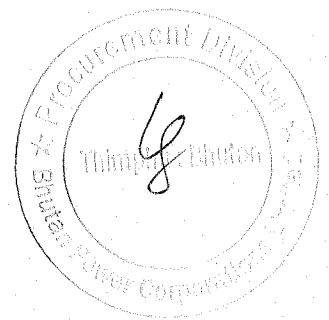


TECHNICAL SPECIFICATION OF THE LOTS



Lot 1-XLPE Cables

1.0 Scope

This specification covers the design, manufacture and testing of cables at manufacture's work before dispatch, packing and transportation to BPC stores.

2.0 Design Criteria

2.1 Standards

The cables under this specification shall comply with the requirements of latest edition of the following standards including amendments:

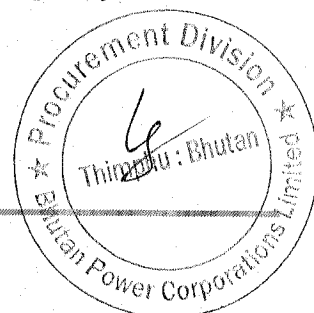
IEC: 60183, 60227,60502, 60885, 50480 IS (Indian standards): 1554 (Part-I) IS: 1753 IS: 3961 Part-II IS: 3975 IS: 4905, IS:5831, IS: 7098 (Part- III), IS: 7098 (Part-II), IS: 7098 (Part-I), IS: 8130, IS: 10418, IS: 10810, ASTM D 2863, IEEE-383, IEC-332 (Part-I), IEC-754 (Part-I), ASTM D – 2843, SS-4241475, (Swedish standard)

2.2 Cable Design

- i) The cables shall be suitable for installation in a monsoon area having 100% relative humidity and low temperature which is likely to accelerate rusting in steel. However, for the reference ambient temperature may be taken as 40° C with the relative of 100%. The galvanizing of steel armour has to be of the highest quantity for such an ambient condition.
- ii) The cable shall operate with the following requirements.
 - a) Maximum continuous conductor temperature and allowable conductor temperature during short circuit shall be taken as 70°C and 160°C respectively for PVC insulated and 90°C and 250°C respectively in case of XLPE insulated cable.
 - b) Frequency variation $\pm 5\%$, voltage variation $\pm 10\%$ and combined frequency and voltage variation of $\pm 10\%$.
- iii) Amongst the various standards given above, for design, stringent conditions specified in the above standards shall be applicable.

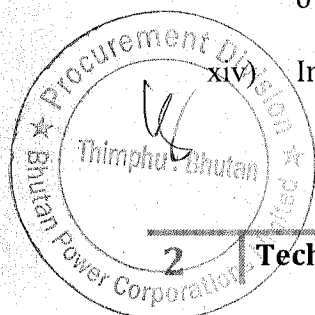
2.3 General Technical Requirement

- i) The cables shall be suitable for laying in racks, ducts, covered trenches, conduits and underground buried installation with chances of flooding by water.
- ii) Cables shall be designed to withstand mechanical, electrical and thermal stresses developed under steady state and transient operating conditions.
- iii) The aluminium/copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be of uniformly good quality free from defects. All aluminium used in the cables shall be of H2 grade.



Section VII- Schedule of Supply

- iv) Aluminium conductor used in power cables shall have tensile strength of more than 100N/sq. mm. The conductor of control cables shall be manufactured from plain annealed copper. All the conductors shall be multi-stranded.
- v) PVC insulation shall be suitable for continuous conductor temperature of 70°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90°C and short circuit conductor temperature of 250°C.
- vi) The cable cores shall be laid up with fillers between the cores wherever necessary. It should not stick to insulation and inner sheath. All the cables, other than single core un-armoured cable shall have distinct extruded PVC inner sheath black in colour as per IS 5831.
- vii) The fillers and inner sheath shall be of non-hygroscopic flame-retardant material shall be softer than insulation and outer sheath shall be suitable for the operation temperature of the cable.
- viii) The armouring shall be as per relevant standards.
- ix) Suitable chemicals shall be added to the outer sheaths of all cables to protect them from rodent and termite attack. These chemicals shall not have any harmful effect on the human being.
- x) Cores of the cables of up-to 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted:
- | | |
|----------|---------------------------------|
| 1 core - | Red, Black, Yellow & Blue |
| 2 core - | Red & Black |
| 3 core - | Red, Yellow & Blue |
| 4 core - | Red, Yellow, Blue & Black |
| 5 core - | Red, Yellow, Blue, Black & Grey |
- xi) For reduced neutral conductors the core shall be black.
- xii) In addition to manufacturer's identification on cables as per IS/IEC, following marking shall also be embossed over outer sheath.
- a) Cable size and voltage grade.
- b) Sequential marking of length of the cable in meters at every one meter. The embossing shall be progressive, automatic, on line and marking shall be legible and indelible.
- xiii) Allowable tolerance on the overall diameter of the cables shall be ± 2 mm maximum, over the declared value in the technical data sheets.
- xiv) In plant repairs to the cables shall not be accepted.



- xv) Identification of cores - the insulated cores of HT power cables shall be identified by coloured code.

3.0 General Constructional Requirements

3.1 General

The power cables, control cables, PVC cables are required for the power supply, control and protection of various equipment.

3.2 Type of Cable

The cable shall be single core (XLPE) type as specified in the Price Schedule.

3.3 Conductor

The cable conductor shall be made from stranded aluminium to form compact conductor having a resistance within the limits as per the relevant standards. All the cables of size 25mm² and above shall have sector shaped conductors. The minimum no. of strands in conductor shall be 7 (seven) except as otherwise specified.

3.4 Conductor (Shield)

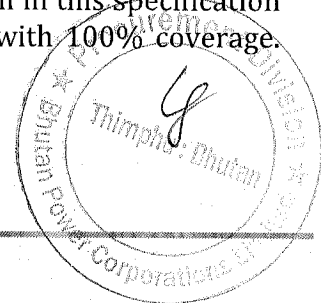
The conductor having a semi-conducting screen shall ensure perfectly smooth profile and avoid stress concentration. The conductor screen shall be extruded in the same operation as the insulation; the semi-conducting polymer shall be cross-linked for XLPE cables.

3.5 Insulation

The insulation of the cable shall be extruded type and shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi-conducting screen and insulation. The insulation of the cables shall be of high standard quality.

3.6 Insulation Shield

In cables to confine electrical field to the insulation, a non-magnetic semi-conducting shield shall be put over the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by triple extrusion/process. The cable insulation shield shall be strippable. Metallic screening of appropriate size as per the cable fault level given in this specification shall be provided. Copper tape shall be wrapped helically with 100% coverage. Appropriate shall be 0.4mm.



3.7 Sheath

The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of adequate thickness and applied by a continuous process to produce a sheath of consistent quality free from all defects.

- i) The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by 'Triple Extrusion' process to ensure perfect bonding between the layers. The core identification shall be by coloured strips or by printed numerals.
- ii) The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST2 compound. The extruded inner sheath shall be of uniform thickness.
- iii) The outer sheath of the cables shall be applied by extrusion over the armouring and shall be of PVC compound conforming to the requirements of type ST2 compound
- iv) The dimensions of the insulation, inner sheath and armour materials shall be governed by relevant standards.

3.8 Armour

Hard drawn aluminium wire armouring/galvanized steel tape/wire armouring shall be used for single core and multi core cable, respectively. The hard drawn aluminium wire for armour shall be of H4 grade, as per relevant Standards.

3.9 Serving/Cutter Sheath

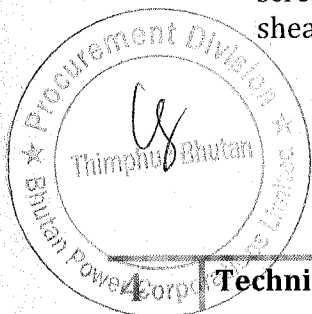
Extruded PVC serving as per relevant standard shall be applied over the armouring with suitable additives to prevent attack by rodent and termites. All serving must be given anti-termite treatment.

3.10 Construction

Cable shall have suitable fillers laid up with the conductors to provide a substantially circular cross section before the sheath is applied. Fillers shall be suitable for the operating temperature of the cable and compatible with the insulating material. All materials shall be new, unused and of finest quality. Workmanship shall be neat, clean and of highest grade.

(a) 11 kV System – Power Cable

The cable shall be 11 kV (earthed system) grade, heavy duty, stranded aluminium conductor, XLPE insulated, provided with conductor screening and insulation screening, galvanized steel wire/strip armoured, extruded PVC of Type ST2 outer sheathed, as per system requirement, wherever these cables are needed.

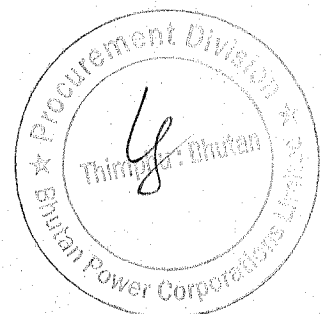


4.0 Cable Drums

- 4.1 HV cables shall be supplied in a steel drum. The covers with wood is acceptable. The wood used for construction for the drum shall made from hard wood, be properly seasoned, sound and free from defects. Wood preservative shall be applied to the entire drum.
- 4.2 Bidder shall indicate in the offer the standard length for each size of the cable. The cable length per drum shall be subject to tolerance of $\pm 0.5\%$ of the standard drum's length. The bidders shall take into consideration the wastages in the pricing and quote accordingly. IS tolerance shall not be applicable.

However, the cable drums shall be selected so those through joints are eliminated. Typical drum lengths shall be 250m.

- 4.3 A layer of PVC sheet shall be applied to the surfaces of the drums and over the outer most cables layer. A clear space of at least 40 mm shall be left between the cables and the logging.
- 4.4 Each drum shall have the following information stencilled on it in indelible ink:
- i. Contract No.
 - ii. Name and address of the consignee
 - iii. Maker's name and address
 - iv. Drum No.
 - v. Size of cable, code name and length of cable in meter
 - vi. Gross weight of the drum with protective lagging including cable
 - vii. Weight of the empty drum with protective lagging.
 - viii. Net weight of the cable.
 - ix. Arrow marking of unwinding position of the cable end, lot number.
- 4.5 Packing shall be sturdy and adequate to protect the cables from any injury due to mishandling or other conditions encountered during transportation handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.



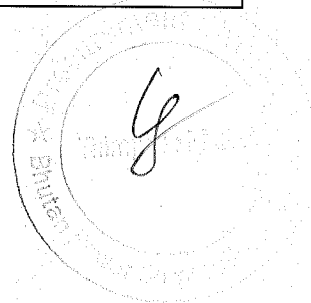
Lot 2: Polymer Insulators

Item 2: Polymer Strain Insulators for 220 kV,120 kN			
SL#	Description	Unit	Specification
1	Name of the manufacturer		
2	Standard applicable to manufactured and tested		IEC 61109
3	Size and Designation of Ball & Socket assembly	mm	20
4	Core diameter	mm	20
5	Tolerance on Core Diameter	±mm	0.5
6	Nominal length (Section Length)	mm	2175
7	Tolerance on Nominal Length	±mm	50
8	Dry Arcing distance	mm	1933
9	Shed Profile		Aerodynamic
10	Shed Profile (Regular alternating)		Alternate
11	Shed Diameter-Big/Small	mm	139/108
12	Tolerance on Shed Diameter	mm	As per IEC
13	Minimum Creepage distance	mm	7595
14	Tolerance on Creepage distance	mm	No Negative tolerance
15	Guaranteed mechanical strength	kN	120
16	Routine mechanical load	kN	60
17	System nominal Voltage	kV	220
18	Highest System Voltage	kV	245
19	System frequency	Hz	50
20	Material		
	a) FRP Rod		ECR Grade Boron free
	b) Sheds with % contents of silicone		30%
	c) Housing		Silicone Rubber
	d) End Fittings- Ball		Gr. EN8 D-Forged
	e) End Fittings- Socket		SG Iron - Cast
	f) Grading Rings		Aluminium Alloy
21	Minimum thickness of sheath covering over the core	mm	3
22	Power Frequency withstand voltage (Wet/ Dry)	kV (rms)	460/480
23	Impulse Withstand Voltage (Dry)		
	Positive	kV (Peak)	1050
	Negative	kV (Peak)	1050
24	Galvanising-Minimum mass of zinc coating	gms/sq. mt.	620
25	Packing		Corrugated tube



Lot 2: Polymer Insulators

Item 2: Polymer Strain Insulators for 132 kV,90 kN			
SL#	Description	Unit	Specification
1	Name of the manufacturer		
2	Standard applicable to manufactured and tested		IEC 61109
3	Size and Designation of Ball & Socket assembly	mm	16
4	Core diameter	mm	20
5	Tolerance on Core Diameter	±mm	0.5
6	Nominal length (Section Length)	mm	1450
7	Tolerance on Nominal Length	±mm	42
8	Dry Arcing distance	mm	1300
9	Shed Profile		Aerodynamic
10	Shed Profile (Regular alternating)		Alternate
11	Shed Diameter-Big/Small	mm	139/108
12	Tolerance on Shed Diameter	mm	As per IEC
13	Minimum Creepage distance	mm	4495
14	Tolerance on Creepage distance	mm	No Negative tolerance
15	Guaranteed mechanical strength	kN	90
16	Routine mechanical load	kN	45
17	System nominal Voltage	kV	132
18	Highest System Voltage	kV	145
19	System frequency	Hz	50
20	Material		
	a) FRP Rod		ECR Grade Boron free
	b) Sheds with % contents of silicone		30%
	c) Housing		Silicone Rubber
	d) End Fittings- Ball		Gr. EN8 D-Forged
	e) End Fittings- Socket		SG Iron - Cast
	f) Grading Rings		
21	Minimum thickness of sheath covering over the core	mm	3
22	Power Frequency withstand voltage (Wet/ Dry)	kV (rms)	275/285
23	Impulse Withstand Voltage (Dry)		
	Positive	kV (Peak)	650
	Negative	kV (Peak)	650
24	Galvanising-Minimum mass of zinc coating	gms/sq. mt.	620
25	Packing		Corrugated tube



Section VII- Schedule of Supply

Lot 3: CTPT COMBINED UNIT

1. GENERAL:

This specification covers the design, engineering, manufacture, assembly, stage testing, inspection, supply and delivery of following equipment:

- a) 33kV outdoor type combined CT PT Unit
- b) 11 kV Outdoor type combined CTPT Unit

APPLICABLE STANDARDS:

Unless otherwise modified/specified in this specification, the CT/PT Unit shall comply with the latest version of the following standards: -

- 1) Current Transformers - IS:2705
- 2) Potential Transformers - IS:3156
- 3) HV Porcelain Bushing - IS:2099
- 4) Oil - IS:335
- 5) Terminal Connector - IS:5561
- 6) Application guide for CT - IS:4201

2. TYPE RATING AND PERFORMANCE REQUIREMENTS:

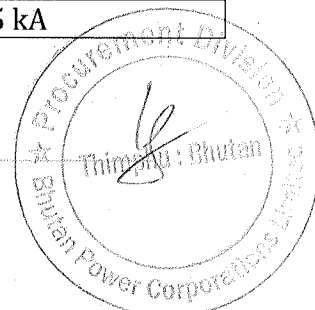
3.1. The 3 Phase 4 Wire, CT/PT unit should be of pole mounting type for outdoor use. They are to be used in Three Phase with solidly earthed neutral and suitable for 50Hz network. The equipment is required for operation of HT meters installed inside the substation building and should be oil cooled.

3.2. CT/PT Metering Equipment unit shall comprise of 3 nos CTs conforming to IS: 2705 and 1 No Three phase PTs conforming to IS-3156, with latest amendments.

3.3. The rating and other Electrical Characteristics shall be as follows: -

Metering CT

Sl. No.	Technical Description	Requirement	
1	Rated voltage	33kV	11 kV
2	Primary Current Rating	100-50 A, 200-100A	100-50 A, 75-25 A
3	Secondary Current Rating	1A	1A
4	Rated Burden	10 VA	10 VA
5	Accuracy Class	0.5s	0.5 s
6	Short time current rating	16kA for 1 sec	25 kA for 1 sec
7	Dynamic peak current	40kA	62.5 kA



Section VII- Schedule of Supply

Metering PT

Sl#	Technical Description	Requirement	
1	Rate Voltage	33 kV	11 kV
2	Primary Voltage	$33/\sqrt{3}$ kV	$11/\sqrt{3}$ kV
3	Secondary Voltage	$110/\sqrt{3}$ V	$110/\sqrt{3}$ V
4	Rated Burden	15 VA	10 VA
5	Accuracy Class	0.5	0.5
6	Winding connection	Star-Star	Star-Star

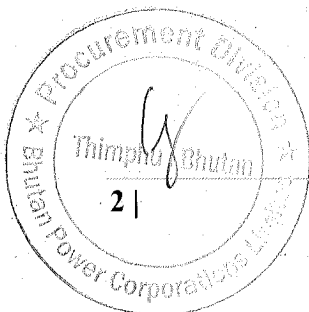
Technical Requirement

Sl#	Parameters	Requirement	
1	Highest System Voltage	36 kV	12 kV
2	Rated system Voltage	33 kV	11 kV
3	Frequency	50 Hz \pm 1%	
4	Impulse withstand Voltage	170 kV (peak)	75 kV (peak)
5	Power Frequency withstand voltage	70 kV (rms)	28 kV (rms)
6	Creepage distance	900 mm	300 mm
7	Power frequency withstand voltage on secondary winding	3 kV (rms)	
8	Max. Temperature rise above ambient temp.	55°C	
9	Minimum Clearance		
	Phase to Phase	320 mm	250 mm
	Phase to earth	350 mm	190 mm

4. CLIMATIC CONDITIONS

4.1. The CT PT unit shall be suitable to work satisfactorily under the following climatic conditions:

i	Maximum ambient temperature (°C)	40
ii	Minimum ambient temperature (°C)	-20
iii	Maximum altitude above mean sea level (m)	2500
iv	Relative humidity (%)	20% to 100%
v	Average Annual rainfall	1400 mm
vi	Maximum Wind pressure	195 kg/m sq.



Section VII- Schedule of Supply

5. DESIGN AND CONSTRUCTION

The equipment shall be designed to ensure satisfactory operation under all conditions of service to facilitate easy inspection, cleaning and repairs.

The metering equipment (CT and PT) shall be contained in a weather proof outdoor structure/RCC mounting type M.S. tank with 6 nos. of weather proof bushings with Brass stud as per rating of combined CT: PT (metering equipment) units. These bushings shall conform to IS-2099. The dimension and electrical characteristics of the bushing shall be in accordance to IS.

The design shall incorporate every reasonable precaution and provisions for safety of all those concerned in the operation and maintenance of the equipment. A pressure relief valve/Explosion vent shall be invariably provided at the top cover of the tank of the ME (Metering Equipment).

All outdoor apparatus shall be so designed that water cannot collect at any point and enter the ME. The top cover of the tank, secondary terminal cover, inspection chamber cover plate may be designed accordingly to prevent the accumulation/stagnation of water on the ME surface.

All connections and terminals shall be of sufficient size for carrying the specified currents continuously without undue heating.

All bolts, nuts, washers in contact with non-ferrous parts shall be of brass.

Top cover flange of metering unit should be provided with 4 nos. bolt with sealing holes for proper sealing arrangement at all four corners of the tank and cover. Secondary terminal box cover should have 8 nos. nuts & bolts with 4 bolt duly hole for sealing arrangement. For this, 8 nos. holes should be provided on the cover & flange of secondary terminal box at the corners & middle of each face for fixing nut bolts.

All ferrous parts including bolts & nuts liable to corrosion, forming integral part of the equipment shall be hot dip galvanized.

The core shall be high grade non-ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy, at both normal and over current/ voltage.

All winding shall be of insulated high grade Electrolytic copper wire and the manufacturing of the units shall be done in completely closed and air-conditioned room otherwise Fibre glass insulation sleeves are to be provided for primary winding. Details of winding and core shall be furnished.

The volume above the oil level in the tank shall be filled with Nitrogen gas conforming to commercial grade as per relevant standard. A suitable space needs to be provided for dry nitrogen in order to accommodate the volumetric expansion



Section VII- Schedule of Supply

of oil due to change in temperature. The volume of space to be provided for dry nitrogen shall be atleast 10% in volume that of total quantity of oil in ME.

The procedure for filling of dry nitrogen and making the unit hermetically sealed shall be as per manufacturer's standard practice.

Sealing bolts for sealing at 4 points on the secondary terminal box (both inner & outer door), inspection cover, the top cover of the tank shall be provided. This may be made by providing a hole on tail of corner bolts of adequate size to pass the sealing wire of above 13 SWG.

The voltage transformer shall be so designed that the increased magnetizing currents due to any persisting over voltage, does not produce injurious overheating.

The winding shall be neatly laid and anchored. The CT & PT winding within the tank shall have proper mounting arrangement. Floating windings with paper insulation are not acceptable. The windings must be secured & fixed to guard against physical movements during transit and/or during system short circuits. This shall be verified during final inspection of the lot, on opening of one CT:PT Unit at firms work.

The metering set tank and other metal parts shall be galvanized both inside & outside as per latest applicable standards.

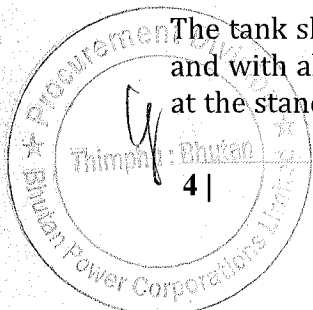
Primary terminals: - Primary Terminals shall be adequately sized as per current rating of the CT/PT Unit. No undue overheating shall occur even for 150% overloading of the CT/PT unit. The primary winding shall be of adequate cross section to carry continuously the rated current plus 50% over load continuously. The CT should not be saturated at 150% loading.

The oil filled container incorporating the CT and PT should be fitted with incoming and outgoing primary terminals and secondary terminal box. Adequate level of oil shall be maintained in the tank for proper cooling & curb flashover. M and L (Main side and Load side) shall be indelibly marked/embossed on the top cover of MS tank to identify the incoming and outgoing terminals of CT/PT unit.

During lowest temperature condition when oil level is lowest, atleast 40mm of bushing bottom shall remain dipped in the oil.

The mounting of the bushing on the metering equipment should be in oblique plane. CT primary and secondary terminals shall be marked clearly as indicated in relevant Standards, the terminal marked P1 of primary and S1 of secondary in case of current Transformer and corresponding in case of PT shall have the same polarity at any instant.

The tank shall be built with a plate of 5 mm thick top and 3 mm sides and bottom and with all fittings shall be capable of withstanding without leakage or distortion at the standard test pressure. All joints of the tank and fittings shall be hot oil tight



Section VII- Schedule of Supply

and no leakage should occur during service. Both side of the joint should have continuous welding.

The welded joints of the metering unit shall be strengthened by providing 25 x 25 x 3mm angle all along the welded length and welded properly inside the tank. All joints of the tank and fitting shall be oil tight.

ME shall be provided with an oil gauge. The oil gauge glass shall be fixed to the side of the raised wall of the inspection box for monitoring the oil level of the ME.

The tank shall be provided with necessary lifting lugs.

The secondary terminal box cover, tank cover and inspection cover and other vertical joints where gaskets are used may be suitably bent with necessary sealing arrangement with sealing bolts at all corners. Bolts should be at least 10 mm diameter GI bolts spaced maximum 70 mm apart. This is to safeguard against seepage of water into tank in case of damaged gasket.

The 6 mm gaskets shall be dovetailed without joints to prevent moisture entry. In case of dovetailed joint, they shall not be more than two. The gaskets shall be of good quality Neoprene or superior quality rubberized gasket. The quality of gasket should be selected keeping in mind the ambient temperature of 75°C.

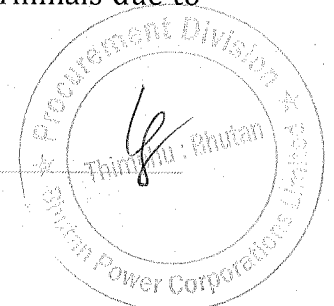
EARTHING: Two earthing terminals of adequate size protected against corrosion, metallicly clean and identified by means of the sign marked in a legible and indelible manner adjacent to the terminals shall be provided.

Size of the primary conductor or CT circuit shall be worked out on the basis of nominal current density and also to meet out requirements stipulated in clause 9.6 of IS 5705 (Part-I) 1992 relating to short time thermal current test. The requirements of size of conductor shall be worked out for both criteria and higher of the two cross section area will have to be adopted.

PT winding should have uniform insulation throughout from live terminal to neutral end, and not the graded insulation. Secondary winding of PT should be three phase star connected with neutral brought out. On secondary side of PT four terminals shall be marked as r, y, b and n.

The Secondary terminal box incoming hole should be suitable for 40 mm dia GI pipe and at a suitable height from bottom to avoid replacement/ modification of secondary wires pipe when ME is replaced.

The secondary terminals should be suitable for termination of 4 Sq.mm cable. Disconnecting type Terminal Box (TB) shall be provided for CT with provision for CT shorting. The terminals should be provided at least 70 mm height from incoming hole and clearances shall be as per IS to avoid shorting terminals due to secondary wires.



Section VII- Schedule of Supply

The CT/PT unit shall be supplied with first filling of high grade oil. The insulation oil used in the tank shall comply with the requirements specified in latest relevant IS: 335/93. The test certificate of oil being used shall be provided at the time of inspection. The oil in the CT/PT shall be filled under vacuum. Oil drain valve or sampling cock or non-return type oil filling valve provided to facilitate factory processing shall be sealed before dispatch of CT/PT unit.

The tank should be given three coats of rust preventing paint and finished with light grey no. 631- IS-5 on all external surfaces. The internal surface of the tank shall be painted with two coats of suitable oil -insoluble paint. All the fuses and the links for PT shall be provided at the Terminal Boxes.

The insulating materials for winding between HV & LV between interlayer of the winding and for end turn shall be as per relevant standard. However, end turns have to be provided with reinforced insulation and end connecting the bushing shall be provided extra insulation of fiber glass sleeve.

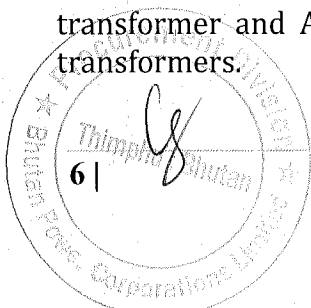
6. NAME PLATE AND MARKING:

The CT/PT Unit shall be provided with non-corrosive, legible name plate with the information specified in relevant standards, duly engraved/punched on it. The following details shall be provided on the Name Plate:

- a) Property of "Bhutan Power Corporation Limited"
- b) Manufacturer's Name :
- c) P.O.No & date :
- d) Serial No :
- e) Year and Month of Manufacture :
- f) CT ratio/Accuracy Class/Burden :
- g) PT ratio/Accuracy Class/Burden :
- h) CT Serial No:
- i) PT Serial No:
- j) Overall CT PT multiplying factor :
- k) Rated frequency :
- l) Highest System Voltage :
- m) Rated Insulation Level :
- n) Standard (CT/PT):
- o) Connection Diagram

The Primary and Secondary terminals of the CT/PT unit shall be clearly marked. The polarity and the other details shall be permanently etched on the body of the CT/PT unit.

The terminals of the instrument transformer shall be clearly marked by distinctive letters as stated in Annex "C" of ISS: 3156/Part. I/1992 (latest version) for voltage transformer and Annex "C" of IS-2705/Part. I/1992 (latest version) for current transformers.



Section VII- Schedule of Supply

The above name plate shall be metallic and shall be affixed on a MS Plate which shall be welded to the body of CT PT chamber so that there is no passage hole when the name plate is removed.

7. MOUNTING ARRANGEMENT:

The CT/PT unit shall be suitable for mounting on double pole steel structures. The necessary flanges bolts etc for the base of CT shall be supplied and these shall be galvanized.

8. TERMINAL CONNECTORS:

The Terminal connector (bimetallic for Cu terminal) shall be provided with the CT/PT unit. The Terminal connector shall be so designed to work effectively without any overheating of the CT/PT unit's Primary terminal in case of over loading.

The terminal connector shall be suitable for connecting ACSR, DOG Conductor.

The Terminal Connector shall be manufactured and tested as per IS:5561 or equivalent IEC

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

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

Suitable terminal earth connectors for earthing connections shall also be provided.

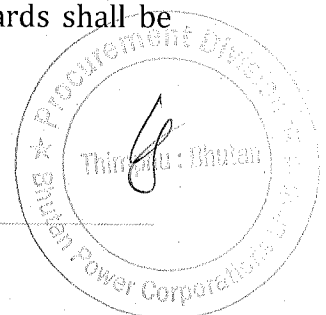
9. TESTS:-

9.1. TYPE TESTS:-

The equipment offered should be fully type tested and shall include with its valid Type Test Certificates, issued by an approved, reputed, independent testing laboratory. In case, the equipment of the type and design offered has already been type tested, the supplier shall furnish type test reports along with the offer. The type test report should not be more than 7 years old, reckoned from the date of Bid opening. The tenderer shall also submit along with type test certificate, copies of drawings of the equipment actually tested (duly authenticated by testing agency) indicating the complete bill of material and material of various parts.

9.2. ACCEPTANCE AND ROUTINE TESTS

All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier.



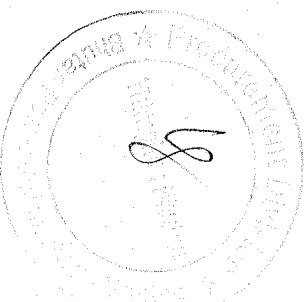
TECHNICAL SPECIFICATIONS

Lot 4: Current Transformers

Item 1: 66 kV outdoor Current Transformer

CT type: outdoor dead tank, CT type: outdoor dead tank, Highest system voltage: 72.5kV, CTR 800-400/1A, Rated frequency: 50Hz, Rated STC: 20kA for 1sec, Insulation level: 166kV rms/386kV peak

	Core 1	Core 2	Core 3	Core 4
Core	Core 1	Core 2	Core 3	Core 4
Ratio	800-400	800-400	800-400	800-400
Secondary current	1	1	1	1
Secondary terminals	1S1-1S2-1S3-1S4	2S1-2S2-2S3-2S4	3S1-3S2-3S3-3S4	4S1-4S2-4S3-4S4
Rated burden in VA	-	30VA	-	-
Accuracy Class	PS	0.2	PS	PS
ALF/ISF	-	-	-	-
Min Knee Point Voltage	150/300/600V	-	150/300/600V	150/300/600V
Max Rct at 75degC	1/2/40hms	-	1/2/40hms	1/2/40hms
Max Iext at Vk/4@600/1A	60mA	-	60mA	60mA



Item 2: 33 kV Outdoor Current Transformer

CTR: 300-150/1A, Voltage : 33kV, HSV: 36kV, Frequency: 50Hz, Type : outdoor, dead tank, IL: 36/80/200kVP, Rated STC: 16kA for 1 Sec, Insulation level : 166kV rms/386kV peak

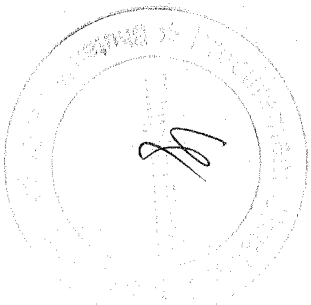
Core	1	2	3
Ratio(A)	300-150	300-150	300-150
Secondary Current (A)	1	1	1
Secondary Terminal	1S1-1S2-1S3	2S1-2S2-2S3	3S1-3S2-3S3
Burden (VA)	15	15	-
Accuracy Class	0.5	5P 20	PX
T. RATIO/ISF≤	5		1/300-150
RTC (75°C) ≤	Ω	Ω	5Ω
Vk ≥	V	V	100V
Ie at Vk/2 ≤	mA	mA	30 mA



Item 3: 11 KV Indoor Current Transformer

11KV indoor current transformer, Ratio 400-200/1+1+1A, STC 18.4KA for 1sec, Ie at V_k/2 ≤ 30, IL 12/28/75kV, V_k ≥ 300V @ Core3

Core	1	2	3
Ratio	400-200	400-200	400-200
Secondary Current (A)	1	1	1
Secondary terminals	1S1-1S2-1S3	2S1-2S2-2S3	3S1-3S2-3S3
Burden	15 VA	15 VA	-
Purpose	0.5	5P10	PS



Lot 5: Cable Termination Kits

General Specifications

- a. The cable accessories should be suitable for storage without deterioration in properties at temperatures up to 50 deg C and should have unlimited shelf life.
- b. Fluorinated Silicon Grease should be provided for filling up the minor nicks & scratches on the insulation that may occur while removing the Semi conducting screen of the Cable.

1. END TERMINATIONS

- a. Class of Termination:
The End termination should be Class - I as defined by IEEE 48 Standard & amended up to date.
- b. Stress Control:
 - The stress control at the screen cutback should be provided by a Heat Shrinkable tubing having a minimum volume resistivity of 10^{10} Ohms cm. The relative permittivity of the tubing should be at least 15.
 - To eliminate voids caused at the step due to semiconducting screen cutback, the manufacturer should provide a high permittivity mastic, the permittivity of which should be at least 15.
 - The impedance of the stress control tubing should not change over a range of temperature of 0 deg C - 125 deg C, which is the temperature range over which an XLPE cable is expected to operate

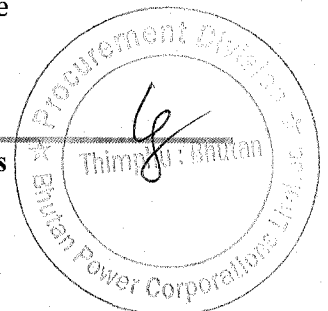
c. Protection to Insulation:

A heat shrinkable tubing should be applied over exposed cable dielectric.

The material should be:

- (1) Non tracking
- (2) Weather resistant
- (3) Erosion resistant
- (4) U. V. radiation resistant

Test reports conforming that there is no degradation of the material after prolonged exposure to elevated temperatures. This should include



Section VII- Schedule of Supply

- Thermal endurance- An Arrhenius plot to confirm the life expectancy on continuous at a temperature of 90 deg C.
- The materials should pass Tracking & Erosion Resistant test in accordance with ASTM D 2303.
- For weather resistance the materials should be tested on Atlas weather-O-meter test.
- The materials should be tested as per EMMAQUA test procedure for evaluating it's resistance to Ultra Violet radiations.

d. Environment sealing:

At the lugs end the sealing against ingress of moisture should be provided by non tracking sealant strips followed by heat shrinkable non tracking, erosion & weather resistant tubing precoated with non tracking sealant.

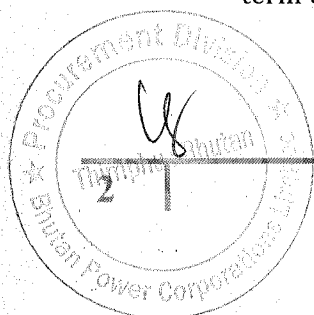
For 3 core cable the sealing at the crutch area should be provided by a heat shrinkable non tracking erosion & weather resistant breakout internally coated with a non tracking hot melt adhesive.

e. Provision for Earthing

The Copper tape screen and armour of the cable should be earthed by tinned copper braids of appropriate size provided with lug at one end.

2. TEST

- a. The kits should be tested as per test sequence of VDE 0278 or IS: 13573 as per latest amendments
- b. The Joints/ Terminations should be type Tested for series 1 and series 2 along with **SALT FOG TEST** as per testing procedures.
- c. All Heat Shrinkable components should be tested as per ESI-09-13. The bidder shall furnish test reports along with the bid.
- d. The manufacturer should provide life assessment test (accelerated ageing test) reports to prove that the heat shrinkable components are capable of retaining their properties within acceptable limits during the course of long term usage.



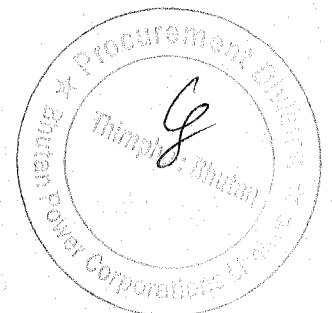
- e. TERT (Track Erosion and Resistance test) should be conducted on heat shrinkable tube used in termination to prove that they are non tracking.
- f. The manufacturer should also furnish graphs showing the variation of impedance of the stress control tubing with respect to (1) change in temperature and (2) Time (aging at constant temperature).

Cable Termination Kits for 33 kV GIS

Cable termination kits required for the project should be screened separable connectors, designed to connect single XLPE cable to medium-voltage gas insulated switchgears and other equipment using Type C bushing interface=630 A specified up to 33kV. The test shall be done as per IEC 61442-2005/IEC 60502-4

It should be made up of insulating material characterized by high tracking resistance, elongation at break and non-flammability. It should be protected by a thick-walled outer conductive screen connected to earth and suited for indoor installations. The overall and cut back dimensions should be designed to take up minimum space in the terminal box.

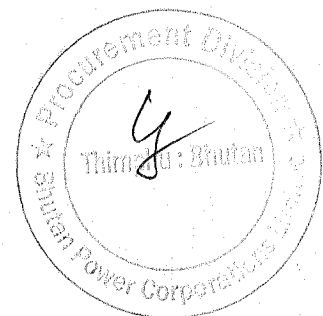
The screened connector need not be removed for over sheath testing. Conductor connection should be suitable for both mechanical lugs and crimping. Provision should be provided for cable testing without disconnecting the connectors from the bushings.

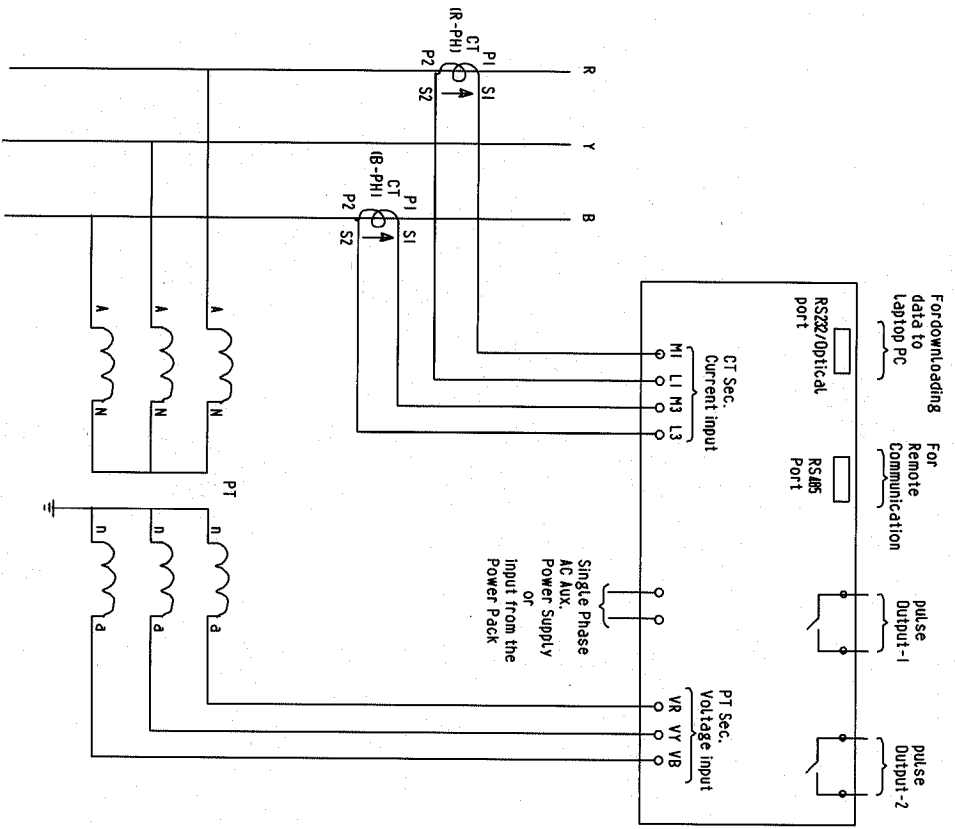


Lot 8: HT Energy Meters**General Requirement of HT Meters (3ph, 4 wire)**

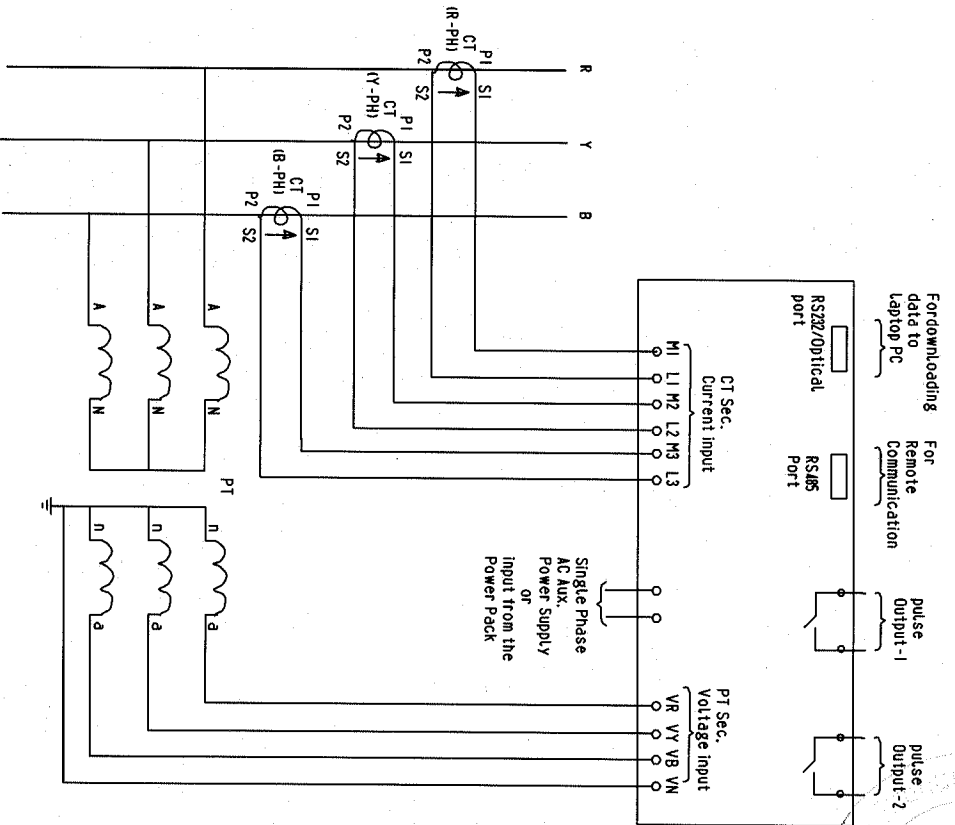
Description	Particulars
Applicable standards	IEC 62053-22, IS 14697
Accuracy Class	0.5s
Basic Current	1 A
Rated Voltage	63.5 V (Phase to neutral)
Rated frequency	50 Hz
Measure energy values	Active, Reactive and Apparent
Max. demand reset provisions	Following max. demand resetting options will be provided: <ul style="list-style-type: none"> Resetting through MRI/Laptop cable of communicating with the meter. Automatic reset at the end of every month
Data retention by NVM	Minimum 10 years data retention even in unpowered condition
AMR/RMR facility	Meter can be read remotely using GPRS/GSM modem
Communication ports	<ul style="list-style-type: none"> Optical communication port for data downloading using MRI/LAPTOP/MODEM. Separate MODBUS based RS485 port for SCADA application
Sealing provisions	2 sealing arrangements on meter body, 2 sealing arrangements on meter terminal cover and one sealing arrangement on optical port shall be provided
Anti tamper features	Anti tampered features shall be provided
Commissioning type for CT & PT	Meters will be secondary commissioned type i.e. meters will record and display parameters as per actual voltage and currents available at secondary of PT and CT.
Material of meter body	High grade engineering plastic
Meter power supply body	Self powered and Aux. supply of single phase AC or input from power pack (DC)
Rating plate details	Bhutan Power Corporation limited Purchase order no. & date Manufactured by: <i>(insert manufacturers name)</i> Meter serial no. with bar code Rest details will be as per international standards

The typical connection diagram for **three-phase four-wire meter** is shown on drawing no. BPC-DDCS-2022-4





TYPICAL CONNECTION DIAGRAM FOR THREE -PHASE, THREE -WIRE METER



TYPICAL CONNECTION DIAGRAM FOR THREE -PHASE, FOUR -WIRE METER



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

TITLE

NAME

DATE

DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

DESIGNED BY

TYPICAL DRAWING ON MV ENERGY METER CONNECTION

CHECKED BY

APPROVED BY

DRAWING NO. BPC/DDCS/2022/4

REVISION 2022

