Center using communication system and AMR software.

3.2.0 General Construction

- DCU shall be a self contained, stand alone box with minimum 1 serial (RS485) port for meter connection and with one RJ45 Ethernet 10/100/1000mbps port. DCU shall be IEC 61850-3 compliant. DCU shall have in built modem or external modem facility. DCU shall have Modbus port in addition to DLMS.
- DCU should be flush mounted or surface mounted and to be supplied with suitable enclosure for installation in the control room. The enclosure shall be complete with the internal wiring and have all the necessary arrangement for the termination of various communication and power cables in the enclosure.
- DCU should not have any moving parts such as a hard disk, to ensure smooth and reliable operation for long term.
- The DCU shall be normally powered from the station battery backup supply rated at 110/220 VDC/ 230VAC.
- DCU should have protection against entry of dust.
- Substantial EMI (Electro Magnetic Interference) and ESD (Electro Static Discharge) will be present at DCU site, effect of which shall be duly considered while designing the system. Performance of the overall system shall not be hampered by such interference. EMI/ESD tolerance shall comply with IEC61850-3 standard.
- DCU should be able to operate in environment with temp up to 45°C and humidity up to 90% without any significant effect on its performance.
- The mechanical design and construction of each unit sub-assembly shall be inherently robust and rigid under various conditions of operation, adjustment, replacement, storage and transport.
- DCUs shall also withstand without any damage or mal-operation reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. They shall have an IP-54 or better category dust-tight construction, and shall be capable of satisfactory operation in an indoor, non-air conditioned installation.

3.3 Local Display and LEDs

LEDs for status like power on, communication activity etc should be provided on the face of DCU.

4.0 Communication with MDAS

Entire project has to be primarily based on GPRS/Internet/VSAT/2G/3G/4G network and OPGW where ever available..

Communication system should meet following requirements:-

- All communication between DCUs and MDAS should be through secured Virtual Private Network (VPN) tunnel (encrypted data) which shall be transparently managed between each DCU and the MDAS.
- For communication with MDAS, each DCU should be provided with Ethernet port. This is needed even for substation that presently does not have OPGW since OPGW is likely to be added in the future. For locations that does not presently have OPGW, built-in GPRS modem capable of transferring the data to MDAS using TCP socket communication using DLMS/COSEM protocols. In both cases there shall be no requirement to assign public static IPs to this GPRS device.
- A fixed public IP shall be provided for the internet landing point at central location where MDAS to connect the GPRS/3G/2G/Internet network to MDAS.
- Transfer of data from DCU to MDAS should be on physical Ethernet and secured VPN form.
- The DCU should be able to run the meter protocol drivers to read each type of meter and transfer them to the Control Centre. The DCU must support DLMS/COSEM(HDLC & TCP) as well as MODBUS to communicate with meters.
- DCU should be capable of GPRS/3G operating at 900, 1800, 2100 MHz. should support both Data and SMS transmission. It should have both GSM and GPRS/EDGE/3G/2G/Internet features.
- DCU should support TCP, UDP, HTTP, FTP, SMTP, Max.
- DCU should have capacity to report to different three masters. (one MDAS & another on IEC104 protocol to SCADA server and one spare)

4.1.1 Acquiring energy and status data from energy meters

DCUs shall be connected with local energy meters through optical fibre with suitable media converter (which shall be DC powered)/ switch in between. Connection to the local energy meters shall be firm and secure from any unintended disconnection. DCU should implement IEM protocols. It shall be possible to change/update the energy meter protocol driver from CDCS. DCUs shall not send any command other than the command to read the energy data, status data and GPS clock synchronization of IEM clock. Several RE pooling stations are expected to come in Maharashtra. It is envisaged that the number of meters at RE pooling stations would be very high. Thus high speed fibre optic connection between IEM and DCU is desirable to ensure timely collection of data.

4.1.2 Providing Energy Data and Status to CDCS

DCUs shall be provided with suitable SIM/modem etc. in order to have connectivity over Optic Fibre/VSAT/ G S M /2G/ 3 G / 4G/Internet with SLDC. All communication between DCU and CDCS shall be on secure VPN.DCU shall accept following commands from CDCS/GPS Clock and shall function as per the command:

4.1.2.1 Energy data collection from energy meters.

4.1.2.2 Acquiring status and alarm from energy meters.

4.1.2.3 Modification of DCU Configuration

4.1.2.4 IEM clock synchronization with GPS clock.

5.1.1 Energy Data Collection

DCUs shall query energy data and transfer the same to CDCS based on the command received from CDCS. Command may be for one time demand of data or it may be on cyclic 24 bases. DCU shall be able to query data from all or selected energy meters for the selected period based on the command from CDCS. DCUs shall be able to read energy data from all make of energy meters available in the market like L&T, Secure and Elster, etc. supplied as per this Technical Specification.

Each meter has a unique identification number and each meter location has unique identification code. DCU shall collect data from a single or group of meters based on meter number or meter location code. DCUs shall collect data from energy meters and transfer the same to CDCS. As DCU functions on read and forward philosophy for energy meter data, no storage is envisaged in the DCUs for energy data. However, if vendor thinks that provision of storage in DCUs may be required to meet the requirements of the AMR system, storage may be provided. However, such storage shall take care of currency of data while responding to commands from CDCS.

5.1.2 Status Data Collection

DCUs shall query periodically all energy meters connected to it for status or any alarm etc. Any change in status or alarm shall be reported to CDCS immediately.

DCUs shall acquire connected energy meter details like meter identification number, make, Low Voltage flag etc. periodically as well as whenever it's powered on. Any meter change activity like meter number, Low Voltage flag etc. shall be reported to CDCS immediately.

DCUs shall be self-monitoring for alarm like power failure, communication disconnection, and disconnection from energy meters and report the same to CDCS immediately.

DCUs shall have non-volatile memory for storing status data of energy meters duly time stamped, details of connected meters like make, meter number, status change. Non-

volatile memory should be able to store such data for at least one month in round FIFO buffer.

5.1.3 DCU Configurations change

Each DCU shall have a unique identification number normally not required to alter at site. DCUs shall accept and respond command for making configuration changes in DCU like periodicity of energy data/status data collection/GPS clock signal for IEM clock synchronization. For each configuration change, DCU shall respond with task successful or failure message to CDCS. Configuration commands from CDCS may be in the form of single command or multiple commands in a command file. DCU shall accept and make changes in configuration through data command on GSM / 3G / 4G/2G/Internet. DCU shall receive the configuration command from CDCS on same channel used for transfer of data to CDCS. DCUs shall store all configuration data locally in a separate non-volatile memory. All changes to configuration shall take place first to this memory. Only after receiving a specific command from CDCS, the saved configurations should come into effect. However, any other functionality should not get affected during accepting and responding to configuration commands from CDCS. DCUs are not required to store history of configuration changes as all history shall be maintained in CDCS.

5.1.4 IEM clock synchronization with GPS clock

DCU shall have the intelligence to synchronize the IEM clock time with GPS clock time. Input GPS clock signal to DCU shall be from CDCS (at SLDC) GPS clock. If CDCS clock synch signal is not available to DCU, DCU will get GPS clock reference from station GPS.

6.1.1 Providing energy data to local computer/Laptop

DCUs shall have provision for communication with local personal computer/laptop. DCU shall provide meter status, alarm etc. and energy data to local personal computer, if required. Local PC shall be able to query energy data from selected or all energy meter by using web browser and intuitive user interface. The web browser shall be same as CDCS web browser to access the IEMs installed at local station. No special software should be required to be installed at local computer for this communication. All communication with local computer shall be password protected. PC for data downloading at each DCU location shall be arranged by respective site/ utility.(Local PC is not considered under present scope)

6.2 Central Data Collection System (CDCS)

A central data collection system (CDCS) shall be provided at SLDC for collection and processing of data from DCUs installed at remote locations. CDCS shall perform following functions:

6.2.1 Communication with DCUs.

6.2.2 Collection of energy data from DCUs.

6.2.3 Collection of status data form DCUs

6.2.4 Remote Configuration of DCUs

6.2.5 GPS clock signal to DCU

6.2.6 Processing of energy data.

6.2.7 Storing of data.

6.2.8 Providing data to energy accounting software.

6.2.9 Reporting functions.

6.2.10 Monitoring and Alarming.

6.2.11 Audit trail and logging.

6.2.12 Meter management.

6.2.13 shall have user Interface for

6.2.13.1 Data/Report uploading on website.

6.2.13.2 Data/Report access for predefined list of meters to SLDCs with secure user name and password for intrastate energy accounting.

6.2.13.3 Data/Report for MSETCL and other utilities.

6.2.14 CDCS shall include a web based application for utilities/stations to manually upload the data in case of AMR communication system failure due to any reasons. The following shall be taken care of in this regard:

6.2.14.1 The web application link shall be made accessible to all stations through SLDC website.

6.2.14.2 The downloaded data shall be in encrypted format.

6.2.14.3 Each utility shall be given User name and Password for login the web application.

6.2.14.4 Browser shall have the list of all Utilities and its station names.

6.2.14.5 Each station shall upload the encrypted data by selecting their Utility name and Station name.

6.2.14.6 Web Application shall generate the confirmation message to the station on successful uploading of data.

6.2.14.7 Web application shall generate the popup message at CDCS with Utility name and Station name on receipt of data.

6.2.14.8 All the encrypted data received at CDCS via web application shall be stored in predefined path.

6.2.14.9 CDCS shall have the provision to decrypt the data and store in the database for the further processing.

6.2.14.10 The web server in MDAS should have the capability to give web access to accept the files downloaded through MRI from the IEMs.

6.3.1 Communication with DCUs

The CDCS shall have a dedicated Communication Server – This shall manage the VPN Connections, DCU Communication, Alarm management, Logging, DCU Configurations as well as GPS clock signal to DCU. The Interface of the Communication Server shall be standards based such that, up gradation of either Communication System or Application Server will not need a commensurate replacement of the other. The CDCS shall have a Network Management Interface that provides a Dash Board of the DCU's and their status / Alarms and Meter's that are not communicating.

6.3.2 Collection of energy data from DCUs

CDCS shall collect data from energy meters through DCU for selected/configured meter location periodically or on demand at any time. CDCS shall have scheduler software, which shall issue command to the concerned DCU and collect the required energy meter data. It shall be possible to schedule data downloading on hourly basis.

6.3.3 Collection of status data from DCUs

CDCS shall have a DCU monitoring module. This module shall monitor each DCU for its working status, parameters and any alarm etc. The monitoring data shall be collected periodically or on demand at any time from all or selected DCUs. Possible periodicity of data collection would be once in a day.

6.3.4 Remote Configuration of DCUs

CDCS shall be provided with software module for remote configuration of selected or batch of DCUs. Remote DCU configuration module should be able to configure each parameter of DCU individually or in batch mode. It shall be possible to download the following changes to the remote device in addition to other required changes:

6.3.4.1 Poll cycle for collection of energy data.

6.3.4.2 Fixed public IP of CDCS server of the Control Centre

6.3.4.3 Changes in meter protocol driver.

6.3.5 Processing of energy data

Collected energy meter data (5-min) shall be provided to the data processing module. The time block period of the raw output from CDCS shall be used defined (5/15-min). This module shall check the data for completeness, error etc. and if any error is found, the same shall be displayed as an alarm.

6.3.6 Storing of data

If collected data is error free, it shall be provided to a data storage module. Data storage module shall load the collected energy data in to the database as per its structure. Archival of data shall be through ORACLE Enterprise Edition database latest available version with RAC and with HA.

MAHATRANSCO is the absolute owner of all data collected and stored in the database and all data should be made available to authentic MAHATRANSCO user using ORACLE DATABASE access or in any open format like XML or JSON.

Any changes in data by the human should be properly audited with all details and system should be made completely full proof from external tampering

6.3.7 Providing data to energy accounting software

CDCS should have software module for providing energy meter data from the database to the energy accounting software. At present Meter data should be in acceptable format of the existing 15 min settlement mechanism at SLDC. It will be bidders responsibility to make necessary changes in meter data output format on switch over settlement mechanism at SLDC from existing to DSM in future.

6.3.8 Reporting

CDCS shall have data reporting capability implemented through a separate dedicated module. Reporting module should be able to give report output on screen, in pdf or in XLS/csv form as per MSETCL requirements.

Reports may be based on pre-configured criteria or based on adhoc query. Report should include statistical analysis and outlier detection in the data.

6.3.9 Monitoring and Alarm

CDCS at SLDC shall provide DCU monitoring and self-monitoring functions to monitor the operating conditions and the performance of the system. SMS with email notification & alarm in case of VT failure and Line under S/D.

A suitable network management system (NMS) shall be provided at CDCS to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration & parameterization of the networking devices and the nodes.

Any detected problems shall be reported through local display, built-in event logging and to remote console or printer. Severe problems, such as loss of communication, shall generate alarms locally and e-mail notifications to configured e-mail address. User shall be able to enable and disable alarms individually.

CDCS shall generate an alarm whenever “data not received” occurs for one or more times for one or more DCU/IEM data. The alarm shall indicate which DCU/IEM has the problem. All Alarms (such as loss of supply to IEM, DCU failure, Communication failure, AMR failure etc.) to be generated in CDCS within 5 min. of the event.

6.3.10 Performance levels for AMR and CDCS

Data from all the installed IEMs shall be received at CDCS within 8 hours after the scheduled hour. Report for missing data if any shall be generated instantly on demand.

Issues observed in data collection, processing, report generation etc. shall be flagged by SLDC to the vendor for redressal in line with the Emergency Support Response/Resolution time.

6.3.11 Audit trail and logging

CDCS should have audit and logging function for each and every activities either completed successfully or failed should be logged.

The system shall provide audit trail of user and system activities that enables data changes to be tracked and reported, including changes made by the system administrator.

For editing of energy meter data, the system shall record the following information in a log and store it for a minimum of 12 months:

6.3.11.1 User ID

6.3.11.2 Date and Time of Change

User shall be prompted to input a reason for editing using either a standard reason code or a free form text field. In addition to data stored in the edit log, each interval containing edited data shall be marked with a status to indicate that the data has been edited. The pre-edited value shall be stored in the database as a previous version, which can be retrieved using “as-of” date functionality.

Changes to configuration data by users shall be logged by Date, time, and user ID and such logs shall be stored for a minimum of 12 months.

Critical changes relating to measuring parameters (pulse multipliers, transformer ratios, etc.) and formulae change shall be stored indefinitely as a previous version. The database for these is to be maintained in CDCS.

For regular system tasks, such as meter communication, task processing, validation, etc. the information will be kept for minimum one month.

Full data and system audit ability such as version controls and data retrieval according to the date and time. Additionally, all versions of meter data shall be stored such that they may be retrieved by “as-of” date for user to inspect.

7. General Requirements

Components of AMR system shall meet following physical requirements:

7.1 Data Concentrator Unit (DCU)

7.1.1 General Construction

7.1.1.1 DCU shall be a self-contained, stand-alone, tamper proof sealed box with necessary ports for external connection. It shall be flush mounted or surface mounted without requirement of a separate panel.

7.1.1.2 DCU shall not have any moving parts such as a hard disk, to ensure smooth and reliable operation for long term.

7.1.1.3 All external connections to DCU should be secure so as to avoid accidental disconnection.

7.1.1.4 The DCU shall be powered from the station battery backup supply rated at 220V/110V DC supply or normal AC supply.

7.1.1.5 DCU shall have protection against entry of dust, lizards etc be IP54 compliant. Ingress protection level may be decided on the basis of Indoor/outdoor installation.

7.1.1.6 DCU shall be able to operate in environment with temperature up to 50°C and humidity up to 90% without any significant effect on its performance.

7.1.1.7 The mechanical design and construction of each unit sub-assembly shall be inherently robust and rigid under various conditions of operation, adjustment, replacement, storage and transport.

7.1.1.8 DCUs shall also withstand, without any damage or mal-operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. They shall have an IP-54 category dust-tight construction and shall be capable of satisfactory operation in an indoor, non-air conditioned installation.

7.1.2 Local Display

A local display for status like power on, communication activity etc. and alarms like power failure communication fault etc. shall be provided on the face of DCU.

A web based display of DCU dashboard displaying all status; logs of activities, logs of alarm etc. shall be provided which shall be accessible from local PC as well as on CDCS.

7.2 CDCS

7.2.1 Dot NET or equivalent architecture such as Java based technologies shall be used for development of CDCS software.

7.2.2 System shall support entry / modification of data manually by an authenticated user.

7.2.3 Uploading meter data files manually to the AMR system by an authenticated user shall also be supported.

7.2.4 System under this project shall be complete in all respects including software, hardware, servers, LAN equipment's, cabling, modems, server racks etc.

7.2.5 The servers or computer system shall be in redundant mode in main and standby configuration. In case of failure of main standby should take over the work of data collection automatically.

7.2.6 Data collection system shall use multi-tier architecture having separate tier for database, application server and client.

7.2.7 Application tier shall utilize Web based architecture based on Microsoft .NET framework or equivalent architecture.

7.2.8 Client tier shall be any web browser like MSIE, Firefox, and Chrome etc.

7.2.9 All human machine interfaces with software system shall be web-based.

7.2.10 The Application shall be secured with password-protected access. It shall support multiuser access with role-based security.

7.2.11 CDCS shall be implemented by using server machines. Two machines shall be used for hosting software and DBMS in main and standby mode. One server shall be used as communication front end for all communication with DCUs as well as clients.

Minimum configuration of servers may be:

7.2.11.1) Server will be of 4 sockets & populated with 2 sockets with 6 cores each.
Intel® Xeon® E5-2687W v4 (30M Cache, 3.00 GHz), 9.6GT/s QPI, 12C/24T (160W) DDR4 2400MHz Cache 30MB.

7.2.11.2) 512GB RDIMM, 2400MT/s

7.2.11.3) 1TB hot pluggable, RAID 5 for Server Internal HDD

7.2.11.4) Remote Management- Shall be able to manage through dedicated 1G remote management port with Remote Access Controller with KVM redirection.

Any license required for KVM redirection should be included with support for 3 years.

7.2.11.5) DVD+/-RW SATA Internal

- 7.2.11.6) Power Supply and Fans-Dual, Hot-plug, Redundant Power Supply (1+1). Redundant hot swap fans.
- 7.2.11.7) USB 3.0 ports-4 nos.(minimum)
- 7.2.11.8) Supported OS- shall support following Hypervis or VMWare/RHEV/Hyper V/Citrix
- 7.2.11.9) Form Factor - 1U Rack with rack mounting kit
- 7.2.11.10) Management Software - Server management software with power management features and 3 years support should be included
- 7.2.11.11) NIC Port - 4 X 1Gbps NIC card
- 7.2.11.12) Hardware may be desktop based with keyboard, mouse and monitor etc.
- 7.2.11.13) Office 2016 or latest Business (64 bit) or latest
- 7.2.11.14) Operation System: MS windows 2016/ latest Std. Server 64bit (Oracle edition Linux)
- 7.2.11.15) 23" Wide TFT Monitor
- 7.2.11.16) makes: HP/DELL/Lenovo /equivalent

Client PC Specification: (Minimum Requirement)

- Processor - Intel 6th Gen Intel Core i7 (6700)
- 16 GB DDR3 RAM (expandable up to 32 GB)
- 500GB 7200rpm or Higher
- Graphics: Intel Integrated Graphics or Higher
- Integrated sound controller; Gigabit Ethernet controller; DVD writer dual layer ; 104 Keys OEM Keyboard and OEM Optical Mouse; all necessary Plug-ins/utilities and driver software, bundled in CD/DVD Media
- 4 USB Port
- 23 " TFT Monitor
- Windows 10 Professional or latest, MS office 2016 or latest

The above-mentioned server specification is minimum requirement, if the vendor AMR application requires higher configuration than vendor has to quote for the same. After supply of material during commissioning or during observation period if any server hardware/software up gradation required than it shall be in **vendor scope**.

7.3 Communication System

7.3.1 DCU shall have in-built modem or external modem facility. In case of in-built modem all modem/SIM installed shall be securely and firmly mounted on DCU itself.

7.3.2 It shall be possible to change modem/SIM without uninstalling DCU.

7.3.3 Mounting or un-mounting of modem/SIM shall be accessible from front of DCU.

7.3.4 The Modem shall meet the following environmental specifications, IP55 housing, Storage Temperature: -20 degrees to +70 degree Celsius, Operating Temperature: - 10 degrees to +60 degree Celsius, Humidity: - 95% RH (Non - Condensing).

8. System Sizing and Performance Requirements

AMR System shall meet the following system sizing and performance requirements. The system sizing and performance requirements are specified for main subsystem. Standby subsystem shall have the same sizing and performance requirements. The Acceptance of the product shall be based on the Owner/SLDC approved test protocols/ schedules to be submitted in advance by the Bidder ahead of factory/site inspection.

8.1 System Sizing

The system sizing for AMR System is only specified for initial sizing. The delivered system shall be expandable as the input and output requirements grow. Vendor is required to demonstrate their system's expandability in FAT (Factory Acceptance Test).

8.1.1 CDCS

CDCS shall meet following sizing requirements:

8.1.1.1 Population of Energy Meters

CDCS shall be capable to receive data from a minimum 800 DCUs, which is capable of collecting data from minimum 10 energy meters connected per DCU, at the minimum data collection interval. However, CDCS shall have provision to collect and handle data from up to 1000 DCUs and up to 15000 energy meters without any significant degradation of performance. However the bidder may propose a reliable cost-effective solution without comprising timely availability of data from such locations.

CDCS shall be capable of integration of multi vendor IEMs with DLMS protocol.

8.1.1.2 Data Storage-

A SAN (Storage Area Network) based storage with adequate storage facility and with remote mirroring for providing high availability shall be used for keeping backup of data and system, images on hard discs. SAN shall also be able to restore data and system images from backup. It shall be possible to restore the system within one hour from image backup. The bidder shall design and offer the storage

capacity minimum for a period of five years for at least 10,000 IEMs. The SAN shall be at least 30 TB usable space with RAID 1-0. From total usable space 90% SAS with at least 10000RPM or better and 10% SSD which works as cache to main memory. Further it is desired that at-least one hard disk shall be available as a spare in SAN box.

8.1.1.3 Clients

CDCS shall be capable of supporting minimum 100 clients for providing collected data. Each client output shall be individually configurable by users.

8.1.2 DCU

The number of meters at site may vary from 2 no. to 35 nos. Bidder shall decide the DCU requirement accordingly with sufficient future expansion capability. The detailed list of meters installed at substations as on date is attached in Annexure – AE.

8.2 Data Handling Performance Requirements

CDCS shall meet the following performance requirements for data collection and data processing.

8.2.1 Performance requirements for CDCS

CDCS shall receive process and archive the complete data from all DCUs within specified time as guaranteed by the vendor excluding the waiting time for data arrival. This performance requirement shall be met under the maximum number of input DCUs and maximum number of SEMs with the maximum number of data points as specified for the delivered as-build or expanded system.

8.2.2 Performance requirements for DCU

DCU shall receive complete data from energy meters and send the same to CDCS within specified time guaranteed by the vendor. This performance requirement shall be met under the maximum number of SEMs as specified for the delivered as-build or expanded system.

8.3 System Availability Requirements

AMR system and its subsystems and system components shall meet the following availability requirements.

The CDCS shall have measured availability of 98% or better during availability test.

The CDCS software shall be considered available when all of the functions described in this specification, except as noted, are operating as specified at their scheduled periodicity and within the execution time parameters and at the same time all hardware is available as specified.

The CDCS shall continue to operate without interruption under any single point of failure

condition. That is, there shall be no hardware or software element whose failure renders the CDCS unavailable. This requirement shall specifically include all hardware, the interconnections among hardware, power supplies, and enclosures of the OP or PT subsystems.

CHAPTER – III: METER DATA PROCESSING (MDP) AND REPORTING

This section describes the envisaged system architecture of Meter Data Processing (MDP) and Reporting in Host Region.

1. Intent of MDP and Reporting

The intent is to provide the requirement details of Oracle/ Standard RDBMS such as ORACLE Enterprise Edition database latest available version with RAC and with HA oriented Meter Data Processing Software having compatibility to exchange and share data / information with similar Database systems that may be used by SLDC, ALDC, other utilities with a view to meet requirements of Data Warehousing and Business Intelligence systems etc. The Client Interface shall be Browser/console based and report formats shall be in user defined multiple formats like PDF, MS Excel, CSV, Text etc. The software is intended to meet the state energy accounting requirements for the commercial mechanism adopted in respect of bulk power supplies and inter-State exchanges within and across a Region. This document describes the details of various functions like meter data - collection, formatting /conversion and facilities of existing software (which is to be replaced with the new proposed ORACLE Enterprise Edition database latest available version with RAC and with HA and proposed solution for meter data processing.

2. Collection, Processing and Computation of Meter Data

2.1 As the end-to-end metering system shall be supplied by the single successful bidder and all meters data shall be available at CDCS through AMR system. Database creation in MDP software shall be done by designing a suitable interface between MDP and CDCS at SLDC.

2.2 While importing data from CDCS to MDP, any discrepancy or missing of data in any particular block or wrong raw data format shall be displayed and downloaded in the form of a report. The output format shall be Station wise, utility wise and Period wise.

2.3 MDP software shall have the options to generate the list of Meter IDs whose data is not available, List of meter IDs whose data is available for day wise for the required period.

The format for Data availability Report (data availability / non availability) shall be jointly decided in co-ordination with SLDC & STU.

2.4 The Computation (Multiplication of raw data with CT/PT Ratios to arrive at actual values) of meter data in MDP shall be done automatically after activating the import option for data fetching from CDCS.

2.5 All meter data computations (Active energy, Reactive energy and Voltage etc.) in MDP shall be in 5-min block wise only.

2.6 MDP shall have the provision to access and correct the IEMs raw data in database, if required. The corrected raw data shall replace the old data.

2.7 IEMs Details (Master file) in MDP:

2.7.1 MDP shall keep database (Meter No., Location ID, Utility Name, Station Name, Description, Meter Type, HV Voltage, LV Voltage, HV Current, LV Current etc.) of all IEMs used in accounting.

2.7.2 One of the inputs required for computation of energy from raw data is a Master file containing details (CT/PT ratio, location, etc.) of all the available IEM's.

2.7.3 Whenever master file shall be modified, the old version of the master file shall be stored in database with date stamping. When computation of raw data for old dates is required, the S/W shall fetch the meter details (Meter ID, HV Voltage, LV Voltage, HV Current, LV Current etc.), for the mentioned period, from the required version of the Master file.

2.7.4 There shall be provision for Updation of existing IEMs database and to add new IEMs to MDP database.

2.7.5 The format for MDP Master File format shall be jointly decided in co-ordination with SLDC & STU.

3. Computation of Injection/Drawal Of Utilities

3.1 Energy data of IEMs shall be used for Computation of Injection/Drawal of utilities, which shall include application of algebraic functions on a set of predefined IEMs. Such injection/drawal of utilities may itself be treated as a fictitious meter data, which can be calculated through application of algebraic functions on real meter data.

3.2 Addition and deletion of new utility shall be user defined. There shall also be provision to update the file with date stamp.

3.3 There shall be two types of database for Fictitious IEMs. One for Fictitious ID details with description and other is for formulae set. All the data formats shall be user configurable.

3.4 The format for Fictitious Meter Description & Formula File Format shall be jointly decided in co-ordination with SLDC & STU.

3.5 Computation formula of a fictitious meter may involve other fictitious meters in its formula. Therefore, the software shall have the capability to compute the same. The

fictitious meters used in the formula have to be computed first before they are used in other formulae.

3.6 Software shall have the capability to replace any meter used in fictitious formulae with its Check/Standby meter with application of transmission loss in case of non-availability/discrepancy of main meter data. The replacement can be for a block/day/week. The percentage of loss to be applied shall be defined by user in configuration file base on the type and voltage rating. **The format for Loss Configuration File shall be jointly decided in co- ordination with SLDC & STU.**

3.7 All changes in fictitious meter in block wise shall be stored in database for future requirements.

3.8 MDP shall be capable of fetching computed IEM data and fictitious meter data of required date and time block through query.

3.9 If, while computing fictitious formula, any meter data is found missing/invalid, the same shall be shown in an error dialogue box with an option to bypass the same or not.

3.10 MDP shall compute Injection/Drawal of Utilities while incorporating all the changes made in fictitious meter configuration files viz. replacement of main meters with check/Standby meters due to non-availability/ discrepancy of main meter data.

3.11 Report of all replacements and adjustments done shall be provided/available and downloadable.

4. Validation of IEM and Fictitious Meter Data

4.1 IEMs and Fictitious meters are classified in 3 categories - Main, Check and Standby meters.

4.2 Prior to energy accounting, validation of IEMs and Fictitious meters data is essential for accurate energy accounting.

4.3 Validation of Main meters (IEMs & Fictitious Meters) data is done by pair checking with Check and Standby meters (IEMs & Fictitious Meters) data block wise (5/15 min).

4.4 For validation of data, S/W shall have a Pairs configuration file where all set of pairs can be defined.

4.5 Pair checks file shall user configurable for addition/deletion/modification of pairs in accordance with the change in network configuration.

4.6 The format for Pair check Configuration File shall be jointly decided in co-ordination with SLDC & STU.

4.7 When Pair Check option is activated, S/W shall compute the difference between the selected pairs and shall generate the output file which shall consists of actual difference and percentage of difference.

4.8 Generally, the polarity of Main and Check meters is same whereas polarity of Main and Standby meters is reverse. Therefore, S/W shall compute accordingly.

4.9 For calculating percentage difference, the reference energy value shall be the sending end energy value for Main-Standby meter (M-S) set. Since polarity for Main and Check meters is same, the Main meter energy data shall be considered as reference for pair check of Main-Check meter (M-C) set

4.10 Sending end can be decided based on the polarity of the meter data (Sending end polarity is +ve, while receiving end polarity is -ve).

4.11 S/W shall generate the pair check output file which contains block wise difference and percentage difference values of all pairs whose % difference is greater than tolerance value.

4.12 Tolerance percentage value shall be user defined and it may vary from element to element. The Tolerance value shall be user given in Pair Check configuration file for each pair.

4.13 The format for Pair check output File to display the exception values (beyond threshold) shall be jointly decided in co-ordination with SLDC & STU.

5. Loss Computation

5.1 Loss Computation module shall have the options to compute Regional Transmission Loss, Line wise transmission loss (132kV, 220KV, 400KV, 765KV, HVDC etc.), ICT wise loss (765/400KV, 400KV/220KV etc.) and Bus loss (132kV, 220KV, 400KV & 765KV etc.) for each time block and for user define period.

5.2 Transmission Loss Computation: The format for Configuration file for Transmission loss computation & loss output file shall be jointly decided in co-ordination with SLDC & STU.

5.3 S/W shall have the feature to generate loss output files for required period (From “Date and Time block” & To “Date and Time block”) through user query.

5.4 Line Wise Transmission Loss Computation: The format for Configuration file for Transmission loss and Line wise transmission loss output file shall be jointly decided in co-ordination with SLDC & STU.

5.5 S/W shall have the feature of browsing the line wise loss configuration files with respect to utility/Station/Voltage level etc. so that the required pair can be easily computed.

5.6 Software shall also have the provision to compute loss for a user specified no. of time blocks for any entity.

5.7 ICT loss computation configuration file and their output file formats shall be same as that of the line wise loss formats.

5.8 Bus loss Computation: The bus loss configuration shall be user defined. **The format for Configuration file for bus loss computation & bus wise transmission loss output file shall be jointly decided in co-ordination with SLDC & STU.**

6. Reports

(Note: New /modification in given reports should support up to warranty period of project)

6.1 S/W shall have the feature to prepare reports (5/15 min) in user-defined Text, PDF, Excel and CSV formats. Different types of Reports to be prepared are as below.

6.2 Active Energy Reports:

6.2.1 S/W shall have the capability to prepare the day wise active energy reports (in 5/15 min blocks data) of Utilities.

6.2.2 These reports shall be prepared for each utility. The formats shall be user configurable.

6.2.3 The Active energy report shall consist of computed data of all elements which shall be used for computation of drawal/injection of utilities and total value.

6.2.4 These configuration files shall be user configurable. There shall be suitable provisions for addition of new columns in the report to incorporate new elements and there shall also be provision for configuration of new reports to incorporate new utility.

6.2.4 The format for Typical Active energy output file format (15 min) shall be jointly decided in co-ordination with SLDC & STU.

6.3 Reactive Energy Reports:

6.3.1 Reactive Energy Settlement at ISTS level is being done day wise for Low Voltage (<97% of Rated Voltage) and High Voltage (>103% of Rated Voltage) conditions.

6.3.2 S/W shall have the capability to prepare the weekly reactive energy reports of Utilities for submission to WRPC.

6.3.3 These reports shall be prepared for each utility. The Reactive energy report shall consist of Cumulative reactive data (LV & HV registers) of all elements which shall be used for computation of drawal/injection of utilities. However, there shall be an option to

provide reactive energy reports similar to active energy report with block-wise details of reactive energy consumption/injection.

6.3.4 The format for typical block wise Reactive energy output file & Day wise Reactive energy output file format shall be jointly decided in co-ordination with SLDC & STU.

6.3.5 The configuration files shall be user configurable. There shall be provision for addition of new columns in the report to incorporate new elements and there shall also be a provision to configure new report to incorporate new utility.

6.4 Voltage Reports:

6.4.1 S/W shall have the option for preparation of Voltage reports (5/15 min block wise) for required meters. The configuration files shall be user configurable.

6.4.2 The format of 5/15 min block wise Voltage reports are same as that of active energy reports.

6.4.3 The S/W shall fetch the details of meter IDs which have recorded the Low Voltage using low voltage logging symbols “*” and “Z”.

6.4.4 The format for Low Voltage Log file & Zero Voltage Log file format shall be jointly decided in co-ordination with SLDC & STU.

6.5 Frequency Report:

6.5.1 Frequency data of reference IEM (user defined) shall be used for DSM Accounting. If main reference meter data is not available, first standby meter (user defined) frequency data shall be used for accounting. If both main and first standby meter frequency data are not available for a particular period, second standby meter (user defined) frequency data shall be used for these periods.

6.5.2 The S/W shall have a user frequency configuration file for selection of any of the reference IEMs.

6.5.3 The format for Frequency Report output file format of reference IEM frequency data to submit to RPC for DSM accounting shall be jointly decided in co-ordination with SLDC & STU.

6.5.4 S/W shall have the module to compare the frequency data recorded by all IEMs with reference IEM frequency data and to generate the report/trend for any required period (Date and Time) through query. The module shall also have the option to define frequency

tolerance value. If difference in the frequency data is greater than the tolerance then report shall show the same.

6.5.5 The format for Frequency Comparison Report shall be jointly decided in co-ordination with SLDC & STU.

7. Issues to be addressed In New MDP to cater to SLDC Requirement

7.1 As the input raw data to new MDP S/W is in 5-min blocks, all computations in new data processing software shall be done in 5-min only.

7.2 While reports generation, Data Processing Software shall provide two options to generate processed data reports in 15/5-min depending upon the user requirement.

7.3 The format of the 15-min processed data reports shall be exactly same as that of the existing 15-min processed data reports in text files for compatibility at SLDC end.

8. Issues to be addressed during Transition Phase

Presently the time period for Scheduling and Settlement at ISTS level is 15-min. Special Energy Meters data is used for computation of injection/drawal of all entities, which are under the jurisdiction of SLDC. Injection/Drawal computed from SEMs data is used as input data for preparation of following regional accounts.

- Deviation Settlement (Weekly)
- Reactive Energy (Weekly)
- Congestion (Weekly)
- Ancillary Services (Weekly)
- Regional Energy Account (Monthly)
- Transmission Deviation Account (Monthly)

Bidders are encouraged to refer the appropriate regulation to understand the settlement system.

Until the amendments for 5-min Settlement in the appropriate regulations come, the settlement at the interstate level shall continue to be done at 15-min interval. Hence, the data of 5-min interval received from the IEMs shall be converted to 15-min interval at CDCS, so that it is compatible with the existing software for energy accounting at SLDC. However till commissioning of CDCS meter data should be of 15 min interval

Shutdown Coordination for meter installation

The successful bidder shall prepare and submit a schedule for replacement/testing of meters to MSETCL and SLDC. If the meter installation requires shutdown of transmission elements, the indent for the same shall be forwarded to SLDC/WRLDC through the respective utilities/MSETCL 45 days in advance for the approval of the WRLDC/SLDC.

MSETCL shall coordinate for gate pass and other administrative approvals from the utility in whose premises the IEM/DCU have to be installed. SLDC shall coordinate the shutdown as per the approved list subject to real time grid conditions. The bidder shall keep suitable margins for grid related uncertainties while formulating the meter installation plan.

9. Other Reports

As on date of delivery, the supplied S/W shall comply with all statutory regulation as required under CERC/MERC/IEGC as applicable and the same should be declared by the vendor during delivery along with warranty certificate.

The module shall provide interface for generating user defined reports using arithmetic, logical and statistical functions.

10. Graphs/Trends

10.1 S/W shall have the option to display the graphs/trends in user defined standard chart type such as line scatter plot, bar chart etc. of different electrical quantities (Energy, Voltage, Frequency etc.) already stored in database for the required period (Date and Time) through query.

10.2 There shall also be a provision to display the Actual vs Schedule graphs of utilities for user defined period. S/W shall have the provision to upload standard CSV 15/5 min schedule data.

10.3 There shall be provision to download the Graphs/Trends in required formats (JPEG, PDF etc.)

10.4 The X and Y axis parameters of the graphs are user definable.

I. GENERAL SOFTWARE REQUIREMENTS

AMR System and MDP software shall meet the following general software requirements.

1. Upgradability and updates

Software which shall be provided as a part of present scope shall receive updates, patches, bugs, fixes to keep software up to date all the time. All software kernel/OS and application programs supplied shall be fully up-gradable through firmware upgrade and/or other software upgrade methods. The firmware/software upgrade may include

1.1 General software updates.

1.2 Adding new features and functionalities, such as supporting new data format and communication protocols.

1.3 Fixing bugs and deficiencies.

The Vendor shall keep SLDC and MSETCL informed of the latest software updates of revisions available after the system is shipped.

Users shall be able to perform the necessary software update in the field.

2. Software Security Requirements at Delivery

The development of the software for AMR and MDP system shall be done in consultation with SLDC. Software at delivery shall meet following requirements in accordance with general software security assurance practices.

2.1 Security Tested and Configured

All software and associated application software modules shall be the most secure version of the software available at the time of start of the Factory Acceptance Test. The delivered software shall to be tested to ensure the followings:

2.1.1 Free of computer viruses, worms, Trojan horses, and other software contaminants

2.1.2 Unused services are disabled / removed; this includes device drivers for devices not included in the hardware.

2.1.3 Unused networking protocols.

2.1.4 Unused administrative utilities, diagnostics, network management, or system management functions.

2.1.5 Administrative utilities, diagnostics, network management, or system management functions or workstations unused by administrators.

2.1.6 Backups of files, databases, and programs, used during system installation/upgrade but not needed in the operational system

2.1.7 Accounts that are not End-User Administrator shall be removed, this include any guest accounts (with and without passwords) or default administrator or maintenance accounts other than the initial system administrator account for Procurement Entity or any guest accounts or default administrator or maintenance accounts for any third party software.

2.2 Maximum Initial Security Settings

The software shall be shipped with all security settings at their maximum setting. All software shall be delivered with all the latest relevant patches installed.

All security-related parameters and options shall be placed at their most restrictive settings at the delivery, i.e. affording the access and execution privileges to the smallest class of users consistent with meeting the functional specifications, and restricting their rights to the narrowest range of privileges.

2.3 No Automatic Downloading and Execution of Executable Code

It shall not be possible to download any executable code into the CDCS or DCU and execute the downloaded software code automatically without system administrator's (SLDC) approval. All software shall be removed that would otherwise make it possible to execute a scripting language (such as Active X, Java, Java scripts, etc.), including software in the browser and e-mail processor, where applicable.

2.4 File Access Control

The CDCS and DCU software shall support controlled access privileges for files, including at least access, read, write, execute and combinations of these. The access privileges for each user can only be assigned by system administrator of CDCS or DCU as the case may be, and shall be assigned on an individual user account basis.

The default access privileges for each new user account shall be no access to any file on the system at all.

No user, including system administrator, shall be given the privilege of modifying operating system files and other files that are never supposed to change while the system is running.

2.5 Free of “Electronic Self-Help” Enabled Software

It shall be strictly prohibited for delivered software to contain embedded faults or back-door mechanisms that allow the software manufacturer to remotely disable some or all of the functions of the software, or affect their performance, or in any way degrade its operation (so-called “electronic self-help” in the terms of the Uniform Computer Information Transactions Act). The software shall not contain any mechanism that automatically disables some of all of its functions or degrades their operation on a certain date or upon the occurrence of a specific event.

3. Application Software Modification

Modifications in application software to comply with the prevailing CERC/MERC regulations for energy accounting and/or to implement the decisions at the WRPC level shall be in the scope of the vendor. These modifications shall be considered as a part of Scope. The modification shall be done in consultation with SLDC.

4. Source Code

After completion of the project, Table Structures, data structure and functional modules (with proper detail documentation) with ER diagram/Table description diagram shall be handed over to MSETCL and SLDC. Interface for any required changes in the configuration for ex. Addition/deletion of interface points, data extraction in the required format etc.

As per MSETCL requirement all the credential (user name & password) of any software (Standard/customized)/hardware/OS/database developed should be share with MSETCL through proper channel.

5. Essential characteristic of system

Target system provides following essential properties

- 1) **Accessibility:** The system should able to provide all access to all data in open format which is generated by all entities which is required for decision making irrespective of the support of vendor who has supplied the component.
- 2) **Durability:** The system should provide full data guarantee irrespective of any type of hardware, network or any such failure. The system should sustain for all types of failure and provide plan to overcome from such failures. The system should also ensure that there should not be any data loss due to operating conditions.
- 3) **Security:** The system should ensure be full proof for any security hacks.

- 4) **Scalability:** The system should be scalable system at each level so that scalability should be achieved by adding component not by replacing them.
- 5) **Functional Completeness:** The target system should be fully functionally complete and provide data & processing for all external systems like accounts and finance.
- 6) **Performance:** The system should have real time response and such measures should be provided for each level
- 7) **External interfaces:** The system should be able to interact with external system like MIS and GIS system to accomplish total system optimization. It should also accommodate the external system and should provide uniform data views.
- 8) **Standard:** The component which will be used to provide build the system should indicate and maintain standards.
- 9) **Maintainability:** The system can be fully maintained by the MAHATRANSCO in future. The vendor should provide the source code, full configurable software, data dictionary, data flows, documentation to incorporate new changes as well as operations, adequate training at each level.

II. GENERAL HARDWARE REQUIREMENTS

AMR System and MDP shall meet the following hardware requirements.

1. Operating Environment

AMR system and MDP hardware shall be supplied that shall be suitable to operate in environment indicated in the service conditions without any significant effect on its performance.

2. Security Requirements

AMR System and MDP hardware and packaging design shall meet physical security requirements like measures to prevent unauthorized access to certain system hardware components.

3. Network Monitoring Tool

MIS Reports: Bidder shall submit the following reports on a weekly basis in a mutually decided format.

1. Summary of issues/complaints logged with the OEMs.
2. Summary of changes undertaken in the Data Centre including major changes like configuration changes, patch upgrades etc.
3. Summary of any configuration changes or any service/hardware installed in primary Data centre.

4. Summary of system's rebooted.
5. Detail report of issues/complaints which are un-resolved with appropriate reason.
6. All relevant reports required for calculation of SLAs.
7. Consolidated report for resource wise availability and resource utilization.
8. Report showing resource wise exceed of pre-defined threshold parameter.

4. Cyber Security Requirements

TECHNICAL SPECIFICATION FOR FIREWALL

Firewall should meet requirement of BIS 16335 latest version. Firewall should also include Intrusion Detection and Prevention system to detect and prevent intrusion, worm, virus etc. Definition updates for virus, signatures, software patches etc. which should be done up to completion of Maintenance period. The firewall must separate internet from DMZ. The application and data base server must be in DMZ. The fire wall should operate in HA mode with at least 3 years of license subscription.

The following strategies shall be followed for secure configuration of firewalls.

- Clean-up rule.
- Place a 'Deny Any-Any' rule at the end of the rule base.
- Never create an 'Allow any-any' rule.
- Allow rules should be created only for required services.
- This will result in all traffic being disallowed, unless specifically allowed.
- Lockdown/stealth rule
- All traffic destined for the firewall itself should be disallowed.
- Anti-spoofing rule.
- Place anti-spoofing rule as per RFC 1918 and 2827.
- Enable DoS/ DDoS features on Firewall
- Enable application level filtering of firewall

Firewall should also provide Intrusion detection & Prevention system; IDS shall be able

to perform following actions:

- Capability for Detecting the intrusion attempt that may take place, intrusion in progress and the intrusion that has taken place.
- Flag and check unauthorized access
- Notify/Alarm/message of intrusion to:

- Management console
- Event log
- Administrator by e-mail

Create an audit trail for user and file access activity, including file accesses, changes to file permissions, attempts to install new executables and/or attempts to access privileged services

- In an event where user accounts are added, deleted, or modified, changes to key system files and executable is done in by unauthorized account or there is an unauthorized attempt to overwrite vital system files, to install Trojan horses or back doors suitable action should be taken such as:
 - Terminate User (intruder) Login
 - Disable User (intruder) Account
 - Forge a TCP FIN packet to force intruder connection to terminate
- Should provide events check for suspicious file transfers, denied login attempts, physical messages (like an Ethernet interface set to promiscuous mode) and system reboots.

CHAPTER – V: DOCUMENTATION REQUIREMENTS

Documentation of AMR system and MDP shall meet following requirements. All documents shall be supplied in hard copies as well as computer readable soft version:-

1. Design Documents

Before starting the manufacturing of the AMR system components, a design document shall be submitted. The design document must essentially (but not limited to) included:-

- System Overview
- Functional diagram
- Flow diagram
- Functions of each major component
- Physical details of each major component
- Overall networking scheme
- System configurations
- Cyber Security Provisions

Similarly the design document for MDP shall also include (not limited to) the above sections.

2. Software Requirement Specifications Document

After approval of Design document software requirements specifications (SRS) document for the application software for CDCS and DCU should be prepared and submitted for approval. This SRS should be prepared as per IEEE standard 830 of latest version for recommended practice for software requirements specifications. Software should be designed as per approved SRS.

3. User Manuals

Following user manuals shall be prepared and supplied for the system:-

3.1 User Manual for SLDC

User manual for central site (SLDC) i.e. location where CDCS shall be installed and where all data collection activities shall be taken up, should contains all user instructions, block diagrams, user screens etc. in order to make itself contain complete document required for operation of complete AMR and MDP system including each and every component of the metering system.

3.2 User Manual for Sub-station

Separate user manual shall be provided which shall be used by the users located at DCUs site. This user manual shall contain details of IEMs, external connections to DCU, communication system, block diagram of system at DCU site, instructions of using DCU system, trouble shooting of DCU system etc. This user manual should be self-contained and shall not require any external reference document in order to use and trouble shoot DCU system.

3.3 Training Documents

Training document to be used during training of site personals shall contain major functional details of the overall metering system, its features and major instructions for understanding the overall working of the system.

3.4 Testing Documents

Testing documents shall be prepared and submitted as per Testing Requirements section of this specification.

CHAPTER – VI: ACCEPTANCE TEST PLAN & PROCEDURE (SAT / FAT)

All equipment, materials and software for AMR and MDP System shall be subject to both Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT). The purpose of Acceptance Testing is to determine compliance to this specification in every respect in regard to the delivered and installed system.

1. Acceptance Test Plans and Procedures

The Vendor shall develop and document proposed Test Procedures and Test Plans for Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT) of the delivered and commissioned system and its components. Vendor shall finalize the proposed FAT and SAT acceptance test plans and procedures. The final Test Procedures and Test Plans shall be subject to review and approval prior to testing.

The Acceptance Test Plans (ATP) shall enable MSETCL to verify the ability of the delivered and commissioned system and its components to individually and simultaneously fulfill all functional and performance requirements of the system set forth in the contract through a series of mutually agreed to structured tests.

All system documentations shall be completed, reviewed and approved by MSETCL in consultation with SLDC before any testing.

The ATP shall include, but not be limited to, functional tests that demonstrate compliance of the functional, performance, software, hardware, communication, interface, and operational aspects of the delivered and installed system.

2. Factory Acceptance Test (FAT)

The Vendor shall perform a preliminary FAT (Pre-FAT) prior to the FAT. The pre-FAT shall be a complete dry run of the FAT, following the test plans and procedures. The intent is for the Vendor to detect and correct most design, integration, and database, display, and performance problems prior to the FAT. The representatives of MSETCL shall have the right to witness all or parts of pre-FAT for which vendor shall intimate MSETCL in sufficient advance.

Test results (including documentations and certifications) for tests conducted by Vendor or third parties that are not included in the FAT test plan and procedures shall be furnished to MSETCL prior to FAT for review and evaluation. Vendor and/or third parties conducted tests deemed inadequate shall be repeated until accepted by MSETCL.

Vendor's project manager shall sign off each test of Pre-FAT. The completed test results shall be sent to MSETCL for review before their representative's travel to the Vendor facilities for the FAT. All tests shall be conducted using the contract-specified databases unless MSETCL authorizes the Vendor to use a test database.

The FAT shall be conducted according to the FAT Test Plan and Test Procedure documents approved by MSETCL in consultation with SLDC shall cover, as a minimum:

- **Visual Inspection** – To verify that the system to be delivered has all required components and is properly configured. Visual inspection shall verify acceptable workmanship and that all equipment, including cables and connectors, are appropriately labeled
- **Hardware Diagnostic Test** – Individual tests of all system hardware. These tests shall consist of running standard hardware diagnostic programs, plus all special diagnostic programs used by the Vendor.
- **Communications and Interfacing Test** – Verify that all interconnected system components, such as data acquisition, control, monitoring, and data management functions are operating properly when correctly connected.
- **Software Development Tools** – Verify that all required software development tools, utilities, software diagnostics, and debugging tools for the system, including the UI and database, are included in the system and are functioning correctly.
- **Functionality verification** – Verify that all system functions are working normally as set forth in the contract.
- **Performance Testing** – Verify that the system throughput, timing and response time requirements are satisfied. Tests shall include verification of:
 - ✓ Data exchange times
 - ✓ Local and remote request response times
 - ✓ Communication latency
 - ✓ User Interface function response time
- **Security Testing** – Verify that the system meet the software at delivery security requirements and other aspects of secure operation and system access including:
 - ✓ Communication error detection capabilities
 - ✓ Correct operation of system configuration, control, maintenance, and management procedures

- ✓ Safe system recovery with no erroneous data or control operation generation after system restarts.
- ✓ Protection against unauthorized access to the system and control functions
- **Environmental Testing** – Verify that
 - ✓ All system functions shall operate correctly over the specified temperature range.
 - ✓ The accuracy of the inputs and outputs remain valid over the specified temperature range.

The test schedule shall allow sufficient time for verification and/or additional unstructured testing by the SLDC/MSETCL's representative, who shall be able to schedule unstructured testing at any time, including during structured tests.

3. Site Acceptance Test (SAT)

The SAT will be conducted by the OWNER with support as required from the vendor after the system has been installed and commissioned. The system will be subjected to a subset of the functional and performance tests. The SAT will also include any type of testing that could not be performed in the factory. Unstructured tests will be employed by the MSETCL and SLDC's representative, as necessary, to verify overall system operation under field conditions. Any defects or design errors discovered during the SAT shall be corrected by the Vendor. The SAT includes the commissioning test, the functional and performance test, and the cyber security audit after the installation of the delivered system.

3.1 Commissioning Test

The commissioning tests shall be conducted by the vendor and include:

- The same visual inspection and verification as in FAT
- Loading of the software and starting the system. At the option of the MSETCL, all software shall be recompiled from the source or distribution media.
- Interface of the AMR and MDP System to communications facilities for all data sources and other systems that interface with the AMR System.
- Initialization and preliminary tuning of application software as needed.

3.2 Site Functional and Performance Test

The site functional and performance test ("site test") shall be comprised of a subset of the functional and performance tests conducted in FAT. The tests to be performed shall be proposed by the Contractor and approved by MSETCL in consultation with SLDC. These

tests shall be extended as necessary to test functions simulated during the FAT, such as communications with all field devices and all other systems that interface with the CDCS.

3.3 Site Cyber Security Audit

The site cyber security audit shall repeat the audit performed during factory testing.

3.4 Test Approval

The Vendor shall maintain a complete computer record of all test results with variance reporting and processing procedures for approval by MSETCL and SLDC. In the event that the AMR/MDP system does not successfully pass any portion of the Acceptance Testing, the Vendor shall notify the MSETCL and SLDC of the specific deficiency. The Vendor shall promptly correct the specified deficiency, which will then be re-tested until successful.

CHAPTER – VII: TRAINING

Comprehensive training programs shall be provided to enable the efficient and effective use and operation of the deployed system by users of the system, and to develop a self-sufficient hardware and software support team within MSETCL, SLDC, STUs and the registered users of MSETCL/SLDC.

Training shall include, where appropriate, a combination of formal training classes, workshops, as well as continuous (informal) knowledge transfer from the Vendor's technical specialists to the personnel of SLDC and its constituents during the deployment process and after the commissioning of the AMR and MDP system. In-person training sessions could be offered at Vendor's location or at the MSETCL/SLDC own facilities or any other locations of choice by both parties.

1. Training for personnel at Generating/Transmission/Utility substation where IEM is installed

Hands on training program for personnel at Generating Stations/Transmission/Utility substation shall cover the following:

- Features of IEM, DCU, Communication Interface
- IS/IEC protocols
- Extension of Auxiliary Supply, CT/PT connection
- Time synchronization through station GPS, Time correction through software
- Data downloading from IEM
- Data uploading through web interface
- Installation of software in local PC/Laptop
- System Diagnostics

Minimum duration of training session shall be 1 day.

Soft and hard copy of the training manual shall contain Step by Step procedure (on screen shot type and desktop video capture) for

- Installation/Re-installation of software in to Laptop / PC
- Meter maintenance/site-testing procedure as per relevant IS/IEC standard.
- Procedure for data downloading from Meter by Laptop/Desktop PC

2. Training programs for system users

Training program for system users shall include but not restricted to the following:

- System overview including system functionalities and features

- System configuration and operations oriented training
- System alarms handling
- Local/Remote configuration procedures
- Engineering oriented training for development/testing
- Minimum classroom training for a group of system users shall be 18 hours (6 hours x 3 days). Minimum hands-on training for a team of system users shall be 48 hours (6 hours x 8 days). The group shall comprise of representatives from SLDCs, ALDCs, MSETCL and Registered Users of SLDC etc.

3. Training program for system hardware and software support team

Training program for hardware and software support team shall include but not restricted to the following:

- System overview including system design and detailed as-built system configuration information
- System software maintenance
- System hardware maintenance
- Engineering oriented training for development/testing
- System diagnostics and troubleshooting oriented training for engineers and technicians
- Minimum training for hardware and software support team shall be 18 hours (6 hours x 3 days). The software support team shall comprise of representatives from SLDC/MSETCL IT TEAM.

The bidder shall prepare and provide a description of the proposed training programs with course content, and technical level of the instruction for review and approval by the MSETCL and SLDC at the beginning of the deployment, and shall work with the SLDC to schedule, organize and execute the approved training programs.

Two hard copies and one soft copy of operating manual of the meter and DCU/AMR/MDP containing all details shall be made available to MSETCL and SLDC each.

SUPPORT AND MAINTENANCE REQUIREMENTS

Vendor shall provide on site as well as remote support in order to keep system operational with system functionalities and performance in accordance with the specifications.

1. Scope of Warranty

During warranty period, vendor would be responsible for repair/ replacement/ modification/ rectification of software, hardware either manufactured or bought out. Warranty covers all IEM,DCU,switches, servers, software and all other equipment of AMR and MDP. It will be bidders responsibility to Update the softwares used in AMR and MDP scheme including data availability and MDP reports throughout the warranty period without any extra charges to MSETCL/SLDC.

Addition/Deletion of IEMs in the MDAS database and application software shall be the responsibility of the Bidder without any extra cost to MSETCL during the warranty period.

The bidder should provide ATS (Annual Technical Support) for ORACLE & other application softwares during the warranty period (7 years).

2. On-Site Support and Maintenance

Vendor shall maintain a team of skilled personals having sufficient knowledge of the system in order to diagnose and set right any problem in AMR and MDP system in minimum time. Since, the locations of DCUs under this AMR system is geographically spread across entire Maharashtra, the vendor shall locate its supporting personals so as any problem may be rectified within 48 hours of reporting.

Vendor shall maintain an online web based help desk system on its own website for logging complaints and checking the resolution status round the clock on all days of the year. Web based help desk shall be accessible to the user through browser via Internet. Separate username and password shall be provided with separate privileges for users of central site as well as DCUs site. DCUs site user shall be able view logs of complaints and status logged by that user only. However, SLDC/MSETCL shall be able to view logged complaints and their status irrespective the initiator of compliant. Any complaint shall remain open until and unless approved its closure by SLDC/MSETCL. All logs shall be suitably time stamped. The severity level of the complaint shall be assigned by SLDC/MSETCL.

Vendor shall post one Full Time Equivalent (FTE) resident engineer to central site (SLDC) throughout the warranty period in order to diagnose and set right any problem in AMR/MDP/reporting system in minimum time. He/she shall coordinate with the substation

personnel and the back end team of the vendor for complaint resolution. Resident engineer shall be provided with mobile phone for communication for escalation of complaint.

Vendor shall maintain this mobile phone live and shall maintain same number throughout the contract period.

3. Remote Support and Maintenance

No remote login shall be permitted.

4. Updation and Patches

Vendor shall keep updated all supplied software kernel/OS and application software with all latest patches and upgrade. There shall be no separate liability for License renewable on the system user.

5. Maintenance and Support Of Brought Out Items

Vendor shall take back-to-back support from manufactures of bought out items like servers, printers and like items. However, vendor shall be responsible for all coordination work from OEM for all types of support and maintenance.

6. Charges for support services

All recurring expenditure for support services shall be borne by the vendor.

7. Problem/Defect Escalation Order

The successful bidder shall submit their organization's escalation order for this project in the following format:

Details of Vendor Executive	Description	Escalation Order
Name Designation Email ID Mobile number	Overall accountability	4 th level
Name Designation Email ID Mobile number	SLDC Department head to interact if there is any change in business requirement or some change request need to be implemented within the existing contract or any other issue that need to have a mutual consent to move forward and if the problem/defect in the existing software is not resolved	3 rd level

	within the specified resolution time.	
Name Designation Email ID Mobile number	SLDC Team Lead to report if any concerns and some items within the scope need to be fixed in priority	2 nd level
Name Designation Email ID Mobile number	Interactions with SLDC Team, to provide support, resolve the defects and work together for seamless operation.	1 st level
TABLE-1: ESCALATION MATRIX		

8. System Availability

The nature of maintenance support required for systems and components are described in the Table – II below:

Sr. No.	System	Scope	System Availability
1	AMR system (Data collection and storage in database)	Hardware and software	98 %
2	MDAS & Meter Data Processing	Hardware and software	98%
TABLE-2: SYSTEM AVAILABILITY REQUIREMENT			

Bidder shall be responsible for coordination with the OEM for all matter related to that equipment. The bidder shall also be responsible for meeting the overall response times and availability requirements as specified in the specification.

The maintenance of the System shall be comprehensive and shall comprise of the following category of works which is further elaborated for each of the different subsystems:

- **Preventive Maintenance Activity** (performance monitoring, system backup, patch management, updates, emergency response and troubleshooting)
- Maintaining a minimum no. of specified spares.
- Integration of new module etc.

9.1 Preventive Maintenance Activity

The preventive maintenance activity to be performed by the Vendor to keep the system running at optimum level by diagnosis and rectification of all hardware and software failures would broadly include:

- **Repair / replacement of defective equipment** -The bidder shall be responsible for repair/replacement of all the hardware including consumables required for the various systems **within 48 hrs**
- Monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components.
- Providing all necessary assistance to Owner for addition and modification of database, Database sizing activities including Backup and restore of the system.
- Restoration of the systems upon its failure and to restore the functioning of the various systems.

9.2 Hours of Cover

The vendor shall provide engineers who have an experience and skill to maintain the AMR/MDP system to the desired level of availability. The vendor's on-site support for Control centre shall be standard hours of service i.e. Monday to Friday- 9:00 am to 5:30 pm local time (IST) throughout a year.

One expert Engineer on FTE basis having expertise in metering system shall be available during the standard hours of service at SLDC. The timings for Emergency Support shall be 24 hours a day, 7 days a week throughout the year.

Vendor and its personal have to follow all rules and regulations of owner's office premises in view of owner's certifications of ISO-9001, ISO-14001, OHSAS-18001 and ISO-27001 including any other future certification.

9.3 Problem/Defect Reporting

The bidder shall submit an appropriate problem/defect reporting procedure to meet the requirement of all severity level cases to get the approval of the same from MSETCL/SLDC.

The problems will be categorized as follows:

Severity 4 – Emergency	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability. For e.g. system crash/both servers are not working.
Severity 3 – Serious	Degradation of services or critical functions such as to negatively impact system operation. Failure of any redundant system component such that the normal redundancy is lost. For e.g. meter data of a whole station is not available/both main & standby meter data not available/Main server not working, system shifted on standby server.
Severity 2 – Minor	Any other system defect, failure, or unexpected operation. For e.g. Main meter data is not available, however standby/check meter data is available.
Severity 1 – General	Request for information, technical configuration assistance, “how to” guidance, and enhancement requests.
TABLE-3: SEVERITY LEVELS	

9.4 Response and Resolution Time

This section describes the target times within which the bidder shall respond to support requests for each category of severity. The Initial Response Time is defined as the period from the initial receipt of the support request (email/telephone/fax or any other communication channels) and the acknowledgment of the vendor subject to the Maximum time defined in Table -4. The Action Resolution Time shall be computed after the expiry of the ideal initial response time subject to the Maximum time defined in Table -4.

This period includes investigation time and consideration of alternative courses of action to remedy the situation. The Action is defined as a direct solution or a workaround.

Except for Severity Level 4 all response and resolution times (hours and days) specified below are working hours only:

Severity	Ideal Initial Response Time	Action Resolution Time (to be commenced after end of ideal initial response time)	Action
4	1 hrs.	6hrs.	An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored – may be by workaround.
3	3hrs.	12hrs.	Attempt to find a solution acceptable to Owner (dependent on reproducibility) as quickly as practical.
2	8hrs.	2days	Evaluation and action plan. Resolution time is dependent on reproducibility, ability to gather data, and Owner's prioritization. Resolution may be by workaround.
1	1days	4days	Report on the problem/query is to be furnished.
TABLE-4: EMERGENCY SUPPORT RESPONSE/RESOLUTION TIME			

The bidder shall submit the detailed format and procedure for all the activities such as Reporting time, Resolution time, Downtime etc. along with the bid proposal.

9.5 Availability Calculation

It is the endeavor of both the bidder and owner to maximize system availability to the extent possible. The bidder shall provide guaranteed availability for various types of Systems as specified in Table - 2. The non-availability hours for availability calculation shall be counted from the end of the allowed Action Resolution time. The web based help desk software application shall have features for complaint reporting, severity level assignment, initial response time stamping, remarks of the resident engineer regarding actions taken, complaint resolution time stamp and statistics for computing duration of system outage under different severity level categories. There shall be separate login for SLDC and MSETCL for certification of the complaint resolution time. The complaint resolution time stamp shall be generated only after endorsement/acknowledgement by SLDC engineer in-charge.

Duration of outages over and above the Action Resolution time, as defined in Table - 4 in each of the Severity levels shall be counted for the non- availability computation and shall

be clearly brought out in the web based help desk. The resolution may be accomplished by a work around, and such solution shall mark the end of non-availability.

In the event of frequent failures at a site, due to a common cause, the first FPR (Field Problem Report) logged shall be used for the purpose of availability calculation. However, simultaneous multiple outages due to unrelated cause would be counted separately.

9.6 Availability computation for AMR/MDP System

Availability shall be computed on weekly basis. The formula to be used for availability computation would be as under:

$$\text{Availability for per week} = \frac{\{\text{THQ} - (\text{S4} + \text{S3} + \text{S2} + \text{S1})\} \times 100\%}{\text{THQ}}$$

Where THQ is Total hours in week

S1 is the total nonavailability hours in severity level-I in the week

S2 is the total nonavailability hours in severity level-II in the week

S3 is the total nonavailability hours in severity level-III in the week

S4 is the total nonavailability hours in severity level-IV in the week

The target availability would be 98% or better. The monthly availability will be calculated as average of weekly availability of the month. For availability calculations nonavailability of data due to equipment (Hardware and software) failure will be considered. Nonavailability of data to SLDC due to communication issues will not be considered for availability calculations

9.7 Reliability Indices

The following reliability indices shall also be automatically generated on weekly basis from CDCS and archived for download on demand.

9.8.1 System Average Interruption Duration Index

The System Average Interruption Duration Index (SAIDI) shall measure the average duration for which the meter data was unavailable during a week. An Interruption shall be defined as the non-availability of meter data at SLDC end at the scheduled hour (for e.g. at 09:00 hrs everyday)

To calculate SAIDI, each interruption during a week shall be multiplied by the duration of the interruption to find the interruption time during which meter data was not available at SLDC. The time duration of all such interruptions would then be summed up to determine the total unavailability minutes. To find the SAIDI value, the total

unavailability minutes would be divided by the total no. of meters. The **formula is**

$$\text{SAIDI} = \frac{\sum(\text{ri} * \text{Ni})}{\text{NT}}$$

Where,

SAIDI = System Average Interruption Duration Index in minutes.

Σ = Summation function.

ri = Restoration time, in minutes.

Ni = Total number of meters interrupted.(due to failure/faulty)

NT = Total number of meters in the system.

For example the SAIDI for a sample week having three cases of interruptions is computed in the table below. It is assumed that the interruption and restoration in each case occurred simultaneously. It is further assumed that the system has a total of 1,500 meters.

Date of Interruption	No. of meters whose data was unavailable at SLDC after 48hrs of reporting of failures	Interruption Duration (minutes)	Unavailability (minutes)
Date-1	50	120	6000
Date-2	25	240	6000
Date-3	100	30	3000
Total			15000
TABLE-6: CALCULATION OF UN AVAILABILITY MINUTES			

The SAIDI for the above case would be

$$\text{SAIDI} = \frac{15000}{1500} = 10 \text{ min}$$

This implies that on an average, each meter was out for 10 minutes in the above week.

9.8.2 Average Service Availability Index (ASAI)

The Average Service Availability Index (ASAI) would be the ratio of the total number of minutes that meter data was available during a week to the total minutes in the week ($7 \times 24 \times 60 = 10080$). This is sometimes called the service reliability index. The ASAI shall be computed as

$$\text{ASAI} = \left[1 - \frac{\sum (r_i * N_i)}{(NT * T)} \right] \times 100$$

Where,

ASAI = Average System Availability Index, percent.

Σ = Summation function.

T = Time period under study, minutes.

ri = Restoration time, minutes.

Ni = Total number of meter data interrupted.

NT = Total number of meters installed in the system.

The ASAI value for the sample week based on the interruption data reported in Table-2 would be as under

The meter data unavailability minutes = 15000.

Study period = $7 \times 24 \times 60 = 10080$

$$\begin{aligned} \text{ASAI} &= \left[1 - \frac{15000}{(1500 * 10080)} \right] \times 100 \\ &= 99.90\% \end{aligned}$$

10) WARRANTY

Part-A (Meter)

10.1 The IEM shall be under warranty for **7 Years** from the date of handing over of project. The bidder shall be responsible for meter testing as per CEA metering regulations. Support and maintenance during 7 years of warranty period is bidders responsibility.

10.2 The warranty would include repair, replacement, part material replacement cost and both way (return) transportation cost (including insurance of transit).

10.3 Meter software, if upgraded by OEM should be supplied free of cost with initiation taken from party. Remote service person name to be indicated during bidding.

10.4 Meters which are found defective/inoperative at the time of installation or become inoperative/defective within the warranty period, these defective/inoperative meters shall be replaced within 48 hrs. of receipt of report for such defective/inoperative meters.

10.5 Copy of warranty certificate shall be submitted to owner as per applicable standard.

10.6 Bidder has to test the IEM in NABL accredited LAB and submit test report to MSETCL engineer before installation of IEM. Type test will be only for random sample (1 nos. For each lot) & all the meters will be required to be tested at NABL accredited lab for routine test.

Part-B (AMR/MDP)

10.7 The AMR system and MDP software shall be under warranty for a period of **7 years** from the date of handing over of project. A bidder has to give support for Ten (10) years.

10.8 The warranty shall include repair, replacement, part material replacement and both way (return) transportation cost (including transit insurance) of the hardware items in the AMR system and MDP software.

10.9 The software developed shall be kept under warranty for a period of 7 years from date of handing over of project to MSETCL. Necessary support towards un-interrupted operation of the software along with support for integration with third party software shall be ensured during warranty period and also for future three years. For the warranty period, bidder shall provide on-site, web and telephonic support for application support, as & when required, on all days of the week. In case site visit is necessary for the software system restoration/ updating, all such required visits shall be free and without any additional financial implication.

10.10 During the warranty period, the bidder shall implement the modifications in the software to implement amendment in CERC/MERC Regulations regarding metering and energy accounting.

11. PENALTY DURING WARRANTY

Bidder has to replace the faulty equipment's (Hardware & software) in project within 48 hours from the date of information to bidder by mail or on phone or a mechanism developed by bidder. If bidder fails to replace/rectify the equipment's (Hardware & software) within 5 (Five) days then penalty will be levied as per table given below. The period of 5 days will be calculated from 00.00 hrs of next days of intimation to bidder. The penalty will be limited to the cost of equipment ordered in PO.

Sr. No	Name of Equipment	Penalty in Rs. per day per equipment
1	Interface Energy Meter	500
2	Data Concentrator	500
3	LIU	100
4	Control Cable	100
5	Communication Cable	100
6	Network Switch at substation	100
7	Network switch at control center	100
8	Server	500
9	Software	1000
10	GPS	500
11	Personal computer	100
12	KVM switch	100
13	Any other equipment not covered in above but affects data	100

12. Procedure for calculation of penalty and recovery thereof

The bidder has to submit quarterly report of nonavailability of data at CDCS due to faulty/failed/nonfunctional equipment (software and hardware). The report should be equipment-wise/location-wise and with duration in days for which data was not available. Based on quarterly equipment failure report, the penalty calculation should be done as per table given at Sr. No 9 above. Bidder should submit the quarterly equipment failure report to Superintending Engineer (EA) SLDC. This report will be confirmed by the Superintending Engineer (EA) SLDC from the system. The necessary correction if any will be done by bidder and resubmit it to Superintending Engineer (EA) SLDC. The bidder

and Superintending Engineer (EA)SLDC or his representative will jointly sign the report along with penalty levied to the bidder.

Office of the Chief Engineer (SLDC) will maintain record of quarterly penalties levied till end of warranty period of seven years. At the time of refund of Performance Bank Guarantee ,the penalty amount (Accumulated in Seven years) will be deducted from the Performance Bank Guarantee and balance will be returned to the bidder.

13. SPARES/FUTURE REQUIREMENT

Bidder shall maintain sufficient number of IEMs as spares/future requirement at each substation/Utility sub-station/ Generating station.

14. REFERENCE STANDARDS TO BE COMPILED WITH

Sr. No.	Reference Details	Reference Title
1	IS-15959:2011	Data Exchange for Electricity Meter Reading Tariff & Load Control – Companion Specification
2	IS-14697:1999	Specifications for AC Static Transformer operated Watt Hour & VAR-Hour meters, class of 0.2S and 0.5S
3	IEEE 830-1998	IEEE Recommended Practice for Software Requirements Specifications

TABLE-7: IS / IEEE STANDARD

15. REFERENCES

- 1 CEA (Installation & Operation of Meters) Regulations 2006 available at <http://www.cea.nic.in/meteringreg.html>
- 2 Functional Requirement of AMI – CEA report available at http://www.cea.nic.in/reports/others/god/dpd/ami_func_req.pdf
- 3 CERC Regulations on IEGC, DSM, Congestion Alleviation, Ancillary Services, Sharing of Transmission Charges as available at http://www.cercind.gov.in/updated_consolidated_reg1.html
- 4 Report on Scheduling, Accounting, Metering and Settlement of Transactions in Electricity “SAMAST”, <http://www.forumofregulators.gov.in/Data/WhatsNew/SAMAST.pdf>

TATA POWER CO. LTD.

TECHNICAL SPECIFICATION FOR THREE PHASE, FOUR WIRE Class 0.2 ABT Meters (Lag+Lead)

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Document No.	MMG-ABT	Approved By	N Manjunath
Issue No.	01	Issue Date	10.01.2020

13.1 Interface Meters: Functional requirements

- (a) The Interface meters suitable for ABT shall be static type, composite meters, as self contained devices for measurement of active and reactive energy, and certain other parameters as described in the following paragraphs. The meters shall be suitable for operating with auxiliary supply AC 60 to 110 volts 1 phase 50 Hz AND DC 220 Volts or DC 110 Volts. The meters shall be suitable for being connected directly to voltage transformers (VTs) having a rated secondary line-to-line voltage of 110 V, and to current transformers (CTs) having a rated secondary current of 1 Amp or 5 Amp (3 phase 4 wire). The reference frequency shall be 50 Hz. The meter should be **DLMS compliant**. Meter shall be programed as **Lag + Lead** configuration i.e. Leading PF shall not be considered as unity.
- (b) The meters shall have a non-volatile memory in which the following shall be automatically stored:
- (i) Average frequency for each successive 15-minute block.
 - (ii) KWh import consumption in each 15 minute block
 - (iii) KWh export consumption in each 15 minute block
 - (iv) KVARh lag consumption in each 15 minute block
 - (v) KVARh lead consumption in each 15 minute block
 - (vi) KVAH import (Lag+Lead) consumption in each 15 minute block
 - (vii) KVAH Export (Lag+Lead) consumption in each 15 minute block
 - (viii) Power factor in each 15 minute block
 - (i) Net KWh transmittal during each successive 15-minute block, upto second decimal, with plus/minus sign
 - (ii) Cumulative KWh transmittal at each midnight, in six digits including one decimal.
 - (iii) Cumulative VARh transmittal for voltage high condition, at each midnight, in six digits including one decimal.
 - (iv) Cumulative VARh transmittal for voltage low condition, at each midnight, in six digits including one decimal.
 - (v) Date and time blocks of failure of VT supply on any phase, as a star (*) mark.
- (c) The meters shall store all the above listed data in their memories for a period of at least sixty days. The data older than 60 days shall get erased automatically on First-in-First –out (FIFO) basis. Each meter shall have an optical port on its front for tapping all data stored in its memory using a hand held data collection device (i.e. CMRI). The meters shall have at-least one RS-485 / Ethernet LAN port suitable for transmitting the data to remote location using appropriate communication medium. The communication protocol shall be open protocol and shall not be proprietary nature.
- (d) It shall be possible to reprogram at site only those parameters, which do not affect the integrity of the data or basic settings of the meters. Reprogramming of critical parameters such as CT Ratio, PT Ratio, ToD registers etc, at site, shall be possible.
- (e) The active energy (Wh) measurement shall be carried out on 3-phase, 4-wire principle, with accuracy as per class 0.2 S of IEC-687/IEC-62053-22.
- (f) The Var and reactive energy measurement shall also be on 3-phase, 4-wire principle, with accuracy as per class 0.5 of IEC-62053-23 or better. There shall be two reactive energy registers, one for the period when average RMS voltage is above 103% and the other for the period the voltage is below 97%.
- (g) The 15-minute Wh shall have a +ve sign when consumer is drawing power from grid, and a –ve sign when consumer is exporting power to grid.
- (h) The meters shall also display (on demand), by turn, the following parameters:

1.) **Auto scrolling (Mode1)** should display following parameters(63)

- Meter Serial Number
- RTC date & time
- Active Energy Cumulative (Total kWh) (Import)
- TOD-1 Active Energy (Cumulative) (Import)
- TOD-2 Active Energy (Cumulative) (Import)
- TOD-3 Active Energy (Cumulative) (Import)
- TOD-4 Active Energy (Cumulative) (Import)
- TOD-5 Active Energy (Cumulative) (Import)
- Reactive Energy (Lag) (Total KVARH) (Import)
- TOD-1 Apparent MD with date & time stamping (Import)
- TOD-2 Apparent MD with date & time stamping (Import)
- TOD-3 Apparent MD with date & time stamping (Import)
- TOD-4 Apparent MD with date & time stamping (Import)
- TOD-5 Apparent MD with date & time stamping (Import)
- Reactive Energy (Lead) (Total KVARH) (Import)
- Apparent Energy (Q1) (Total KVAH) (Import)
- TOD-1 Apparent Energy (Cumulative) (Import)
- TOD-2 Apparent Energy (Cumulative) (Import)
- TOD-3 Apparent Energy (Cumulative) (Import)
- TOD-4 Apparent Energy (Cumulative) (Import)
- TOD-5 Apparent Energy (Cumulative) (Import)
- Active Energy Cumulative (Total kWh) (Export)
- TOD-1 Active Energy (Cumulative) (Export)
- TOD-2 Active Energy (Cumulative) (Export)
- TOD-3 Active Energy (Cumulative) (Export)
- TOD-4 Active Energy (Cumulative) (Export)
- TOD-5 Active Energy (Cumulative) (Export)
- Reactive Energy (Lag) (Total KVARH) (Export)
- TOD-1 Apparent MD with date & time stamping (Export)
- TOD-2 Apparent MD with date & time stamping (Export)
- TOD-3 Apparent MD with date & time stamping (Export)
- TOD-4 Apparent MD with date & time stamping (Export)
- TOD-5 Apparent MD with date & time stamping (Export)
- Reactive Energy (Lead) (Total KVARH) (Export)
- Apparent Energy (Q1) (Total KVAH) (Export)
- TOD-1 Apparent Energy (Cumulative) (Export)
- TOD-2 Apparent Energy (Cumulative) (Export)
- TOD-3 Apparent Energy (Cumulative) (Export)
- TOD-4 Apparent Energy (Cumulative) (Export)
- TOD-5 Apparent Energy (Cumulative) (Export)
- Average PF
- Latest reset- Active Energy (Cumulative) (Import)
- Latest reset TOD-1 Active Energy (Cumulative) (Import)
- Latest reset TOD-2 Active Energy (Cumulative) (Import)
- Latest reset TOD-3 Active Energy (Cumulative) (Import)
- Latest reset TOD-4 Active Energy (Cumulative) (Import)
- Latest reset TOD-5 Active Energy (Cumulative) (Import)
- Latest reset Reactive Energy (Lag) (Total KVARH) (Import)
- Latest reset TOD-1 Apparent MD with date & time stamping (Import)
- Latest reset TOD-2 Apparent MD with date & time stamping (Import)

- Latest reset TOD-3 Apparent MD with date & time stamping (Import)
- Latest reset TOD-4 Apparent MD with date & time stamping (Import)
- Latest reset TOD-5 Apparent MD with date & time stamping (Import)
- Latest reset Apparent Energy (Lead) (Total KVARH) (Import)
- Latest reset- Apparent Energy (Cumulative) (Import)
- Latest reset TOD-1 Apparent Energy (Cumulative) (Import)
- Latest reset TOD-2 Apparent Energy (Cumulative) (Import)
- Latest reset TOD-3 Apparent Energy (Cumulative) (Import)
- Latest reset TOD-4 Apparent Energy (Cumulative) (Import)
- Latest reset TOD-5 Apparent Energy (Cumulative) (Import)
- Latest reset- Active Energy (Cumulative) (Export)
- Latest reset TOD-1 Active Energy (Cumulative) (Export)
- Latest reset TOD-2 Active Energy (Cumulative) (Export)
- Latest reset TOD-3 Active Energy (Cumulative) (Export)
- Latest reset TOD-4 Active Energy (Cumulative) (Export)
- Latest reset TOD-5 Active Energy (Cumulative) (Export)
- Latest reset Reactive Energy (Lag) (Total KVARH) (Export)
- Latest reset TOD-1 Apparent MD with date & time stamping (Export)
- Latest reset TOD-2 Apparent MD with date & time stamping (Export)
- Latest reset TOD-3 Apparent MD with date & time stamping (Export)
- Latest reset TOD-4 Apparent MD with date & time stamping (Export)
- Latest reset TOD-5 Apparent MD with date & time stamping (Export)
- Latest reset Apparent Energy (Lead) (Total KVARH) (Export)
- Latest reset- Apparent Energy (Cumulative) (Export)
- Latest reset TOD-1 Apparent Energy (Cumulative) (Export)
- Latest reset TOD-2 Apparent Energy (Cumulative) (Export)
- Latest reset TOD-3 Apparent Energy (Cumulative) (Export)
- Latest reset TOD-4 Apparent Energy (Cumulative) (Export)
- Latest reset TOD-5 Apparent Energy (Cumulative) (Export)
- Latest Reset Average PF
- KVA Rising Demand
- Display Check

In case Cover open & ESD tamper occurs, the display should toggle cover open/ESD indicative message & cumulative kWh readings

2.) **The Push Button** (Mode 2) display (High resolution) should display following parameters (153)

- Meter Serial Number
- RTC date & time
- Active Energy Cumulative (Total kWh) (Import)
- TOD-1 Active Energy (Cumulative) (Import)
- TOD-2 Active Energy (Cumulative) (Import)
- TOD-3 Active Energy (Cumulative) (Import)
- TOD-4 Active Energy (Cumulative) (Import)
- TOD-5 Active Energy (Cumulative) (Import)
- Reactive Energy (Lag) (Total KVARH) (Import)
- TOD-1 Apparent MD with date & time stamping (Import)

- TOD-2 Apparent MD with date & time stamping (Import)
- TOD-3 Apparent MD with date & time stamping (Import)
- TOD-4 Apparent MD with date & time stamping (Import)
- TOD-5 Apparent MD with date & time stamping (Import)
- Reactive Energy (Lead) (Total KVARH) (Import)
- Apparent Energy (Q1) (Total KVAH) (Import)
- TOD-1 Apparent Energy (Cumulative) (Import)
- TOD-2 Apparent Energy (Cumulative) (Import)
- TOD-3 Apparent Energy (Cumulative) (Import)
- TOD-4 Apparent Energy (Cumulative) (Import)
- TOD-5 Apparent Energy (Cumulative) (Import)
- Active Energy Cumulative (Total kWh) (Export)
- TOD-1 Active Energy (Cumulative) (Export)
- TOD-2 Active Energy (Cumulative) (Export)
- TOD-3 Active Energy (Cumulative) (Export)
- TOD-4 Active Energy (Cumulative) (Export)
- TOD-5 Active Energy (Cumulative) (Export)
- Reactive Energy (Lag) (Total KVARH) (Export)
- TOD-1 Apparent MD with date & time stamping (Export)
- TOD-2 Apparent MD with date & time stamping (Export)
- TOD-3 Apparent MD with date & time stamping (Export)
- TOD-4 Apparent MD with date & time stamping (Export)
- TOD-5 Apparent MD with date & time stamping (Export)
- Reactive Energy (Lead) (Total KVARH) (Export)
- Apparent Energy (Q1) (Total KVAH) (Export)
- TOD-1 Apparent Energy (Cumulative) (Export)
- TOD-2 Apparent Energy (Cumulative) (Export)
- TOD-3 Apparent Energy (Cumulative) (Export)
- TOD-4 Apparent Energy (Cumulative) (Export)
- TOD-5 Apparent Energy (Cumulative) (Export)
- Average PF
- Latest reset- Active Energy (Cumulative) (Import)
- Latest reset TOD-1 Active Energy (Cumulative) (Import)
- Latest reset TOD-2 Active Energy (Cumulative) (Import)
- Latest reset TOD-3 Active Energy (Cumulative) (Import)
- Latest reset TOD-4 Active Energy (Cumulative) (Import)
- Latest reset TOD-5 Active Energy (Cumulative) (Import)
- Latest reset Reactive Energy (Lag) (Total KVARH) (Import)
- Latest reset TOD-1 Apparent MD with date & time stamping (Import)
- Latest reset TOD-2 Apparent MD with date & time stamping (Import)
- Latest reset TOD-3 Apparent MD with date & time stamping (Import)
- Latest reset TOD-4 Apparent MD with date & time stamping (Import)
- Latest reset TOD-5 Apparent MD with date & time stamping (Import)
- Latest reset Apparent Energy (Lead) (Total KVARH) (Import)
- Latest reset- Apparent Energy (Cumulative) (Import)
- Latest reset TOD-1 Apparent Energy (Cumulative) (Import)
- Latest reset TOD-2 Apparent Energy (Cumulative) (Import)
- Latest reset TOD-3 Apparent Energy (Cumulative) (Import)
- Latest reset TOD-4 Apparent Energy (Cumulative) (Import)
- Latest reset TOD-5 Apparent Energy (Cumulative) (Import)
- Latest reset- Active Energy (Cumulative) (Export)
- Latest reset TOD-1 Active Energy (Cumulative) (Export)

- Latest reset TOD-2 Active Energy (Cumulative) (Export)
- Latest reset TOD-3 Active Energy (Cumulative) (Export)
- Latest reset TOD-4 Active Energy (Cumulative) (Export)
- Latest reset TOD-5 Active Energy (Cumulative) (Export)
- Latest reset Reactive Energy (Lag) (Total KVARH) (Export)
- Latest reset TOD-1 Apparent MD with date & time stamping (Export)
- Latest reset TOD-2 Apparent MD with date & time stamping (Export)
- Latest reset TOD-3 Apparent MD with date & time stamping (Export)
- Latest reset TOD-4 Apparent MD with date & time stamping (Export)
- Latest reset TOD-5 Apparent MD with date & time stamping (Export)
- Latest reset Apparent Energy (Lead) (Total KVARH) (Export)
- Latest reset- Apparent Energy (Cumulative) (Export)
- Latest reset TOD-1 Apparent Energy (Cumulative) (Export)
- Latest reset TOD-2 Apparent Energy (Cumulative) (Export)
- Latest reset TOD-3 Apparent Energy (Cumulative) (Export)
- Latest reset TOD-4 Apparent Energy (Cumulative) (Export)
- Latest reset TOD-5 Apparent Energy (Cumulative) (Export)
- Latest Reset Average PF
- Previous reset- Active Energy (Cumulative) (Import)
- Previous reset TOD-1 Active Energy (Cumulative) (Import)
- Previous reset TOD-2 Active Energy (Cumulative) (Import)
- Previous reset TOD-3 Active Energy (Cumulative) (Import)
- Previous reset TOD-4 Active Energy (Cumulative) (Import)
- Previous reset TOD-5 Active Energy (Cumulative) (Import)
- Previous reset Reactive Energy (Lag) (Total KVARH) (Import)
- Previous reset TOD-1 Apparent MD with date & time stamping (Import)
- Previous reset TOD-2 Apparent MD with date & time stamping (Import)
- Previous reset TOD-3 Apparent MD with date & time stamping (Import)
- Previous reset TOD-4 Apparent MD with date & time stamping (Import)
- Previous reset TOD-5 Apparent MD with date & time stamping (Import)
- Previous reset Reactive Energy (Lead) (Total KVARH) (Import)
- Previous reset- Apparent Energy (Cumulative) (Import)
- Previous reset TOD-1 Apparent Energy (Cumulative) (Import)
- Previous reset TOD-2 Apparent Energy (Cumulative) (Import)
- Previous reset TOD-3 Apparent Energy (Cumulative) (Import)
- Previous reset TOD-4 Apparent Energy (Cumulative) (Import)
- Previous reset TOD-5 Apparent Energy (Cumulative) (Import)
- Previous reset- Active Energy (Cumulative) (Export)
- Previous reset TOD-1 Active Energy (Cumulative) (Export)
- Previous reset TOD-2 Active Energy (Cumulative) (Export)
- Previous reset TOD-3 Active Energy (Cumulative) (Export)
- Previous reset TOD-4 Active Energy (Cumulative) (Export)
- Previous reset TOD-5 Active Energy (Cumulative) (Export)
- Previous reset Reactive Energy (Lag) (Total KVARH) (Export)
- Previous reset TOD-1 Apparent MD with date & time stamping (Export)
- Previous reset TOD-2 Apparent MD with date & time stamping (Export)
- Previous reset TOD-3 Apparent MD with date & time stamping (Export)
- Previous reset TOD-4 Apparent MD with date & time stamping (Export)
- Previous reset TOD-5 Apparent MD with date & time stamping (Export)
- Previous reset Reactive Energy (Lead) (Total KVARH) (Export)
- Previous reset- Apparent Energy (Cumulative) (Export)
- Previous reset TOD-1 Apparent Energy (Cumulative) (Export)

- Previous reset TOD-2 Apparent Energy (Cumulative) (Export)
- Previous reset TOD-3 Apparent Energy (Cumulative) (Export)
- Previous reset TOD-4 Apparent Energy (Cumulative) (Export)
- Previous reset TOD-5 Apparent Energy (Cumulative) (Export)
- Previous Reset Average PF
- R Phase Voltage
- Y Phase Voltage
- B Phase Voltage
- R Phase Current
- Y Phase Current
- B Phase Current
- Instantaneous active Power
- Instantaneous reactive Power
- Instantaneous apparent Power
- Phase sequence
- Instantaneous PF R-ph
- Instantaneous PF Y-ph
- Instantaneous PF B-ph
- Net average PF
- MD reset count
- Defrauded Energy Cumulative KWH
- Defrauded Energy Cumulative KVAH
- High resolution Cumulative energy in KWh (Import)
- High resolution Cumulative energy in KWh (Export)
- High Resolution Reactive Energy Cumulative KVARH Lag (Import)
- High Resolution Reactive Energy Cumulative KVARH Lag (Export)
- High Resolution Reactive Energy Cumulative KVARH Lead (Import)
- High Resolution Reactive Energy Cumulative KVARH Lead (Export)
- High Resolution Apparent Energy KVAH (Import)
- High Resolution Apparent Energy KVAH (Export)
- Cumulative tamper count
- History of last 3 tampers
- LCD Test

3.) **The Battery (Mode 3)** display (High resolution) should display following parameters(38)

- Active Energy Cumulative (Total kWh) (Import)
- TOD-1 Active Energy (Cumulative) (Import)
- TOD-2 Active Energy (Cumulative) (Import)
- TOD-3 Active Energy (Cumulative) (Import)
- TOD-4 Active Energy (Cumulative) (Import)
- TOD-5 Active Energy (Cumulative) (Import)
- Reactive Energy (Lag) (Total KVARH) (Import)
- TOD-1 Apparent MD (Import)
- TOD-2 Apparent MD (Import)

- TOD-3 Apparent MD (Import)
- TOD-4 Apparent MD (Import)
- TOD-5 Apparent MD (Import)
- Reactive Energy (Lead) (Total KVARH) (Import)
- Apparent Energy (Total KVAH) (Import)
- Active Energy Cumulative (Total kWh) (Export)
- TOD-1 Active Energy (Cumulative) (Export)
- TOD-2 Active Energy (Cumulative) (Export)
- TOD-3 Active Energy (Cumulative) (Export)
- TOD-4 Active Energy (Cumulative) (Export)
- TOD-5 Active Energy (Cumulative) (Export)
- Reactive Energy (Lag) (Total KVARH) (Export)
- Reactive Energy (Lead) (Total KVARH) (Export)
- Apparent Energy (Total KVAH) (Export)

Note: Latest reset is History 1

Previous reset is History 2

For manual display :

PI add Channel 1 and Channel 2 in following Pages:

1	Main Energy Parameters
2	High Resolution Parameters
3	Last IP Parameters

- (i) The three line-to-neutral voltages shall be continuously monitored, and in case any of these falls below 70%, the low voltage condition shall be suitably indicated and recorded. Each meter shall have a built-in calendar and clock, having an accuracy of 30 seconds per month or better.
- (j) The meters shall be totally sealed and tamper-proof, with no possibility of any adjustment at site, except for a restricted clock correction
- (k) Internal MF shall be 1. CTR and PTR programmed in meter shall be -/1, 5 A and -/110V.
- (l) MD Reset Push Button is to be disabled.
- (m) Display Digits Configuration for Energy and Demand shall be : 5+3
- (n) Meters shall support 5 TOD slots as follows :

TOD 1	22.00 to 06.00 Hrs
TOD 2	06.00 to 09.00 Hrs
TOD 3	09.00 to 12.00 Hrs
TOD 4	12.00 to 18.00 Hrs
TOD 5	18.00 to 22.00 Hrs

- (o) MD integration period shall be 15 min and MD recording shall be with Blocked window method.
- (p) Load survey parameters shall be reconfigured for Total Energy instead of Fundamental Energy.
- (q) Lead PF to be considered as UPF for energy calculation.
- (r) Meter auto reset date shall be first of every month.

Data download capability of Meters

All meters shall have downloading facilities of metered data through Common Meter Reading Instrument (CMRI). CMRI shall be capable of downloading data/information from various makes of AC static energy meters when loaded with the corresponding meter specific downloading software(s) called meter reading instrument programs). The CMRI shall be able to extract information about energy data, load survey data, billing parameters, meter status, meter anomaly and tamper data from the memory of the meter and store for retrieval at a later stage. The meter shall be able to store at least 100 such events on FIFO basis. Vendor shall provide all necessary support for AMR communication purpose.

Calibration LED

Calibration (Left)	LED	Active total
Calibration (Right)	LED	Reactive

Daily Energy Snap

Daily Energy Snap Parameters

Sno	Parameter Name
1	Active Import Total (Q1+Q4)
2	Active Export Total (Q2+Q3)
3	Active Import Fundamental (Without Harmonics) (Q1+Q4)
4	Active Export Fundamental (Without Harmonics) (Q2+Q3)
5	Reactive Import While Active Import – Q1
6	Reactive Export While Active Import – Q4
7	Reactive Import While Active Export – Q2
8	Reactive Export While Active Export – Q3
9	Apparent – While Active Import
10	Apparent – While Active Export
11	Net Reactive High
12	Net Reactive Low

Daily Energy Snap time

Capture time	0 hrs 0 mins
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Logger

General Information

Survey Integration Period	15
Survey Sampling Period	Disabled

Survey Channels

SNo	Parameter Name
1	Active Import Total (Q1+Q4)
2	Active Export Total (Q2+Q3)
3	Active Import Fundamental (Without Harmonics) (Q1+Q4)
4	Active Export Fundamental (Without Harmonics) (Q2+Q3)
5	Reactive Import While Active Import – Q1
6	Reactive Export While Active Import – Q4
7	Reactive Import While Active Export – Q2
8	Reactive Export While Active Export – Q3
9	Apparent – While Active Import
10	Apparent – While Active Export
11	Net Reactive High
12	Net Reactive Low

Instantaneous Parameters

SNo	Parameter Name
1	Mean Voltage
2	Mean Line Current
3	Frequency

Communication and Security

Baud rate on Channel A	9600
Baud rate on Channel B	9600
Baud rate on Channel C	9600
Protocol Channel A	DLMS Mode
Protocol Channel B	Modbus Mode
Protocol Channel C	DLMS Mode
Protocol Channel TCP1	Modbus Mode
Protocol Channel TCP2	TCP DLMS

Event

SNo	Condition
1	Reverse Current direction phase wise
2	Current Unbalance
3	Missing voltage phase wise
4	Voltage Unbalance
5	Invalid Voltage
6	Feeder Fail(All phases missing)
7	Magnet detection
8	Current missing phase wise
9	Over Voltage
10	Under Voltage
11	Power Failure

Special Days

Sno	Special Date	Apply	Day type	Special Day Start
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TOU and Maximum Demand

General Information

Demand Integration Period	15
Demand Sampling Period	Disabled

Energy parameters for Demand Register

SNo	Parameter Name
1	Active Import Total (Q1+Q4)
2	Active Export Total (Q2+Q3)
3	Active Import Fundamental (Without Harmonics) (Q1+Q4)
4	Active Export Fundamental (Without Harmonics) (Q2+Q3)
5	Apparent – While Active Import
6	Apparent – While Active Export

Energy parameters for TOU Register

SNo	Parameter Name
1	Active Import Total (Q1+Q4)
2	Active Export Total (Q2+Q3)
3	Active Import Fundamental (Without Harmonics) (Q1+Q4)
4	Active Export Fundamental (Without Harmonics) (Q2+Q3)
5	Apparent – While Active Import
6	Apparent – While Active Export

Season dates

Sno	Season Start Date	Dow Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	01-October	On exact date	1	1	1	1	1	1	1

Day types

Sno	Day Type	Start Time	End Time	Rate Register	MD Register
1	1	00:00	06:00	1	1

2	1	06:00	09:00	2	2
3	1	09:00	12:00	3	3
4	1	12:00	18:00	4	4
5	1	18:00	22:00	5	5
6	1	22:00	24:00	1	1

Billing Dates

Sno	Billing date	Apply	Billing Start
1	01-January	Every year	On exact date
2	01-February	Every year	On exact date
3	01-March	Every year	On exact date
4	01-April	Every year	On exact date
5	01-May	Every year	On exact date
6	01-June	Every year	On exact date
7	01-July	Every year	On exact date
8	01-August	Every year	On exact date
9	01-September	Every year	On exact date
10	01-October	Every year	On exact date
11	01-November	Every year	On exact date
12	01-December	Every year	On exact date

Clock Adjustment

Maximum amount of time change	25 secs
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Digital I/O and Alarms

I/O Type:	I/O Description:
3	4 Output and 1 Input

Sno	I/O No	I/O Type	Function	Sub Function
1	1	Fixed Output	Alarm Outputs	Any Phase VT Miss
2	2	Fixed Output	Alarm Outputs	Voltage Unbalance
3	3	Fixed Output	Alarm Outputs	Current Imbalance
4	4	Fixed Output	Healthy Condition	All Phase voltage healthy
5	1	Fixed Input	Time Sync Pulse	1

Measuring

Measuring (Input Parameters)

Meter Wire Type	HV (3P4W)
Primary Line to Line Voltage	110 Volt
Secondary Line to Line Voltage	110 Volt
Primary Current	1 Amp
Secondary Current	1 Amp
Max Current	2 Amp

Display Sequences

Display time outs

Delay for auto return from manual to automatic display cycling sequence	10 Secs
Delay for automatic display cycling sequence	10 Secs
Backlight off duration at end of Automatic display cycling sequence	10 Secs

Configurability of OBIS Code

Display OBIS Code in meter	Enabled
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Configurability Import/Export with +/- Sign

Import/Export with +/- Sign	Enabled
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Automatic display cycling sequence

SNo	Display Parameter Name
1	Display test – all segments on

2	Meter serial number
3	Current date from the base time
4	Current, Energy Reg, Active Import Total (Q1+Q4)
5	Current, Energy Reg, Reactive Import While Active Import – Q1
6	Current, Energy Reg, Reactive Export While Active Import – Q4
7	Current, Energy Reg, Apparent – While Active Import
8	Current, Universal MD Reg , Apparent – While Active Import
9	Current, Energy Reg, Active Export Total (Q2+Q3)
10	Current, Energy Reg, Reactive Export While Active Export – Q3
11	Current, Energy Reg, Reactive Import While Active Export – Q2
12	Current, Energy Reg, Apparent – While Active Export
13	Current, Universal MD Reg , Apparent – While Active Export
14	Power factor for consumed energy Hist 1
15	Power factor for exported energy Hist 1
16	Current, Energy Reg, Net Reactive High
17	Current, Energy Reg, Net Reactive Low
18	Hist 1, Energy Reg, Active Import Total (Q1+Q4)
19	Hist 1, TOU Reg 1, Active Import Total (Q1+Q4)
20	Hist 1, TOU Reg 2, Active Import Total (Q1+Q4)
21	Hist 1, TOU Reg 3, Active Import Total (Q1+Q4)
22	Hist 1, TOU Reg 4, Active Import Total (Q1+Q4)
23	Hist 1, TOU Reg 5, Active Import Total (Q1+Q4)
24	Hist 1, MD Reg 1, Apparent – While Active Import
25	Hist 1, MD Reg 2, Apparent – While Active Import
26	Hist 1, MD Reg 3, Apparent – While Active Import
27	Hist 1, MD Reg 4, Apparent – While Active Import
28	Hist 1, MD Reg 5, Apparent – While Active Import
29	Hist 1, Energy Reg, Reactive Import While Active Import – Q1
30	Hist 1, Energy Reg, Reactive Export While Active Import – Q4
31	Hist 1, Energy Reg, Apparent – While Active Import
32	Hist 1, Energy Reg, Active Export Total (Q2+Q3)
33	Hist 1, Universal MD Reg , Apparent – While Active Export
34	Hist 1, Energy Reg, Reactive Export While Active Export – Q3
35	Hist 1, Energy Reg, Reactive Import While Active Export – Q2
36	Hist 1, Energy Reg, Apparent – While Active Export

Manual Displays

Display Page - Main Energy Par.

SNo	Display Parameter Name
1	Display test – all segments on
2	Current date from the base time
3	Power On time in minutes
4	Power Off time in minutes
5	Current, Energy Reg, Active Import Total (Q1+Q4)
6	Current, Energy Reg, Active Export Total (Q2+Q3)
7	Current, Energy Reg, Active Import Fundamental (Without Harmonics) (Q1+Q4)
8	Current, Energy Reg, Active Export Fundamental (Without Harmonics) (Q2+Q3)
9	Current, Energy Reg, Reactive Import While Active Import – Q1
10	Current, Energy Reg, Reactive Export While Active Import – Q4
11	Current, Energy Reg, Reactive Import While Active Export – Q2
12	Current, Energy Reg, Reactive Export While Active Export – Q3
13	Current, Energy Reg, Apparent – While Active Import
14	Current, Energy Reg, Apparent – While Active Export
15	Hist 1, Universal CMD Reg , Active Import Total (Q1+Q4)
16	Hist 1, Universal CMD Reg , Active Export Total (Q2+Q3)
17	Hist 1, Universal CMD Reg , Active Import Fundamental (Without Harmonics) (Q1+Q4)
18	Hist 1, Universal CMD Reg , Active Export Fundamental (Without Harmonics) (Q2+Q3)
19	Hist 1, Universal CMD Reg , Apparent – While Active Import
20	Hist 1, Universal CMD Reg , Apparent – While Active Export
21	Current, Universal MD Reg , Active Import Total (Q1+Q4)
22	Current, Universal MD Reg , Active Export Total (Q2+Q3)
23	Current, Universal MD Reg , Active Import Fundamental (Without Harmonics) (Q1+Q4)
24	Current, Universal MD Reg , Active Export Fundamental (Without Harmonics) (Q2+Q3)
25	Current, Universal MD Reg , Apparent – While Active Import
26	Current, Universal MD Reg , Apparent – While Active Export
27	Hist 1, Energy Reg, Active Import Total (Q1+Q4)
28	Hist 1, Energy Reg, Active Export Total (Q2+Q3)
29	Hist 1, Energy Reg, Active Import Fundamental (Without Harmonics) (Q1+Q4)
30	Hist 1, Energy Reg, Active Export Fundamental (Without Harmonics) (Q2+Q3)

31	Hist 1, Energy Reg, Apparent – While Active Import
32	Hist 1, Energy Reg, Apparent – While Active Export
33	Hist 1, Universal MD Reg, Apparent – While Active Import
34	Hist 1, Universal MD Reg, Apparent – While Active Export
35	Power factor for exported energy Hist 1
36	Power factor for consumed energy Hist 1
37	Current, Energy Reg, Net Reactive High
38	Current, Energy Reg, Net Reactive Low
39	Rising demands, Apparent – While Active Import
40	Rising demands, Apparent – While Active Export

Display Page - Instantaneous Par.

SNo	Display Parameter Name
1	Phase voltage: phase 1
2	Phase voltage: phase 2
3	Phase voltage: phase 3
4	Line current: phase 1
5	Line current: phase 2
6	Line current: phase 3
7	Apparent power: 3-phase
8	Net active power: 3-phase
9	Fundamental active power: 3-phase
10	Reactive power: 3-phase
11	Power factor: 3-phase
12	Number of billing actions (MD resets)
13	Date of billing action (MD reset)
14	Frequency
15	Instantaneous % voltage of all phases

Display Page - High Resolution Par.

SNo	Display Parameter Name
1	Current, High Resolution Energy Reg, Active Import Total (Q1+Q4)
2	Current, High Resolution Energy Reg, Active Export Total (Q2+Q3)
3	Current, High Resolution Energy Reg, Active Import Fundamental (Without Harmonics) (Q1+Q4)
4	Current, High Resolution Energy Reg, Active Export Fundamental (Without Harmonics) (Q2+Q3)
5	Current, High Resolution Energy Reg, Reactive Import While Active Import – Q1
6	Current, High Resolution Energy Reg, Reactive Export While Active Import – Q4
7	Current, High Resolution Energy Reg, Reactive Import While Active Export – Q2
8	Current, High Resolution Energy Reg, Reactive Export While Active Export – Q3
9	Current, High Resolution Energy Reg, Apparent – While Active Import
10	Current, High Resolution Energy Reg, Apparent – While Active Export
11	Current, High Resolution Energy Reg, Net Reactive High
12	Current, High Resolution Energy Reg, Net Reactive Low

Display Page - Last IP Par.

SNo	Display Parameter Name
1	Previous IP (Integration Period) average frequency
2	Hist 1, SIP Energy Reg, Active Import Total (Q1+Q4)
3	Hist 1, SIP Energy Reg, Active Export Total (Q2+Q3)
4	Hist 1, SIP Energy Reg, Active Import Fundamental (Without Harmonics) (Q1+Q4)
5	Hist 1, SIP Energy Reg, Active Export Fundamental (Without Harmonics) (Q2+Q3)
6	Hist 1, SIP Energy Reg, Net Active (Imp – Exp)
7	Hist 1, SIP Energy Reg, Net Reactive (Q1+Q2-Q3-Q4)
8	Hist 1, SIP Energy Reg, Net Reactive High
9	Hist 1, SIP Energy Reg, Net Reactive Low

Display Page - Tamper Information

SNo	Display Parameter Name
1	Present status of voltage related events
2	Present status of current related events
3	Present status of events other than current and voltage
4	Last occurred event
5	Time of last occurred event
6	Date of last occurred event
7	Last restored event
8	Time of last restored event
9	Date of last restored event

10	Event count
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Display Page - TOD Par.

SNo	Display Parameter Name
1	Hist 1, Universal CMD Reg , Apparent – While Active Import
2	Hist 1, Universal CMD Reg , Apparent – While Active Export
3	Current, Universal MD Reg , Apparent – While Active Import
4	Current, MD Reg 1, Apparent – While Active Import
5	Current, MD Reg 2, Apparent – While Active Import
6	Current, MD Reg 3, Apparent – While Active Import
7	Current, MD Reg 4, Apparent – While Active Import
8	Current, MD Reg 5, Apparent – While Active Import
9	Current, Universal MD Reg , Apparent – While Active Export
10	Current, MD Reg 1, Apparent – While Active Export
11	Current, MD Reg 2, Apparent – While Active Export
12	Current, MD Reg 3, Apparent – While Active Export
13	Current, MD Reg 4, Apparent – While Active Export
14	Current, MD Reg 5, Apparent – While Active Export
15	Hist 1, Universal MD Reg , Apparent – While Active Import
16	Hist 1, MD Reg 1, Apparent – While Active Import
17	Hist 1, MD Reg 2, Apparent – While Active Import
18	Hist 1, MD Reg 3, Apparent – While Active Import
19	Hist 1, MD Reg 4, Apparent – While Active Import
20	Hist 1, MD Reg 5, Apparent – While Active Import
21	Hist 1, Universal MD Reg , Apparent – While Active Export
22	Hist 1, MD Reg 1, Apparent – While Active Export
23	Hist 1, MD Reg 2, Apparent – While Active Export
24	Hist 1, MD Reg 3, Apparent – While Active Export
25	Hist 1, MD Reg 4, Apparent – While Active Export
26	Hist 1, MD Reg 5, Apparent – While Active Export

Configuration ID

Configuration ID	TATAREV1
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MD Button Control

Event	Action
MD Button Control Action	No Action

Billing Registers and Control

Sno	Flag Name	Configured
1	Enable MD reset through communication (by third party software)	Yes
2	Enable Event log reset through communication (by third party software)	Yes

Billing Energy Channels

Lag + Lead Quadrant

Active	Total
Apparent	Lag Only in all quadrant
Net Active	Net Active (I-E)

Please read “Lag Only in all quadrant”
as “**Lag+Lead** in all quadrant”

Energy Billing Parameters

Sno	Parameter Name
1	Active Import Total (Q1+Q4)
2	Active Export Total (Q2+Q3)
3	Active Import Fundamental (Without Harmonics) (Q1+Q4)
4	Active Export Fundamental (Without Harmonics) (Q2+Q3)
5	Reactive Import While Active Import – Q1
6	Reactive Export While Active Import – Q4
7	Reactive Import While Active Export – Q2
8	Reactive Export While Active Export – Q3
9	Apparent – While Active Import
10	Apparent – While Active Export

11	Reactive Import (Q1+Q2)
12	Reactive Export (Q3+Q4)
13	Net Active (Imp – Exp)
14	Net Reactive (Q1+Q2-Q3-Q4)
15	Net Reactive High
16	Net Reactive Low

Instantaneous parameters for Billing

SNo	Parameter Name
1	Total Harmonic Distortion in voltage [phase 1]
2	Total Harmonic Distortion in voltage [phase 2]
3	Total Harmonic Distortion in voltage [phase 3]
4	Total Harmonic Distortion in current [phase 1]
5	Total Harmonic Distortion in current [phase 2]
6	Total Harmonic Distortion in current [phase 3]

Energy limit Definiton

Reactive high voltage limit	103% of V Nominal
Reactive low voltage limit	97% of V Nominal
Low voltage limit	60% of V Nominal
Hysteresis	5%

Event Persistence Time

Sno	Event	Event type	Occurrence time	Restoration time
1	Reverse Current direction phase wise	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
2	Current Unbalance	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
3	Missing voltage phase wise	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
4	Voltage Unbalance	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
5	Invalid Voltage	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
6	Feeder Fail(All phases missing)	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
7	Current missing phase wise	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
8	Over Voltage	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
9	Under Voltage	Non Cumulative Type	5 mins 0 secs	5 mins 0 secs
10	Power Failure	Non Cumulative Type	5 mins 0 secs	On Power Resume

Power Quality

Phase wise THD voltage events

Parameter	Value
Occurrence Limit	5.0%
Restoration Limit	4.0%
Persistence Time	60 Seconds

Phase wise THD current events

Parameter	Value
Occurrence Limit	8.0%
Restoration Limit	7.0%
Persistence Time	60 Seconds

Voltage swell events

Parameter	Value
Occurrence Limit	110.0% of V Nominal
Restoration Limit	105.0% of V Nominal

Voltage sag events

Parameter	Value
Occurrence Limit	90.0% of V Nominal
Restoration Limit	95.0% of V Nominal

Voltage unbalance(Quality) events

Parameter	Value
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Occurrence Limit	20.0% of V Average
Restoration Limit	20.0% of V Average

Voltage interruption events

Parameter	Value
Occurrence Limit	10.0% of V Nominal
Restoration Limit	20.0% of V Nominal

Factory Master

Clem Variable File Name	L:\Release\R&D\RELEASED\FINAL\CLEM\APEXABT\Prod_use\MASKE300APEX100\M6X3G08\M6X3G08.v0F
Clem Object File Name	L:\Release\R&D\RELEASED\FINAL\CLEM\APEXABT\Prod_use\MASKE300APEX100\M6X3G08\M6X3G08.J0F

Miscellaneous

1	Number of Daily Snapshot Days	60
2	Number of Days for Logger	60
3	Number of Parameter Days for Logger	1800
4	For sliding widow, First DIP is fixed window type for all demand time zones	Disable
5	Field configuration of Meter type, Secondary current, I _{max} and Secondary Voltage	Enable
6	Minimum duration for power quality events(Sag,Swell,Unbalance and Interruption) logging(1 to 60sec)	3
7	Maximum duration for power quality counters and events(Sag,Swell,Unbalance and Interruption) logging(1 to 60sec).Min duration value must be less than Max duration	60

Event Limits

Phase wise PT miss

1	Voltage limit for occurrence(% of V nominal)	5
2	Voltage limit for restoration (% of V nominal)	10
3	Line Current limit for occurrence (% of I basic)	10

Voltage unbalance

1	Voltage deviation from average voltage for occurrence(% of average voltage)	10
2	Voltage deviation from average voltage for restoration (% of average voltage)	10

Invalid Voltage

1	Voltage limit for occurrence (% of V nominal)	73
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Phase wise current miss

1	Current limit for occurrence (% of I basic)	1
2	Current limit for restoration (% of I basic)	10
3	Voltage limit for occurrence (% of V nominal)	5

Phase wise current reversal

1	Neutral current limit for software pin derivation (% of I basic) for CT reversal, Open and Bypass	10
2	Current limit 1 for current reversal (% of I basic)(If Neutral current >= Limit)	5
3	PF limit for CTR	0.1
4	Current limit 2 for current reversal (% of I basic)(If Neutral current < Limit)	10
5	Power limit for CTR (% of P nominal)	-5
6	Export mode current limit (% of I basic)	2

Current imbalance

1	Voltage deviation from maximum limit (% of V maximum)	20
2	Average line current limit (% of I basic)	10
3	Current deviation from max. current for occurrence(% of I basic)	30
4	Current deviation from max. current for restoration (% of I basic)	20

Any phase over voltage

1	Voltage limit for occurrence (% of V nominal)	115
2	Voltage limit for restoration (% of V nominal)	110

Any phase under voltage

1	Voltage limit for occurrence (% of V nominal)	75
2	Voltage limit for restoration (% of V nominal)	80

Feeder fail

1	Voltage limit for occurrence (% of V nominal)	20
2	Voltage limit for restoration (% of V nominal)	50

CT Open / CT Bypass

1	Maximum line current for CT Open occurrence (% of I basic)	2
2	Minimum line current for CT Bypass occurrence (% of I basic)	5
3	Minimum line current limit for restoration (% of I basic)	10

**Magnet Detection
(Occurrence)**

1	Cumulative persistence time count (Seconds)	20
2	Cumulative persistence time window (Seconds)	200

**Magnet Detection
(Restoration)**

1	Non-Cumulative persistence time (Seconds)	20
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Neutral Disturbance

1	Cumulative persistence time window (Seconds)	200
2	Cumulative persistence time count (Seconds)	20
3	High frequency limit (Hz)	55
4	Low frequency limit (Hz)	45
5	DC voltage Limit (V)	50

**Neutral Disturbance
(Restoration)**

1	Non-Cumulative persistence time (Seconds)	20
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TECHNICAL SPECIFICATIONS FOR DIGITAL SUMMATION UNIT SUITABLE FOR BULK CONSUMER MULTI-FEEDER STANDARD SUMMATION METERING

Detail specification of Standard Summation is as mentioned below:

1.0 SCOPE

- 1.1 This specification covers the design, engineering, manufacture, assembly, inspection and testing before supply and delivery at site/ FOR destination of digital summation unit, along with other associated equipments as per details given in this specification. The digital summation unit shall be used for commercial/ tariff metering for multi-feeder standard summation application at bulk consumer premises, in conjunction with compatible 0.2Saccuracy class AC static trivector feeder meters.
- 1.2 The summation unit and feeder meter module shall be an integrated part of standard 19" rack. This rack shall also have facility to accommodate summation unit and feeder meter as well. Summator shall have capable to add feeder meters up to 7 nos. feeders meters module. These four 19" racks are accommodated in one summation metering panel with all hardware as details in panel specification. **Number of feeder meters which very two to seven as per site requirements. Purchaser will confirm about number of feeders for which summation is required.**
- 1.3 It is not the intent to specify completely herein all the details of the design and construction of material. The material shall, however, conform in all respects to the best industry standards of engineering, design and workmanship and shall be capable of performing for continuous commercial operation in a manner acceptable to the purchaser. The offered equipment shall be complete in all respects including all components/ accessories for effective and trouble free operation according to the specifications. Such components shall be deemed to be within the scope of this specification irrespective of whether those are specifically brought out or not.
- 1.4 A dedicated digital summation unit shall be provided that shall be capable to collect the required energy parameters from the feeder meter modules and calculate concurrent apparent demand & summated energy parameters as per principle specified below. It shall have the provision to summate the readings of up to seven individual feeder meters in a typical installation.

2.0 GENERAL CONSTRUCTIONAL REQUIREMENTS

The equipment shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured:

- i) Personnel safety against electric shock
- ii) Personnel safety against effects of excessive temperature
- iii) Protection against spread of fire
- iv) Protection against penetration of solid objects, dust and water in normal working condition

All the materials and electronic power components used in the manufacture of the summation unit shall be of highest quality and reputed make to ensure higher reliability, longer life and sustained accuracy.

The summation unit shall be designed with application specific integrated circuits. The electronic components shall be mounted on the printed circuit board using latest Surface Mount Technology (SMT).

All insulating materials used in the construction of meters shall be non-hygroscopic, non-aging and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.

3.0 SEALING

One number sealing screw shall be provided on the front cover of summation module. The sealing arrangement should be suitable for application.

4.0 MARKING OF SUMMATION UNIT

The basic marking on the name plate of summation unit shall be as follows:

- i) Manufacturer's name and trade mark
- ii) Serial Number
- iii) Year of manufacture

5.0 This summation unit shall process the data of feeder meters to provide the summated energy parameters as specified below:

- i) Summated active energy import total
- ii) Summated active energy export total
- iii) Summated active energy import fundamental
- iv) Summated active energy export fundamental
- v) Summated reactive energy lag while active import
- vi) Summated reactive energy lead while active import
- vii) Summated reactive energy lag while active export
- viii) Summated reactive energy lead while active export
- ix) Summated apparent energy (while active import)
- x) Summated apparent energy (while active export)

6.0 CONCURRENT APPARENT DEMAND/ ENERGY CALCULATION

The Summation unit shall calculate the concurrent apparent demand from the incremental active and reactive energy readings of feeder meters. The apparent energy/ demand shall be calculated by vector (Pythagoras) addition of active energy and reactive energy readings of feeder metering modules.

The Concurrent demand shall be computed on the fixed time block principle. The block interval shall be set as 30 minutes that shall be capable to change to other integration period (5/15/ 60 minutes), if required, through suitable high level software as an authenticated transaction.

Summation unit shall provide the following apparent demand and energy parameters:

- i) Summated active import total
- ii) Summated active export total
- iii) Summated apparent energy (while active import)
- iv) Summated apparent energy (while active export)

7.0 The summation unit shall act as the master for all its feeder meters. It shall be possible to have a common MD reset operation, which shall be performed in the summation unit. During this common MD reset operation, MD of all the feeder meters and summation unit shall get reset concurrently. This shall ensure that all feeder meters and summation unit remain synchronized to each other. Further, it shall not be possible to perform individual MD reset operation in feeder meters.

8.0 Maximum Demand Reset: Following provisions shall be available for MD reset in summation unit –

- i) Auto billing at predefined date and time
- ii) Manual via MD reset button (optional)
- iii) Authenticated transaction through suitable high level software/ MRI (optional)

9.0 The summation unit shall also draw its operating power from the auxiliary power supply, in the same manner as feeder meters. There shall be two auxiliary supplies (60-240 V AC/DC) so that the summation system remains alive even if one or more feeder(s) is off. The system shall continue to work even if any one of the above auxiliary supply (AC/ DC) is present.

10.0 Summation module shall have a built-in calendar and clock, having an accuracy of one minute per month or better. The calendar and clock shall be correctly set at the manufacturer's works.

An automatic backup for continued operation of the calendar-clock shall be provided through a long life battery, which shall be capable of supplying the required power for at least two years under meter un-powered conditions. The summation module shall be supplied duly fitted with the batteries, which shall not require to be changed for at least ten years, as long as total supply interruption does not exceed two years.

- iv) The real time clock of the summation unit shall be used as the master clock for its feeder metering modules so that all the feeder meters remain time synchronized with summation unit. For time set, summation unit shall accept authenticated command through suitable high level software/ MRI (optional). Feeder meter time shall synchronize with summation unit and it shall not accept time set command through suitable high level software/ MRI (optional).

11.0 TOD (Time of day registers): The summation unit shall have TOD registers for active energy import and export, apparent energy import and export and apparent MD import and export. Maximum eight time of day registers can be defined. It shall be possible to program number of TOD registers and TOD timings through suitable high level software/ MRI as an authenticated transaction.

12.0 Individual display shall be used for viewing the display parameters of summation unit and feeder meters. Necessary means shall be provided for moving forward/ backward from one display to the other via soft key pad.

The display shall indicate direct values (i.e. without having to apply any multiplying factor) of computed parameters. It should be possible to easily identify the single or multiple displayed parameters through legends on the metering system display.

13.0 The summation unit shall display on demand the following parameters:

- i) Date
- ii) Time
- iii) Summated active energy import total

- iv) Summated active energy export total
- v) Summated active energy import fundamental
- vi) Summated active energy export fundamental
- vii) Summated reactive energy lag while active import
- viii) Summated reactive energy lead while active import
- ix) Summated reactive energy lag while active export
- x) Summated reactive energy lead while active export
- xi) Summated apparent energy (while active import)
- xii) Summated apparent energy (while active export)
- xiii) Summated maximum apparent demand (while active import)
- xiv) Summated maximum apparent demand (while active export)
- xv) MD reset count
- xvi) Date of Billing Action
- xvii) Cause of Billing
- xviii) History1- Summated active energy import energy total
- xix) History1- Summated active energy export energy total
- xx) History1- Summated apparent energy (while active import)
- xxi) History1- Summated apparent energy (while active export)
- xxii) History1- Concurrent Maximum demand for apparent energy (while active import) for current month (0-24 hrs)
- xxiii) History1- Concurrent Maximum demand for apparent energy (while active export) for current month (0-24 hrs)

14.0 Load Survey: Summation unit shall have a non-volatile memory in which the following shall be automatically stored for each successive 30 minute integration period block:

- i) Summated active import total
- ii) Summated active export total
- iii) Summated active import fundamental
- iv) Summated active export fundamental
- v) Summated apparent (while active import)
- vi) Summated apparent (while active export)

30 minute average of above parameters shall be available for last thirty five (35) days. It shall be possible to select either energy or demand view at Base Computer Software (BCS) end. The load survey data should be available in the form of bar charts as well as in spreadsheets. The BCS shall have the facility to give complete time synchronized load survey data both in numeric and graphic form.

15.0 Billing parameters: The predefined date and time for registering the billing parameters of shall be 00.00 hours of the first day of each calendar (billing) month. The summation unit shall store following parameters corresponding to defined bill dates for up to last 12 months:

- i) Summated active energy import total
- ii) Summated active energy export total
- iii) Summated active energy import fundamental
- iv) Summated active energy export fundamental
- v) Summated apparent energy (while active import)
- vi) Summated apparent energy (while active export)
- vii) Concurrent Maximum Demand Apparent (while active import)
- viii) Concurrent Maximum Demand Apparent (while active export)

16.0 Daily midnight parameters: The summation unit shall store following end day parameters for last thirty five (35) days:

- i) Summated active energy import total
- ii) Summated active energy export total
- iii) Summated active energy import fundamental
- iv) Summated active energy export fundamental

17.0 DATA COMMUNICATION CAPABILITY

The summation unit and feeder meter system should have a suitable communication ports following communication ports for local/remote reading. Simultaneous communication over all ports shall be available.

- i) optical port
- ii) RS232 port (for remote communication or dedicated to Modem)
- iii) TCP/IP Ethernet (should be configurable on DLMS TCP/MODBUS TCP)
- iv) USB port (meter data collection)

Meter reading instrument (MRI) shall be used for the purpose of local meter reading via this optical communication port and Pen drive for USB port. MRI shall serve as the interface between meters and PC loaded with Base Computer Software. It shall also be possible to download meter data via this port by connecting laptop computer directly. The overall intention is to have the local ports is to tap the data stored in meter once in a week/month and transmit the same to PC with BCS for view.

Easy integration with third party software over Ethernet, meter shall have support of **two clients** to access meter data over DLMS as well as MODBUS simultaneously.

18.0 The summation unit shall have a unique identification code i.e. serial number, which shall be marked on name plate as well as in its memory.

19.0 Each summation unit shall have a non volatile memory in which the parameters as mentioned in this specification shall be stored. The non volatile memory shall retain the data for a period not less than 10 years under un-powered condition; battery back up memory shall not be treated as NVM.

20.0 TRANSACTIONS

The summation unit shall record critical events (as performed in authenticated manner) of Time set, MD reset operation, Communication status with feeder meter and tariff change. These events shall be logged in roll over mode.

TECHNICAL SPECIFICATIONS FOR 0.2SACCURACY CLASS AC STATIC TRIVECTOR ENERGY METERS, SUITABLE FOR FEEDER METERING

1.0 SCOPE

- 1.5 This specification covers the design, engineering, manufacture, assembly, inspection and testing before supply and delivery at site/ FOR destination of class 0.2S accuracy static HT tri-vector CT/ VT operated meters, along with other associated equipments as per details given in this specification. The meters shall be used for commercial/ tariff metering for inter utility power flows/ bulk consumers as well for Availability Based Tariff (ABT) application.
- 1.6 The meter shall be complied with DLMS User Association for DLMS specification. The meter records parameters under import and or export conditions.
- 1.7 The meter shall be supplied in 3-phase 4-wire mode. However, provision shall be there to configure the meter in 3-phase 3-wire mode, as & when required, through authenticated/secured commands
- 1.8 The metering system shall be housed in rack with draw out type feature capability for inserting the meter module. **Current terminal connection must be shorted when module is drawn out.** The rack shall have facility to accommodate either one or two individual 0.2S accuracy class meter modules for supporting the single and multiple points of installation practices respectively.
- 1.9 The meter shall have wide secondary current range support i.e. same meter shall be put up for 1A or 5A rating as per field availability of CT's. The meter shall support 200% I_{basic}. Meter required to be commissioned at each substation shall be of 3 phase 4 wire.
- 1.10 The meter shall be self-powered. The meter shall normally operate with the power drawn from the VT secondary circuits, without the need for any auxiliary power supply. However, there shall be provision of functioning of the meter with the help of auxiliary supply, both AC & DC. The power supply in self powered condition shall be from all the three phases of VT secondary, preferably equally, to ensure meter power supply when VT fuse(s) failures happen in one or two phases
- 1.11 It is not the intent to specify completely herein all the details of the design and construction of material. The material shall, however, conform in all respects to the best industry standards of engineering, design and workmanship and shall be capable of performing for continuous commercial operation in a manner acceptable to the purchaser. The offered equipment shall be complete in all respects including all components/ accessories for effective and trouble free operation according to the specifications. Such components shall be deemed to be within the scope of this specification irrespective of whether those are specifically brought out or not.

2.0 APPLICABLE STANDARDS

2.1 STANDARDS

The equipment shall conform (for testing, performance and accuracy) in all respects the relevant Indian/ International metering standards with latest amendments thereof unless otherwise specified.

S. No.	Standard No.	Title
1.	IS 14697	AC static transformer operated Watt-hour and VAR-hour meters for class 0.2S and 0.5s

2.	IS 15959 DLMS companion Standard (ICS)	AC static transformer operated Watt-hour and VAR hour meters for class 0.2S category B (ABT compliant) metering
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2.2 Equipments matching with requirements of other national or international standard which ensure equal or better performance than the standards mentioned above shall also be considered. When the equipment offered by the bidder conforms to standards other than those specified above, salient points of difference between standards adopted and standards specified in this specification shall be clearly brought out in the relevant schedule and copy of such standards along with their English translation shall invariably be furnished along with the offer.

3.0 CLIMATIC CONDITIONS

The meters to be supplied against this specification shall be required to operate satisfactorily and continuously under the following tropical conditions of hot, humid, dusty, rust and fungus prone environment.

i)	Max. ambient air temperature (°C)	: 55
ii)	Min. ambient air temperature (°C)	: (-) 5
iii)	Average daily ambient air temp. (°C)	: 32
iv)	Max. Relative Humidity (%)	: 95
v)	Min. Relative Humidity (%)	: 10
vi)	Max. Altitude above mean sea level (m)	: 1000
vii)	Average Annual Rainfall (mm)	: 1200
viii)	Max. wind pressure (Kg/Sq.m)	: 195
ix)	Isoceraunic level (days per year)	: 50
x)	Seismic level (Horizontal Accn. in g)	: 0.3

4.0 PRINCIPAL PARAMETERS

The energy metering rack with meters shall be indoor type connected with the secondary side of outdoor current and voltage transformers and mounted in suitable panel/ cubicles.

S. No.	Item	Specification
1.	Type of Installation	Indoor panel/ cubicle mounted
2.	VT secondary	3x110V/ $\sqrt{3}$ Phase to Neutral (3P4W) Variation -30% to +20%
3.	CT secondary	Ib: 1 A or 5 A (configurable as per requirement)
4.	Auxiliary AC/ DC Supply	60-240 V AC/DC $\pm$ 20%, 50/60 Hz or VT powered
5.	System frequency	50HZ $\pm$ 5%
6.	Earthing System	Solidly Grounded

The meter should be suitable for working with above supply variations without damage and without degradation of its metrological characteristics.

5.0 TECHNICAL REQUIREMENTS

5.1 DISPLAY

The display of the meter shall indicate direct values (i.e. without having to apply any multiplying factor) of measured / computed parameters as per the meter configuration during commissioning. The display values shall accompany suitable legends, signs and OBIS code for identification. The meter shall have Graphical LCD with backlight for proper depicting of values in user friendly manner like values with unit, OBIS codes, negative signs, favourite page etc.

The energy register shall not take roll-over before 1500 hours of continuous operation with power equivalent to rated maximum current at reference voltage and unity power factor.

The meter shall be able to display the following parameters on demand & in Auto scroll mode, but the display of these parameters shall be programmable at site. There should be two push buttons for up & down scroll of display parameters.

1. Real Time Clock – Date and Time
2. Phase wise line Current
3. Phase wise Voltage
4. Signed Power Factor –R phase , Y phase, B phase
5. Three Phase Power Factor – PF
6. Phase wise %THD Current
7. Phase wise %THD Voltage
8. Frequency
9. Apparent Power – KVA
10. Signed Active Power – kW (+ Forward;- Reverse)
11. Signed Reactive Power – kvar (+ Lag; -Lead)
12. Cumulative Energy kWh Import total
13. Cumulative Energy kWh Export total
14. Cumulative Energy kWh Import fundamental
15. Cumulative Energy kWh Export fundamental
16. Cumulative Energy kVAh Import
17. Cumulative Energy kVAh Export
18. Cumulative Tamper Count
19. Cumulative Billing Count
20. Billing Date (Most Recent)
21. Meter serial nos.
22. Cumulative Energy kVAh Lag while active import
23. Cumulative Energy kVAh Lead While active Import
24. Cumulative Energy kVAh Lag while active Export
25. Cumulative Energy kVAh Lead While active Export
26. Cumulative Energy Net Reactive High (i.e. when RMS Voltage >103% Vn)
27. Cumulative Energy Net Reactive Low (i.e. when RMS Voltage <97% Vn)
28. Rising Demand with Elapse Time
29. Maximum Demand Active –Import (0-24 Hrs)
30. Maximum Demand Active – Export (0-24 Hrs)
31. Maximum Demand Apparent While Active Import (0-24 Hrs)
32. Maximum Demand Apparent While Active Export (0-24 Hrs)
33. Last Block Average Frequency
34. Cumulative Maximum Demand –Import
35. Cumulative Maximum Demand –Export
36. High Resolution Active Import total
37. High Resolution Active Export total
38. High Resolution Active Import fundamental
39. High Resolution Active Export fundamental
40. High Resolution Apparent Import
41. High Resolution Apparent Export
42. Net Active Energy (I-E)
43. Net Reactive Energy
44. Net Reactive High (I-E)
45. Net Reactive Low (I-E)

The meter shall have the provision to display graphical representation of current & voltage vectors, both magnitude and angle, for each phases.

5.2 POWER FACTOR RANGE

The metering system shall be suitable for full power factor range from zero (lagging) through unity to zero (leading). The metering module shall work as an active energy import and export meter along with reactive (lag and lead) meter. The energy measurement should be true four quadrant type.

5.3 ACCURACY

Class of accuracy of the metering system shall be 0.2S for energy measurement. The accuracy should not drift with time.

5.4 POWER CONSUMPTION OF METER

- i) The meter must be capable to operate with the power drawn from the Auxiliary Power supply (AC/DC) instead of Station VT power supply.
- ii) Voltage Circuit: The active and apparent power consumption in each voltage circuit including the power supply of metering module at reference voltage, reference temperature and reference frequency shall not exceed 1 Watt per phase and 1 VA per phase respectively.
- iii) Current Circuit: The apparent power taken by each current circuit at basic current, reference frequency and reference temperature shall not exceed 1 VA per phase.

5.5 STARTING CURRENT

The metering module should start registering the energy at 0.1% Ib and unity power factor.

5.6 MAXIMUM CURRENT

The rated maximum current of the metering module shall be 120% of basic current (Ib).

5.7 The meter shall work accurately irrespective of phase sequence of the mains supply.

5.8 GENERAL CONSTRUCTIONAL REQUIREMENTS

Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However the following should be ensured:

- i) Personnel safety against electric shock
- ii) Personnel safety against effects of excessive temperature
- iii) Protection against spread of fire
- iv) Protection against penetration of solid objects, dust and water in normal working condition

All the materials and electronic power components used in the manufacture of the meters shall be of highest quality and reputed make to ensure higher reliability, longer life and sustained accuracy.

The meters shall be designed with application specific integrated circuits. The electronic components shall be mounted on the printed circuit board using latest Surface Mount Technology (SMT).

All insulating materials used in the construction of meters shall be non-hygroscopic, non-aging and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.

The metering system when mounted in panel shall conform to the degree of protection **IP53** in the normal working condition of IS 12063/ IEC 529 for protection against ingress of dust and moisture.

5.9 MANUFACTURING ACTIVITIES

Meter should be manufactured using SMT (Surface Mount Technology) components and by deploying automatic SMT pick and place machine and reflow solder process; the Bidder should own such facilities.

Quality should be ensured at the following stages:

- i) At PCB manufacturing stage, each board shall be subjected to computerized bare board testing.
- ii) At insertion stage all components should under go computerized testing for conforming to design parameters and orientation.
- iii) Complete assembled and soldered PCB should under go functional testing using Automatic Test Equipment.
- iv) Prior to final testing and calibration, all meters shall be subjected to accelerated ageing test to eliminate infant mortality.
- v) The calibration of meters shall be done in-house.

5.10 SEALING

Proper sealing arrangement shall be provided in metering system as follows:

- i) Two numbers sealing screws shall be provided on the front cover of metering module.
- ii) Provision shall be available to seal the back connections on the metering rack using the back plate.
- iii) Provision shall be available to seal optical port.

The sealing arrangement should be suitable for application of Polycarbonate seals.

5.11 MARKING OF METER

The basic marking on the metering module name plate shall be as follows:

- i) Manufacturer's name and trade mark
- ii) Serial Number
- iii) Year of manufacture
- iv) Type Designation
- v) Number of phases and wires
- vi) VT commissioning information
- vii) CT commissioning information
- viii) Reference frequency
- ix) Accuracy Class

Additionally, following information shall also be available on name plate.

- i) Property Of "Purchaser name"
- ii) P.O. No. "Number"

- 5.12** The connection diagram of the connecting 3P4W meter shall be depicted via suitable sticker pasted on meter. The meter terminals shall be properly marked to identify voltage, Current, Auxiliary and communication ports.
- 5.13** The meters shall compute the active energy and load import; active energy and load export from the substation bus bars during each successive **5/15/30 minute** integration period block and store it in its non volatile memory.
- 5.14** The meter shall compute the average frequency during each successive configured block and store in its memory.
- 5.15** The meters shall be suitable for being connected directly through its terminals to VT's having a rated secondary line- to- line voltage of 110 V, and to CTs having a rated secondary current of 1A or 5A. Any further transformers/ transducers required for their functioning shall be in-built in the meters. Necessary isolation and/or suppression shall also be built-in, for protecting the meters from surges and voltage spikes that occur in the VT and CT circuits of extra high voltage switchyards.
- 5.16** The active energy measurement shall be carried out on 3 phase, 4 wire principle with an accuracy as per class 0.2S of IS14697. The meters shall compute the active energy and load import; active energy and load export from the substation bus bars during each successive configured integration period block and store it in its non volatile memory.
- 5.17** The meter shall compute the average frequency during each successive 15 minute block and store in its memory.
- 5.18** The meter shall have Inputs/ Outputs pulsing pins availability. This shall help in transferring the same Energy parameters being recorded inside the meters on pulse output as well for SCADA application at remote distance.
- 5.19** The meter shall compute the reactive power on 3-phase, 4-wire principle, with an accuracy as per relevant IS/ IEC standards, and integrate the reactive energy algebraically into two separate reactive energy registers, one for the period for which the average RMS voltage is greater than 103% (Reactive High), and the other for the period for which the average RMS voltage is below 97.0% (Reactive Low). When lagging reactive power is being sent out from substations bus bars, reactive registers shall move forward. When reactive power flow is in the reverse direction, reactive registers shall move backwards.
- 5.20** Further, the reactive energy shall also be available in four different registers as-
- i. Reactive import while active import
 - ii. Reactive import while active export
 - iii. Reactive export while active import
 - iv. Reactive export while active export
 - v. Reactive import
 - vi. Reactive export
 - vii. Net reactive energy (Q1+Q2-Q3-Q4)
 - viii. Net Reactive high
 - ix. Net Reactive low
- 5.21** Active and Apparent energies shall also be made available by meter in separate energy registers as –
- i. Active energy Import total
 - ii. Active energy Export total
 - iii. Active energy Import fundamental

- iv. Active energy Export fundamental
- v. Net active energy (import – export)
- vi. Apparent energy (while active import)
- vii. Apparent energy (while active export)

5.22 Meter shall have provision to compute apparent energy based on lag only or lag+lead. The same shall be configured at factory end.

5.23 The meters shall be compatible with ABT tariff as well as TOD tariff.

5.24 For reactive power and reactive energy measurement, limits of errors all the four quadrants shall be in accordance to IS14697.

5.25 Each meter shall have a calibration LED (visual) for checking the accuracy of active energy measurement. Further, it shall be possible to switch over the same test output device to reactive energy via suitable means provided on the metering system. This LED shall be visible from the front side.

5.26 The metering system shall normally operate with the power drawn through the auxiliary AC or DC supply. The metering system design should enable the auxiliary supply to be switched automatically between the AC and DC voltage, depending upon their availability. Typical auxiliary voltages available are 110V AC and 110/ 220V DC. The system shall continue to work even if any one of the above auxiliary supply (AC/ DC) is present.

5.27 Meter shall have a built-in calendar and clock, having an accuracy of Accuracy: <2 min/year or better. The calendar and clock shall be correctly set at the manufacturer's works. Summator shall be master to adjustment feeder meters RTC with proper security. Summator shall sync feeder meter time at least once in a day. Summator unit time shall be possible to set through suitable high level software/ MRI as an authenticated transaction.

5.28 The meter shall have two separate batteries one for RTC and one replaceable battery for display. An automatic backup for continued operation of the meter's calendar-clock shall be provided through a long life battery, which shall be capable of supplying the required power for at least two years under meter un-powered conditions. The battery used for display purpose, shall reside in a separate sealable chamber so that it can be replaced at site, in need, without affecting the performance/behavior/operation of the meter.

5.29 TOD (Time of day registers): The meter shall have TOD registers for active energy import and export, apparent energy import and export and apparent MD import and export. Maximum eight time of day registers including universal (0-24 hrs) register can be defined. It shall be possible to program number of TOD registers and TOD timings through suitable high level software/ MRI as an authenticated transaction.

5.30 Maximum Demand (MD) Registration: The meter shall continuously monitor and calculate the average demand of configured parameter during the integration period set and the maximum, out of these shall be stored along with date and time when it occurred in the meter memory. The maximum demand shall be computed on fixed block principle. The maximum registered value shall be made available in meter readings. The integration period shall be set as 15 minutes that shall be capable to change to other integration period (5/15/30 minutes), if required, through suitable high level software/ MRI as an authenticated transaction.

5.31 Maximum Demand Reset: Following provisions shall be available for MD reset in meter –

- v) Auto billing at predefined date and time

Summator shall be master to set feeder meter's maximum demand with proper security. Maximum demand of Summator unit shall be possible to set through suitable high level software/ MRI as an authenticated transaction.

5.32 The display shall be of Graphical LCD type with colored back-lit and soft push button. Individual display shall be provided for all the meters housed in a metering rack.

The display shall indicate direct values (i.e. without having to apply any multiplying factor) of measured/ computed parameters as per the meter commissioning. It should be possible to easily identify the single or multiple displayed parameters through legends on the metering system display like OBIS codes etc.

The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register shall not roll over in between this duration.

5.33 Each of the metering module shall display on demand & in Auto scroll mode the following quantities/ parameters:

- i) LCD segment check
- ii) Date
- iii) Time
- iv) Cumulative active energy import total
- v) Cumulative active energy export total
- vi) Cumulative active import energy fundamental
- vii) Cumulative active export energy fundamental
- viii) Cumulative net active (Import – Export) energy
- ix) Cumulative reactive energy lag while active import
- x) Cumulative reactive energy lead while active import
- xi) Cumulative reactive energy lag while active export
- xii) Cumulative reactive energy lead while active export
- xiii) Cumulative apparent energy (while active import)
- xiv) Cumulative apparent energy (while active export)
- xv) Cumulative Reactive High energy
- xvi) Cumulative Reactive Low energy
- xvii) Last block average of active import energy
- xviii) Last block average of active export energy
- xix) Last block average of the net active (Import – Export) energy
- xx) Last block average frequency
- xxi) MD reset count
- xxii) Maximum demand apparent (while active import) for current month (0-24 hrs)
- xxiii) Maximum demand apparent (while active export) for current month (0-24 hrs)
- xxiv) History-1 Cumulative active import energy total
- xxv) History-1 Cumulative active export energy total
- xxvi) History-1 Cumulative active import energy fundamental
- xxvii) History-1 Cumulative active export energy fundamental
- xxviii) History-1 Cumulative net active (Import – Export) energy
- xxix) History-1 Cumulative apparent energy (while active import)
- xxx) History-1 Cumulative apparent energy (while active export)
- xxxi) History-1 Maximum demand for apparent (while active import)
- xxxii) History-1 Maximum demand for apparent (while active export)
- xxxiii) Present anomaly status
- xxxiv) Date of first occurrence of anomaly
- xxxv) Time of first occurrence of anomaly
- xxxvi) Time of last restoration of anomaly
- xxxvii) Date of last restoration of anomaly

xxxviii) Total anomaly count

Meter shall have provision to configure some selected display parameters in one favorite page.

5.34 Load Survey: Each meter shall have a non-volatile memory in which the at least following energy parameters and instantaneous parameters shall be automatically stored for each successive fifteen (15) minute block. Meter shall have adequate memories to store 250 days load survey data for 10 parameters with 15 minute block.

- i. Real Time Clock, date & time
- ii. Active Energy Import fundamental
- iii. Active Energy Export fundamental
- iv. Apparent while active Import
- v. Apparent while active Export
- vi. Reactive Energy –Q1
- vii. Reactive Energy –Q2
- viii. Reactive Energy –Q3
- ix. Reactive Energy –Q4
- x. Average Frequency
- xi. Voltage – VRN
- xii. Voltage –VYN
- xiii. Voltage –VBN
- xiv. Line Current –L1
- xv. Line Current –L2
- xvi. Line Current -L3

i.e. it can store values of 10 parameters on 5 minutes integration period basis (SIP) for 90 days

It shall be possible to select either energy or demand view at Base Computer Software (BCS) end. The load survey data should be available in the form of bar charts as well as in spreadsheets. The BCS shall have the facility to give complete time synchronized load survey data both in numeric and graphic form.

5.35 Billing parameters: The predefined date and time for registering the billing parameters of shall be 00.00 hours of the first day of each calendar (billing) month. Each meter shall store the following parameters corresponding to defined bill dates for up to last six (12) months:

- i) Active energy import total
- ii) Active energy export total
- iii) Active energy import fundamental
- iv) Active energy export fundamental
- v) Apparent energy (while active import)
- vi) Apparent energy (while active export)
- vii) Maximum demand Apparent (while active import)
- viii) Maximum demand Apparent (while active export)

5.36 Daily midnight parameters: The metering modules shall store following end day parameters for last thirty five (60) days:

- i) Active energy import total
- ii) Active energy export total
- iii) Active energy import fundamental
- iv) Active energy export fundamental

- v) Reactive high energy
- vi) Reactive low energy

5.37 Data Communication Capability:

The metering system should have a suitable communication ports following communication ports for local/remote reading. **Simultaneous communication** over all ports shall be available. These communication modes shall support configuration of the meter locally or from remote, as applicable.

- v) Optical port
- vi) RS232 port (for remote communication or dedicated to Modem)
- vii) TCP/IP Ethernet (should be configurable on DLMS TCP/MODBUS TCP)
- viii) USB port

Meter reading instrument (MRI) shall be used for the purpose of local meter reading via this optical communication port. MRI shall serve as the interface between meters and PC loaded with Base Computer Software. It shall also be possible to download meter data via this port by connecting laptop computer directly. The overall intention is to have the local ports is to tap the data stored in meter once in a week/month and transmit the same to PC with BCS for view.

USB port shall be used for fast data collection locally from meter through Pen drive and saved data in Pen drive shall also be possible to download in PC using suitable S/W or BCS.

RS232 port shall be with **configurable communication baud rate support up to 56700 bps** and optional Ethernet communication port for remote data transfer to a central location. This port shall be capable of data transfer to a remote computer over suitable communication media (GPRS/VSAT/ Leased line/ OFC) using suitable communication hardware (modems/ multiplexer/ communication cables etc.) as required for proper functioning of remote meter reading and meter configuration. **Display, scaling, TOU, Pulse output/Inputs, Clock set, Interval change, Load survey parameters etc shall be programmable at site.**

TCP / IP shall be configured as DLMS ICS and MODBUS. Meter should have support of **ABT parameters over MODBUS** to integrate with third party software. This dual open protocol support shall enable SCADA / DMS support. Ports can be configured as per requirement.

Easy integration with third party software over Ethernet, meter shall have support of **two clients** to access meter data over DLMS as well as MODBUS simultaneously.

5.38 Each meter shall have a unique identification code i.e. serial number, which shall be marked on name plate as well as in its memory. Further all meters of the same model shall be totally identical in all respects except for their unique identification codes.

5.39 The meters shall safely withstand the usual fluctuations arising during faults etc. In particular, 115% of rated VT secondary voltage applied continuously and 190% of rated voltage applied for 3.0 seconds, and 20 times of rated CT secondary current applied for 0.5 seconds shall not cause any damage to or malfunctioning of the meters. Further the immunity of metering system to external magnetic field shall be as per latest CBIP recommendations.

5.40 Each meter shall have a non volatile memory in which the parameters as mentioned in this specification shall be stored. The non volatile memory shall retain the data for a period not less than 10 years under un-powered condition; battery back up memory shall not be treated as NVM.

5.41 The metering modules shall be draw out type with automatic CT shorting feature so as to ease the testing/ replacement of meters without disturbing the system.

5.42 The meter display should depict the total harmonic distortion (THD) of current and voltages up to 31st level of power quantity for providing the feature of supply monitoring to Utility.

6.0 ANOMALY DETECTION FEATURES

6.1 The meter shall have features to detect and log the occurrence and restoration of following anomalies, along with date and time of event:

- i) **Phase wise Missing Potential** – The meter shall detect missing potential (1 or 2 phases) provided the line current is above a specified threshold. The voltage at that stage would be below a specified threshold.
- ii) **Phase wise Current Circuit Reversal** – The meter shall detect reversal of polarity provided the current terminals are reversed. This shall be recorded for 1 or 2 phase CT reversal.
- iii) **Voltage Unbalance** – The meter shall detect voltage unbalance if there is unbalance in voltages.
- iv) **Current Unbalance** – The meter shall detect current unbalance if there is unbalance in load conditions. Meter should ensure true system conditions before going for current unbalance checks.
- v) **CT Miss** – The meter shall detect current miss if the current is below a defined threshold, provided the phase voltage is above a specified threshold.

Snapshots of phase wise voltage, phase wise active current and phase wise power factor shall be provided with above specified anomaly events.

Further, each meter module shall record the following events along with total duration:

- i) **Power On/Off** – The meter shall detect power off if both the auxiliary supplies fail. The event shall be recorded on the next power up. At the same time power on event shall be recorded. No snapshot shall be logged with this event.
- ii) **Feeder Supply Fail** -This event shall be logged when feeder supply, i.e. all the voltages goes below certain threshold. No snapshot shall be logged with this event.

Following additional tampers should also be provided in the meter:

- a. Over voltage
- b. Under voltage
- c. Voltage sag (power quality)
- d. Voltage swell (power quality)
- e. Voltage interruption (power quality)
- f. Voltage unbalance (power quality)
- g. Neutral disturbance
- h. Magnet detection

6.2 Last three hundred & fifty (350) events (occurrence + restoration), in total, shall be stored in the meter memory on first in first out basis.

6.3 There shall be five separate compartments for logging of different type of anomalies :

Compartment No.1	100 events of Missing Potential
Compartment No.2	100 events of CT Reversal
Compartment No.3	100 events for Power Failure / Power On-Off
Compartment No.4	50 events of Transaction related changes as per ICS Category B

Once one or more compartments have become full, the last anomaly event pertaining to the same compartment shall be entered and the earliest (first one) anomaly event should disappear. Thus, in this manner each succeeding anomaly event shall replace the earliest recorded event, compartment wise. Events of one compartment/ category should overwrite the events of their own compartment/ category only. In general persistence time of 5 min. for occurrence and restoration respectively need to be supported in meter.

6.4 Anomaly count should increase as per occurrence (not restoration) of anomaly events. Total no. of counts shall be provided on BCS.

7.0 TRANSACTIONS

The meter shall record critical events (as performed in authenticated manner) of MD reset operation and tariff change. These events shall be logged in roll over mode for up to twenty numbers.

8.0 SELF DIAGNOSTIC FEATURE

The meter shall be capable of performing complete self diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data in memory location all the time. The meter shall have indications for unsatisfactory/ nonfunctioning/ malfunctioning of the following:

- i) Non volatile memory
- ii) RTC battery

The above malfunctioning should be flagged in the meter memory and should be made available in meter reading data.

9.0 TYPE TEST CERTIFICATES

The meters shall be fully type tested as per relevant standards IS 14697. The type test report of the meters shall be submitted by bidder along with the offer. Type test reports shall not be more than 2 years old.

GURANTEED TECHNICAL PARTICULARS – STANDARD SUMMATION UNIT

S. No.	Technical Specification Requirements	Bidder's Offer
1.	Manufacturer's name & Country	Secure Meters Ltd. India
2.	Name and model no. of offered product	Summator 100 S3E021-002
3.	MD Reset provisions a. Auto b. Manual	a. Yes b. Yes
4.	Demand integration period	Configurable (15,30)
5.	Method of concurrent apparent demand/ energy calculation	Real Time computation of apparent for concurrent demand
6.	Load survey parameters recorded in summation unit	- Summated active energy import total - Summated active energy export total - Summated active energy import fundamental - Summated active energy export fundamental - Summated reactive energy lag while active import - Summated reactive energy lead while active import - Summated reactive energy lag while active export - Summated reactive energy lead while active export - Summated apparent energy (while active import) - Summated apparent energy (while active export)
7.	Billing parameters recorded in summation unit	- Summated active energy import total - Summated active energy export total - Summated active energy import fundamental - Summated active energy export fundamental - Summated reactive energy lag while active import - Summated reactive energy lead while active import - Summated reactive energy lag while active export - Summated reactive energy lead while active export - Summated apparent energy (while active import) - Summated apparent energy (while active export)
8.	Daily Midnight parameters recorded in	

	summation unit	- Summated active energy import total - Summated active energy export total - Summated active energy import fundamental - Summated active energy export fundamental
9.	Communication Capability for a. Local reading b. On demand Remote reading	a. Yes b. Yes
10.	Communication ports	Optical, USB, RS232 and Ethernet

GURANTEED TECHNICAL PARTICULARS – FEEDER METERS

S. No.	Technical Specification Requirements	Bidder's Offer
1.	Manufacturer's name & Country	Secure Meters Ltd. India
2.	Type of Meter	R3E
3.	Name of offered product	Apex 100
4.	Type of Mounting	Rack
5.	Standards to which meter complies	IS 15959 cat-B, IS 14697
6.	Accuracy class a. Active energy measurement b. Reactive energy measurement	a. 0.2s b. 0.5s
7.	Metrology indicator provided on meter and switching facility for reactive & apparent energy	LED 1: Active Energy LED 2: Configurable (Reactive or Apparent)
8.	Variation of voltage at which system functions normally as per IS 14697	Yes
9.	Minimum Starting current	0.1 % of Ib
10.	Maximum current	200% of Ib
11.	P.F. range	Zero to Unity (Lag, Lead)
12.	Power consumption per phase a. Voltage Circuit b. Current Circuit	a. 0.1VA/phase b. 0.1VA/phase, <0.5VA/phase @ 5A Ibasic
13.	AC and DC Auxiliary supply ratings for powering up the metering system	60-240 V AC/DC $\pm$ 20%, 50/60 Hz or VT powered
14.	Sealing arrangement	- One seals on front cover - Two seals on Back plate - One seal on Optical port - One seal on MD button - Two seal rack to meter
15.	Energy parameters recorded in meter	- Active energy Import total - Active energy Export total - Active energy Import fundamental - Active energy Export fundamental - Net active energy (import – export) - Apparent energy (while active import) - Apparent energy (while active export) - Reactive import while active import - Reactive import while active export - Reactive export while active import

		11. Reactive export while active export 12. Reactive import 13. Reactive export 14. Net reactive energy (Q1+Q2-Q3-Q4) 15. Net Reactive high 16. Net Reactive low
16.	ABT compatibility	Yes
17.	TOD compatibility	Yes
18.	MD Reset provisions a. Auto on billing date b. Through Summator unit	a. Yes b. Yes
19.	Demand integration period	Configurable (15 & 30)
20.	Survey Integration Period	Configurable (15 & 30)
21.	No. of Load Survey Days	250
22.	Load survey parameters recorded in meter	1. Real Time Clock, date & time 2. Active Energy Import fundamental 3. Active Energy Export fundamental 4. Apparent while active Import 5. Apparent while active Export 6. Reactive Energy –Q1 7. Reactive Energy –Q2 8. Reactive Energy –Q3 9. Reactive Energy –Q4 10. Average Frequency 11. Voltage – VRN 12. Voltage –VYN 13. Voltage –VBN 14. Line Current –L1 15. Line Current –L2 16. Line Current –L3
23.	Billing parameters recorded in meter	1. Active energy import total 2. Active energy export total 3. Active energy import fundamental 4. Active energy export fundamental 5. Apparent energy (while active import) 6. Apparent energy (while active export) 7. Maximum demand Apparent (while active import) 8. Maximum demand Apparent (while active export)
24.	Daily Midnight parameters recorded in meter	1. Active energy import total 2. Active energy export total 3. Active energy import fundamental 4. Active energy export fundamental 5. Reactive high energy 6. Reactive low energy
25.	Daily Midnight Snapshot Days	35
26.	Communication Capability for a. Local reading b. On demand Remote reading	a. Yes b. Yes

27.	Facility of external CT/ VT error compensation	Yes
28.	Anomaly detection features	Yes
29.	Self diagnostics features	Yes
30.	Magnetic immunity	Yes
31.	Communication ports	Optical, USB, RS232 and Ethernet

ANNEXURES -4
STANDARD OPERATING PROCEDURE FOR INTEGRATION OF THIRD-PARTY IEM/DCU IN AMR SYSTEM
(22 SHEETS)


MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD.
(CIN NO. U40109MH2005SGC153646)

From:
Office of the Chief Engineer (AC & I),
Old Load Despatch centre Building,
Thane Belapur road, Airoli Sector-1.
Navi-Mumbai-400708
E-mail : ceaci@mahatransco.in
Tel. No: 022-27600405
Web: <http://www.mahatransco.in>

To,
The Superintending Engineer
Testing & Communication Circle,
MSETCL, Akola/Aurangabad/Karad/
Nagpur/ Nashik/Pune/Vashi.

MSETCL/CO/CE (AC&I)/Integration IEM/ 0102

Date: 06 FEB 2020

SUB: Integration of third party DLMS meters in DAS system.

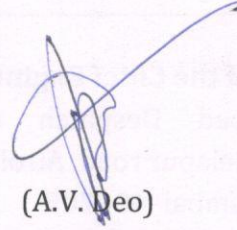
REF: L&T L. No. L&T-C&A/MSETCL/AMR/L-100 dtd. 27-Jan-2020.

This is in connection with the above subject, M/s L&T vide letter under reference informed that for integration of third party IEM to DAS system **the meter has to confirm to the Indian Companion Standard for DLMS as prescribed in the BIS 15959 documents for ABT**.

As the integration of third party IEM with DAS system is in the scope of M/s L&T & requested to provide the following,

1. Sample meter shall be provided at L&T office for testing before integration.
2. Supplier/manufacturer has to provide Association parameters like client ID/Logical ID and passwords (16, 32, and 48).
3. Object list with OBIS captured as per approved MSETCL specification. The approved IEM technical data sheet/specification along with OBIS list is already forwarded by this office.
4. Meter shall support for 5 minute Load profile (LP).
5. Meter support for changeover from 15 minute to 5 minute for LP and in case of changeover from 15 minute to 5 minute, meter supplier/manufacturer has to carry out this changeover as & when required.
6. Meter support for time Sync. & philosophy.
7. Meter supplier/manufacturer has to provide meter configuration tool for changing IP.
8. Configuration of additional template for meter if any in the scope of Meter supplier/manufacturer.

In View of above, it is requested to ensure the above parameters while procuring/purchasing the IEM meters other than L&T make for integration with DAS system of AMR project.



(A.V. Deo)

Chief Engineer (AC&I)

Copy s. w. r. s. to:

The Director (Project/Operation), CO, MSETCL.

Copy f. w. c. to:

**The Chief Engineer EHV PC O&M Zone, MSETCL, Amaravati/Aurangabad/Karad/
Nagpur/ Nashik/ Pune/ Vashi**

Copy to:

**The SE EHV O&M Circle, MSETCL, Amaravati/Akola/Aurangabad/Parli-Vaijanath/
Karad/Kolhapur/Nagpur/Chandrapur/HVDC, Chandrapur/Nashik/Bhusaval/Pune/
Solapur/Kalwa/Panvel/HVDC, Padghe.**



MAHATRANSCO
Maharashtra State Electricity Transmission Co. Ltd.
MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD.
(CIN NO. U40109MH2005SGC153646)

स्वातंत्र्याचा अमृत महोत्सव

From:

Office of the **Chief Engineer (ACI&P)**,
Old Load Despatch centre Building,
Belapur Road, Airoli Sector-1.
Navi- Mumbai – 400708

Thane

Web: <http://www.mahatransco.in>

To,

1. The Superintending Engineer,
EHV O&M Circle, MSETCL,
Amravati/ Akola/ Aurangabad/Parli-Vaijanath/
Karad/ Kolhapur/ Nagpur/ Chandrapur/ HVDC,
Chandrapur/Nashik/Bhusaval/Pune/Solapur/
Kalwa/ Panvel/ HVDC, Padghe.
2. The Superintending Engineer (PAC)
MSETCL, Akola/Aurangabad/Karad/ Nagpur/
Nashik/Pune/Vashi.

MSETCL/CO/CE (ACI&P)/AMR/INT/SOP/No.

00639

Date: 28 DEC 2022

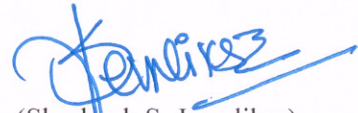
SUB: **Standard Operating Procedure (SOP) for integration of Third Party IEM/DCU in AMR**
System at SLDC, Airoli.

REF: T. O. L. No. L. No. MSETCL/CO/AMR/INT/WO/420 dtd. 11.08.2022.

In context to the above subject, the work order for rate contract for integration services of Interface Energy Meters (IEMs) in Existing Automated Meter Reading (AMR) / MDAS system at SLDC, Airoli was placed to M/s L&T (SEIPL) vide letter under ref. The Standard Procedure to be adopted for integration of Third Party IEMs/DCUs in cases where the integration costs are to be recovered from any of the connectivity holder as per connectivity issued by STU or to be borne by MSETCL is enclosed herewith for information & needful.

You are requested to adopt the **SOP for integration of third party IEMs/DCUs** & follow the directives scrupulously.

Encl. - SOP for integration of third party IEMs/DCUs.


(Shashank S. Jewalikar)
Chief Engineer (ACI&P)

Copy s. w. r. s. to:

1. The Director (Operations), CO, MSETCL, Mumbai.
2. The Executive Director, (MSLDC), Airoli, Navi Mumbai.
3. The Executive Director (Tr. O&M) CO, MSETCL, Mumbai.

Copy s. w. c. to:

1. The Chief Engineer (STU), MSETCL, Mumbai.
2. The Chief Engineer (MSLDC), Airoli, Navi Mumbai.
3. The Chief Engineer EHV PC O&M Zone, Amravati/Aurangabad/Karad/Nagpur/Nashik/Pune/ Vashi.
4. The Chief General Manager (F&A) CO, MSETCL Mumbai.

Copy to:

The Manager (F&A), **EHV O&M Circle, MSETCL**, Amravati/ Akola/ Aurangabad/Parli-Vaijanath/ Karad/ Kolhapur/ Nagpur/ Chandrapur/ HVDC, Chandrapur/Nashik/Bhusaval/Pune/Solapur/Kalwa/ Panvel/ HVDC, Padghe.



**MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD
OFFICE OF CHIEF ENGINEER (AC I & P) CO, AIROLI**

**PROCEDURE FOR INTEGRATION OF THIRD PARTY IEM/DCU IN
AMR SYSTEM**

1. The work order for **rate contract** for **integration services of Interface Energy Meters (IEMs)** in Existing Automated Meter Reading (AMR) / MDAS system at SLDC, Kalwa was placed to M/s L&T by MSETCL vide L. No. MSETCL/CO/AMR/INT/WO/420 dtd. 11.08.2022.

2. The integration of IEMs/DCUs purchased vide W.O. MSETCL/CO/ CE(AC&I)/ AMR/WO/T01/2019-20/0128 dtd 14.02.2020 (AMR Project) and Extn. WO. MSETCL/CO/CE/ACI&P/AMR/EXT/WO/ No. 0113 dtd 10.03.2022 is in the scope of M/s L&T. Hence this procedure is not applicable for the above said orders.

3. **CASE-I:** In cases where the integration costs are to be recovered from any of the **Connectivity holder** [CPP, IPP & EHV consumers, Renewable Energy (Hydro/Solar/Wind), TSS etc.] as per **connectivity issued by STU or IEM/DCU** procured **under project work** & integration charges are **included in the scope of Vendors**; the following procedure is to be adopted for integration of IEMs/DCU in AMR system.

3.1) The Connectivity holder/Vendor has to submit the **AMR system installation completion certificate** as per enclosed **Annexure-I** to SE EHV O&M Circle MSETCL.

3.2) SE EHV O&M Circle MSETCL, has to issue the **demand note** to **Connectivity holders** based on the no. of IEMs to be integrated as mentioned in AMR system Installation completion certificate and as per **work order for rate contract** for **integration services of Interface Energy Meters (IEMs)**.

3.3) The Connectivity holders /Vendor has to deposit / pay the integration charges of IEMs/DCUs as per rate contract work order mentioned above.

3.4) The following SAP entry shall be carried out by EHV O&M circle office on receipt of deposit amount from Connectivity holders/Vendor.

3.4.1) Need to **create customer in SAP system** as soon as deposit is received. Circle office has to intimate customer details to CO F&A core team by e-mail as per prescribed format to create customer id in SAP. After creation of customer id; CO F&A core team, will intimate the same to circle office for passing customer Accounting entries in SAP system.

3.4.2) Entry at the time of receipt of deposit amount from connectivity holder / third party/Vendor: **(This entry will be passed through t code "F-29")**

Bank A/c	Dr.	
Customer with special GL indicator	Cr.	
(underlying GL is "123140-Deposit for IEM A/c")		New GL
(New customer to be created at the time of receipt of deposit)		

SCREEN SHOT of SAP

1

Post Customer Down Payment: Header Data

New Item Requests

Document Date: 15.11.2022 Type: 20 Company Code: 2005
Posting Date: 22.11.2022 Period: 8 Currency/Rate: INR
Document Number: Translatn Date:
Reference: IEM Deposit Cross-CC no.:
Doc.Header Text: IEM third party Deposit
Trading Part.BA: Tax Report Date:

Customer

Account: 1000004889 Special G/L ind: I
Altern.comp.cde:

Bank

Account: 285068 Business Area:
Amount: 181720 LC amount:
Bank charges: LC bank charges:
Value Date: Profit Center:
Text: IEM DEPOSIT Assignment: CH NO

2

Post Customer Down Payment Correct Customer item

More data New Item Withholding tax

Customer: 1000004889 Century Rayon G/L Acc: 123140
Company Code: 2005 test
MSETCL: shahad

Item 2 / credit / 19 I

Amount: 181,720.00 INR
☐ Calculate tax Bus./sectn: 7200 / 7200
Order: Network: /
Profit Ctr: 7200
WBS Element:

Assignment:

Text: IEM DEPOSIT Long Texts

3

Post Customer Down Payment Display Overview

New Item Display Currency Requests Additional Items

Document Date	15.11.2022	Type	ZD	Company Code	2005
Posting Date	22.11.2022	Period	8	Currency	INR
Document Number	INTERNAL	Fiscal Year	2022	Translatn Date	22.11.2022
Reference	IEM DEPOSIT	Cross-CC no.			
Doc.Header Text	IEM third party Deposit	Trading Part.BA			

Items in document currency

PK	BusA Acct	INR	Amount	Tax amnt
001 40	0000285068 Disbs BI 7200 Panve		181,720.00	
002 19I	1000004889 Century Rayon		181,720.00-	

4

Document 1400000471 was posted in company code 2005

3.4.3) Above **SAP entry Document number** along with **customer number** and **attested xerox copy of receipt of deposit** of customer / connectivity holder to be sent to respective **Zonal SE (PAC) circle & ACI&P C. O. office** by e-mail (ceaci@mahatransco.in / setel@mahatransco.in).

3.5) After receipt of information as mentioned above (3.3.3) from O&M Circle office, SE (PAC) has to submit **AMR System Integration Readiness Certificate** as per enclosed **Annexure-II** to SE (Tel) [setel@mahatransco.in] with a copy to CE (ACI&P) [ceaci@mahatransco.in] by e-mail.

3.6) After receipt of **Integration Readiness Certificate & SAP entry Document number** along with **customer number & attested xerox copy of receipt** of integration charges, following activities shall be taken up

3.6.1) E-mail communication will be sent from **SE (Tel), ACI&P CO** to **M/s L&T (SEIPL)** for carrying out integration activities of IEMs.

3.6.2) After receipt of intimation of **completion of integration of IEMs in MDAS** by **M/s L&T (SEIPL)**, the AMR team at ACI &P CO will verify,

(3.6.2.1) the automatic availability of meter data in MDAS / MDP system,

(3.6.2.2) availability of meter data to SLDC through API,

(3.6.2.3) creation of new user in case of new substation & mapping of all activities (e.g. SMS/e-mail, AMR reports etc.) with new user/sub-station like existing AMR user,

(3.6.2.4) In case of Existing S/s, mapping of newly integrated meter in same substation and storage location in existing AMR system.

3.6.3) Creating **PO in SAP** by ACI&P office.

3.6.4) Carrying out **Service Entry in SAP** of PO by ACI&P office.

3.6.5) CE (ACI&P) CO will inform **Service Entry Sheet (SES) No, Customer No. & SAP deposit document No.** to respective SE, EHV O&M Circle MSETCL, through e-mail for **adjustment of R&M expenses** against "**Deposit for IEM**".

The Circle office will follow the following procedure for **adjustment of R&M expenses** against "**Deposit for IEM**". (This entry will be passed through t code "**F-32**").

Customer with special GL indicator (I)	Dr.	
(underlying GL is "123110-Deposit for IEM A/c")		
To R&M A/c (400011)	Cr.	
Note: This is to note here that this GL - 400011 should be Nil at every month end		

SCREEN SHOT of SAP

1

Clear Customer: Header Data

Process Open Items

Account Clearing Date Period

Company Code Currency

Open Item Selection

Special G/L Ind ☒ Standard OIs

Additional Selections

☐ None

☐ Amount

☒ Document Number

2

Clear Customer Process open items

Distribute Difference Charge Off Difference Editing Options Cash Dec. Due

Standard Partial Print Res.Items WH Tax

Account Items 1000004889 Century Rayon

Assignment	Document No.	D. P.	Posting Date	Document D.	T.	Profit Center	W.	INR Gross	CashDiscount	CDPer.
	1400000471	2D	19.11.2022	15.11.2022		7200		181,720.00		

Processing Status

Number of Items Amount entered

Display from Item Assigned

3

General Ledger Simulation

Document Date 22.11.2022 Posting Date 22.11.2022 Fiscal Year 2022

Reference Cross-co. Posting Period 8

CoCd	Item	Litem	PK	S	G/L Account	G/L account name	Amount	Curr.	Profit Center
2005	1	000001	50		400011	R&M IEM	181,720.00	INR	7200
	2	000002	09	I	123140	IEM deposit	181,720.00	INR	7200

4

☒ Document 100060515 was posted in company code 2005

3.6.6) CE (ACI&P) CO office will inform **Service Entry Sheet (SES) No, Customer No. & SAP deposit document No.** to F&A section CO for billing purpose.

4. **CASE-II:** In cases the IEM/DCU which are procured under project works & integration charges are **not included in the scope of Vendors** or IEM/DCU procured excluding under AMR project W.O. MSETCL/CO/CE(AC&I)/AMR/VO/T01/2019-20/0128 dtd 14.02.2020 (AMR Project) and Extn. WO. MSETCL/CO/CE/ACI&P/AMR/EXT/WO/No. 0113 dtd 10.03.2022; the cost of integration of such **IEM/DCU will be borne by MSETCL**. The following procedure is to be adopted for integration of IEMs/DCU in AMR system,

4.1) SE (PAC) along with SE EHV O&M or their representative shall submit installation & commissioning report of IEM/DCU as per enclosed **Annexure-III** to SE (Tel) [setel@mahatransco.in] with a copy to CE (ACI&P) [ceaci@mahatransco.in] by e-mail.

4.2) After receipt of installation & commissioning report,

4.2.1) E-mail communication will be sent from **SE (Tel), ACI&P office** to **M/s L&T (SEIPL)** for carrying out integration activities of IEMs.

4.2.2) After receipt of intimation of **completion of integration of IEMs in MDAS** by **M/s L&T (SEIPL)**, the AMR team at ACI &P CO will verify,

(4.2.2.1) the automatic availability of meter data in MDAS / MDP system,

(4.2.2.2) availability of meter data to SLDC through API,

(4.2.2.3) creation of new user in case of new substation & mapping of all activities (e.g. SMS/e-mail, AMR reports etc.) with new user/sub-station like existing AMR user,

(4.2.2.4) In case of Existing S/s, mapping of newly integrated meter in same substation and storage location in existing AMR system.

3.5.3) ACI&P office will create **PMO/ PO in SAP**.

3.5.4) CE (ACI&P) CO office will inform **Service Entry Sheet (SES) No & PO details** to **F&A section CO** for billing purpose.

Annexure-I

AMR INSTALLATION COMPLETION CERTIFICATE

(To be submitted by Connectivity Holder/Third party)

1. This is to certify that the AMR Equipments viz. IEM, DCU, ES, Panel etc. & other accessories is supplied as per MSETCL technical specifications & approved drawing vide letter no.
dtd. and AMR infrastructure installation is completed satisfactorily at (*Location of site*)

2. As per work order for rate contract for Integration services of Interface Energy Meters (IEMs) in Existing Automated Meter Reading (AMR) / MDAS system,

2.1) **Cat. - I**: Totalnos. of IEMs to be integrated with Existing Kalkitech make DCU which was installed under AMR Project or newly commissioned DCU at location where existing DCU is commissioned during AMR project.

2.2) **Cat. - II**: Totalnos. of IEMs to be integrated with newly commissioned Kalkitech make DCU.

(*Signature with Date & stamp*)

Date:

Name:

Place:

Designation:

(*Note: Please attached check list duly filled to this certificate*)

Annexure-I: Installation & Commissioning Check list
(To be submitted by Connectivity Holder/Third party)

INSTALLATION/COMMISSIONING CHECK LIST				
Sr. No.	Parameter	Yes	No	Remark
1.	Check that IEM meters/DCU/ES and other accessories are properly installed on CRP panel or separate metering panel.			
2.	Check that Separate feeder for DC and AC supply with MCB/DC/AC fuse link provided to extend supply to IEM panels.			
3.	Check that Separate feeder for DC supply with MCB/DC fuse link is provided in Panel to extend DC supply to power ON IEM Meters.			
4.	Check that IEM meter shall be power ON on DC aux. power supply.			
5.	Check that Separate feeder for DC/AC supply with MCB/DC/AC fuse link is provided in Panel to extend supply to power ON DCU.			
6.	Check that DCU shall be power ON on DC aux. power supply or AC supply or both.			
7.	Check that Separate feeder for DC/AC supply with MCB/DC/AC fuse link is provided in Panel to extend supply to Power ON Ethernet switch (ES).			
8.	Check that ES shall be power ON on DC aux. power supply or AC supply or both.			
9.	Check that IEM panel is properly earthed.			
10.	Check that IEM meter shall also have provision to power ON on Voltage Transformer (VT) secondary circuit.			
11.	Check that IEM meter shall be provided with communication ports IEC1107 (Ethernet port)/ RS485 & TCP/IP			
12.	Check that Meter data reading/downloading through optical port by HHU is possible.			
13.	Check that Meter data reading/downloading through optical port shall be transferred to Local computer or storage unit/device is possible & should be unidirectional i.e. from meter to storage device.			
14.	Check that all communication cables are correctly connected to respective device. Also proper ferruling, tagging is done.			
15.	Check that 'Low Voltage LED/LCD' on meter shall glow when AC voltage dropped to specified voltage (70% of Vref).			
16.	Check that meter display will be switch on/changing one indication to next through touch key/push button provided on meter. Also check that meter display will be switch off automatically after one minute.			
17.	Check that IEM meter shall be configured for correct/connected CT/PT ratio.			

PROCEDURE (SOP) FOR INTEGRATION OF THIRD PARTY IEM/DCU IN MDAS SYSTEM AT SLDC AIROLI

Sr. No.	Parameter	Yes	No	Remark
18.	Check that IEM meter shall display the following indication			
	Meter serial and model no.			
	Date & Time			
	Cumulative Wh, Net Wh/ Net VARh transmittal during the previous block, Reactive power (VAR)			
	Average frequency of the previous block & Average % Voltage Average % Voltage			
	Voltage - high VARh registers reading, Voltage - low VARh register reading			
	Low battery indication			
19.	Check that DCU is properly installed & supplied with suitable enclosure for CRP panel or separate metering panel or on Control room wall.			
20.	Check that proper ferruling, tagging of Communication cable & power cable is done at DCU end.			
21.	Check that DCU shall be provided with communication ports _ RS-485/LAN/USB port			
22.	Check that DCU have provision of GSM/GPRS/Modems, Media converter etc.			
23.	Check that DCU Power ON LED working			
24.	Check that DCU Communication healthy LED working			
25.	Check that power failure communication fault healthy LED working			
26.	Check that DCU charger if provided is working properly.			
27.	Check that Ethernet switch is properly installed on CRP panel or separate metering panel.			
28.	Check that proper ferruling, tagging of Communication cable & power cable is done at Ethernet switch.			
29.	Check for correctness of port connected on Ethernet switch.			

(Signature with Date & stamp of Connectivity holder/Vendor)

Annexure-II



**MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD
OFFICE OF CHIEF ENGINEER (AC I& P) CO, AIROLI.**

AMR SYSTEM INTEGRATION READINESS CERTIFICATE

[To be submitted by SE (PAC)]

1. This is to certify that the AMR Equipments viz. IEM, DCU, ES, Panel etc. & other accessories is supplied/procured by vendor as per MSETCL approved technical specifications & are installed/commissioned at(*Location of site*)
2. This is to certify that the IEM & DCU installed and commissioned for above interface locations are not utilized from the material purchased/supplied vide Work Order No. MSETCL/CO/CE(AC&I)/AMR/WO/T01/2019-20/0128 dtd 14.02.2020 (AMR Project) and Extn. WO. MSETCL/CO/CE/ACI&P/AMR/EXT/WO/ No. 0113 dtd 10.03.2022.
3. Installation/commissioning of AMR Equipments (IEM/DCU) are completed at above mentioned site & are ready for integration in MDAS system at SLDC, Airoli.

Signature with Date & stamp

(Note: Please attached check list duly filled to this certificate)

Annexure-II: Check list

- 1] Administrative details:**
- a. Name of Zone/Utility:
 - b. Name of Circle:
 - c. Name of Division:
 - d. Name of s/s & SAP ID:
 - e. Name of Connectivity holders / Sub-station Incharge & Mobile No:

2] Communication Services:			
Status	OPGW	VSAT	GPRS/SIM Card
Availability (Yes/No)			
IP Address	172.16.xx.xx	172.16.xx.xx	10.117.xx.xx
SIM details	-	-	
Extended up to DCU (Yes/No)			
Note: xx.xx - As per sub-station IP scheme.			

3] Details of New Interface Locations

Sr. No.	Name of sub-station (MSETCL/ Utility/ Connectivity holder)	Name of Interface Location/Point (Feeder/ TF/ICT/GT)	Interface Type (T-D/G-T/ T-D EHV etc)	Type of Generation (Solar/Hydro /Wind in case of G-T Type/ Location)	Type of Meter (Main/ Check/ Standby)	Meter Make/Type & Sr. No.	CTR / PTR	*Meter IP Address	Active Import (Wh) /Reactive Import (Var)	Active Export (Wh) /Reactive Export (Var)	Meter Charging Date & Time
1.						Make/Type	CTR		Wh	Wh	Date
						Sr. No.	PTR		Var	Var	HH:MM
2.						Make/Type	CTR		Wh	Wh	Date
						Sr. No.	PTR				HH:MM
3.						Make/Type	CTR		Var	Var	Date
						Sr. No.	PTR				HH:MM
4.						Make/Type	CTR		Wh	Wh	Date
						Sr. No.	PTR				HH:MM
5.						Make/Type	CTR		Var	Var	Date
						Sr. No.	PTR				HH:MM

Note: * In case of new sub-station, the Meter IP address will start from 192.168.0.122 and in case of existing sub-station, the meter IP address will start from next IP address of last meter IP address assigned e.g. last meter IP address is 198.168.0.125, then IP address of next meter will be 198.168.0.126

4] Details of DCU/Communication Gateway									
Sr. No.	Name of sub-station where Existing or New DCU installed/commissioned	Existing DCU [IP Address (LAN Port):192.168.0.121]			New DCU [IP Address (LAN Port):192.168.0.121]			Main + Check meter connected to Existing or New DCU	Standby meter connected to Existing or New DCU
		Make/Type	Sr. No.	No. of IEMs connected	Make/Type	Sr. No.	No. of IEMs connected		
1.									
2.									
3.									
4.									
5.									

Annexure-III

AMR INSTALLATION /COMMISSIONING REPORT FOR THIRD PARTY INTEGRATION OF IEMS



MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD

OFFICE OF CHIEF ENGINEER (AC I& P) CO, AIROLI

[WORK ORDER REFERENCE: MSETCL/CO/CE(ACI&P)/AMR/INT/0420 DTD. 11 AUGUST 2022]

- 1] Administrative details:**
- a. Name of Zone/Utility:
 - b. Name of Circle:
 - c. Name of Division:
 - d. Name of s/s & SAP ID:
 - e. Name of Connectivity holders / Sub-station Incharge & Mobile No:

2] Communication Services:			
Status	OPGW	VSAT	GPRS/SIM Card
Availability (Yes/No)			
IP Address	172.16.xx.xx	172.16.xx.xx	10.117.xx.xx
SIM details	-	-	
Extended up to DCU (Yes/No)			
Note: xx.xx - As per sub-station IP scheme.			

3] Details of New Interface Locations

Sr. No.	Name of sub-station (MSETCL/ Utility/ Connectivity holder)	Name of Interface Location/Point (Feeder/ TF/ICT/GT)	Interface Type (T-D/G-T/ T-D EHV etc)	Type of Generation (Solar/Hydro /Wind in case of G-T Type/ Location)	Type of Meter (Main/ Check/ Standby)	Meter Make/Type & Sr. No.	CTR / PTR	*Meter IP Address	Active Import (Wh) /Reactive Import (Var)	Active Export (Wh) /Reactive Export (Var)	Meter Charging Date & Time
1.						Make/Type	CTR		Wh	Wh	Date
						Sr. No.	PTR		Var	Var	HH:MM
2.						Make/Type	CTR		Wh	Wh	Date
						Sr. No.	PTR				HH:MM
3.						Make/Type	CTR		Var	Var	Date
						Sr. No.	PTR				HH:MM
4.						Make/Type	CTR		Wh	Wh	Date
						Sr. No.	PTR				HH:MM
5.						Make/Type	CTR		Var	Var	Date
						Sr. No.	PTR				HH:MM

Note: * In case of new sub-station, the Meter IP address will start from 192.168.0.122 and in case of existing sub-station, the meter IP address will start from next IP address of last meter IP address assigned e.g. last meter IP address is 198.168.0.125, then IP address of next meter will be 198.168.0.126

4] Details of DCU/Communication Gateway									
Sr. No.	Name of sub-station where Existing or New DCU installed/commissioned	Existing DCU [IP Address (LAN Port):192.168.0.121]			New DCU [IP Address (LAN Port):192.168.0.121]			Main + Check meter connected to Existing or New DCU	Standby meter connected to Existing or New DCU
		Make/Type	Sr. No.	No. of IEMs connected	Make/Type	Sr. No.	No. of IEMs connected		
1.									
2.									
3.									
4.									
5.									

5] INSTALLATION/COMMISSIONING CHECK LIST					
Sr. No.	Parameter	Yes	No	Remark	
1.	Check that IEM meters/DCU/ES and other accessories are properly installed on CRP panel or separate metering panel.				
2.	Check that Separate feeder for DC and AC supply with MCB/DC/AC fuse link provided to extend supply to IEM panels.				
3.	Check that Separate feeder for DC supply with MCB/DC fuse link is provided in Panel to extend DC supply to power ON IEM Meters.				
4.	Check that IEM meter shall be power ON on DC aux. power supply.				
5.	Check that Separate feeder for DC/AC supply with MCB/DC/AC fuse link is provided in Panel to extend supply to power ON DCU.				
6.	Check that DCU shall be power ON on DC aux. power supply or AC supply or both.				
7.	Check that Separate feeder for DC/AC supply with MCB/DC/AC fuse link is provided in Panel to extend supply to Power ON Ethernet switch (ES).				
8.	Check that ES shall be power ON on DC aux. power supply or AC supply or both.				

PROCEDURE (SOP) FOR INTEGRATION OF THIRD PARTY IEM/DCU IN MDAS SYSTEM AT SLDC AIROLI

Sr. No.	Parameter	Yes	No	Remark
9.	Check that IEM panel is properly earthed.			
10.	Check that IEM meter shall also have provision to power ON on Voltage Transformer (VT) secondary circuit.			
11.	Check that IEM meter shall be provided with communication ports IEC1107 (Ethernet port)/ RS485 & TCP/IP			
13.	Check that Meter data reading/downloading through optical port by HHU is possible.			
13.	Check that Meter data reading/downloading through optical port shall be transferred to Local computer or storage unit/device is possible & should be unidirectional i.e. from meter to storage device.			
14.	Check that all communication cables are correctly connected to respective device. Also proper ferruling, tagging is done.			
15.	Check that 'Low Voltage LED/LCD' on meter shall glow when AC voltage dropped to specified voltage (70% of Vref).			
16.	Check that meter display will be switch on/changing one indication to next through touch key/push button provided on meter. Also check that meter display will be switch off automatically after one minute.			
17.	Check that IEM meter shall be configured for correct/connected CT/PT ratio.			
18.	Check that IEM meter shall display the following indication			
	Meter serial and model no.			
	Date & Time			
	Cumulative Wh, Net Wh/ Net VARh transmittal during the previous block, Reactive power (VAR)			
	Average frequency of the previous block & Average % Voltage Average % Voltage			
	Voltage - high VARh registers reading, Voltage - low VARh register reading			
	Low battery indication			
19.	Check that DCU is properly installed & supplied with suitable enclosure for CRP panel or separate metering panel or on Control room wall.			
20.	Check that proper ferruling, tagging of Communication cable & power cable is done at DCU end.			
21.	Check that DCU shall be provided with communication ports RS-485/LAN/USB port			
22.	Check that DCU have provision of GSM/GPRS/Modems, Media converter etc.			
23.	Check that DCU Power ON LED working			
24.	Check that DCU Communication healthy LED working			
25.	Check that power failure communication fault healthy LED working			
26.	Check that DCU charger if provided is working properly.			
27.	Check that Ethernet switch is properly installed on CRP panel or separate metering panel.			
28.	Check that proper ferruling, tagging of Communication cable & power cable is done at Ethernet switch.			
29.	Check for correctness of port connected on Ethernet switch.			

6] CERTIFICATE:

This is to certify that the IEM & DCU installed and commissioned for above interface locations are not utilized from the material purchased/supplied vide Work Order No. MSETCL/CO/CE(AC&I)/AMR/VO/T01/2019-20/0128 dtd 14.02.2020 (AMR Project) and Extn. WO. MSETCL/CO/CE/ACI&P/AMR/EXT/WO/ No. 0113 dtd 10.03.2022.

<i>Signature with Date:</i>	<i>Signature with Date:</i>	<i>Signature with Date:</i>	<i>Signature with Date:</i>
Name & designation of EHV O&M Circle MSETCL Representative (Sub-station incharge)	Name & designation of SE PAC MSETCL Representative (Testing Engineer)	Name & designation of Utility (Tata/Adani/ BEST) Representative	Name & designation of Connectivity Holder Representative

END OF DOCUMENTS