**POWER TRANSMISSION CORPORATION OF UTTARAKHAND LTD.**
**(A Govt. of Uttarakhand Enterprise)**
**CHIEF ENGINEER, OPERATION & MAINTENANCE**
**GARHWAL ZONE, PTCUL**
**26 - CIVIL LINES, ROORKEE - 247667**

E- Tender for "Supply of 145KV, 72.5KV and 36KV CT's ,CVT's/PT's at 132KV Substation Satpuli, Srinagar and Simli"

*DOWNLOADED BY*: -

M/s / Shri _____

| Sr. No. | DESCRIPTION | |
|---|---|---|
| 1. | Tender No. | CE/GZR-06/2022-23 |
| 2. | Name of Work | "Supply of 145KV, 72.5KV and 36KV CT's ,CVT's/PT's at 132KV Substation Satpuli, Srinagar and Simli" |
| 3. | Completion Time | **03 Months from the date of approval of drawings/GTP.** |
| 4. | Route Length in Kms. | -- |
| 5. | Tender issuing office | Office of Chief Engineer (O&M) Garhwal Zone, Power Transmission Corporation of Uttarakhand Ltd. " 26-Civil Lines, Roorkee-247667 |
| 6. | Tender Fees | **Rs. 2,000.00+360.00 (GST@18%) =Rs.2,360.00 (Non refundable)** |
| 7. | EMD/Bid Security | **Rs. 1,16,000.00** |
| 8. | Starting date of issue of Bid documents. The tender document is to be downloaded through website- www.uktenders.gov.in against payment of tender fees as above. The non refundable tender fees as specified above should be sent along with the bids as specified in the bid documents. | 07.06.2022 |
| 9. | Last date of Request of Bid Documents. | As per tender notice / corrigendum if any |
| 10. | Last date of issue of Bid Documents. | As per tender notice / corrigendum if any |
| 11. | Closing Date of receipt of Bid through E-tendering | As per tender notice / corrigendum if any |
| 12. | Address & Place of Submission of Bid supporting documents. | Chief Engineer (O&M), Garhwal Zone, PTCUL, 26-Civil Lines Roorkee-247667. |
| 13. | Date and Time of Opening of Technical Bid | As per tender notice / corrigendum if any |
| 14. | Address & place of Technical bid(Part-1) opening | Chief Engineer (O&M), Garhwal Zone, PTCUL, 26-Civil Lines Roorkee-247667. |
| 15. | Type of Tender | Open Tender |
| 16. | Validity of Bid | 180 days after the date of opening of technical bid (Part-I) |
| 17. | Contact & Telephone No. of the Tender issuing office | Phone No.:- 01332-272256<br>Fax No. : 01332-2722315 |
| 18. | E-mail address of the tender issuing office | ce_oandmg@ptcul.org<br>chiefengineergarhwal@gmail.com |

**CHIEF ENGINEER (O&M) GARHWAL ZONE, ROORKEE**

# पावर ट्रान्समिशन कारपोरेशन ऑफ उत्तराखण्ड लि0
## मुख्य अभियन्ता (परिचालन एवं अनुरक्षण) कार्यालय,
## गढवाल क्षेत्र, 26– सिविल लाईन्स, रूड़की
## ई–निविदा सूचना

पावर ट्रान्समिशन कारपोरेशन ऑफ उत्तराखण्ड लि0 द्वारा "Supply of 145KV, 72.5KV and 36KV CT's, CVT's/PT's at 132KV Substation Satpuli, Srinagar and Simli" against Tender specification No. CE/GZR-06/2022-23 के तहत ई–निविदाऐं आमन्त्रित की जाती हैं। ई–निविदा ऑनलाईन/ऑफ लाईन जमा करने की अन्तिम तिथि 06.07.2022 को समय 15.00 बजे तक हैं, जो दिनांक 07.07.2022 को 15.00 बजे खोली जायेगी। ई–निविदा सम्बन्धित अन्य विस्तृत विवरण ई–निविदा वेबसाईट www.uktenders.gov.in (Tender ID: 2022_PTCUX_45369_1) एवं ई–निविदा सूचना पिटकुल की वेबसाईट www.ptcul.org से प्राप्त की जा सकती हैं । ई–निविदा से सम्बन्धित जानकारी हेतु मो0न0 +91-8899890000 पर सम्पर्क करें.

मुख्य अभियन्ता (परि0एवं अनु0)

"राष्ट्र हित में बिजली बचायें"

**POWER TRANSMISSION CORPORATION OF UTTARAKHAND LTD.**
**OFFICE OF THE CHIEF ENGINEER (OPERATION & MAINTENANCE)**
**GARHWAL ZONE, 26-CIVIL LINES, ROORKEE**
**E-TENDER NOTICE**

Power Transmission Corporation of Uttarakhand Ltd. invites e-tender for "Supply of 145KV, 72.5KV and 36KV CT's, CVT's/PT's at 132KV Substation Satpuli, Srinagar and Simli" against Tender specification No. CE/GZR-06/2022-23. Last date of submission of online/offline e-tender is 06.07.2022 upto 15.00 Hours which shall be opened on 07.07.2022 at 15.00Hrs. Details of E-tender can be obtained from E-tender website www.uktenders.gov.in (Tender ID: 2022_PTCUX_45369_1) and information of E-tender can be seen from PTCUL website www.ptcul.org. For any assistance on e-tendering, please contact on Mb. No. +91-8899890000.

CHIEF ENGINEER (O&M)

"SAVE ELECTRICITY IN THE INTEREST OF NATION"

# Scope of Work

Supply of 145 kV, 72.5 kV, 36 kV CT's and CVT's/PT's at 132 kV Substation Satpuli, Srinagar and Simli as per following details.

| Sl. No. | Description | Unit | Qty. Supplied at | | | Total |
|---|---|---|---|---|---|---|
| | | | 132 kV S/S Srinagar | 132 kV S/S Satpuli | 132 kV S/S Simli | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | 145 KV (5 Core) Current Transformer (Ratio 800/400/1 A) | Nos. | 2 | 3 | 1 | 6 |
| 2 | 145 KV (5 Core) Current Transformer (Ratio 200/100/1 A) with Junction Box | Nos. | 2 | 4 | 1 | 7 |
| 3 | 145 KV Capacitive Voltage Transformer | Nos. | 2 | 1 | 1 | 4 |
| 4 | 72.5 KV Current Transformer (Ratio 400/200/1 A) | Nos. | 3 | Nil | Nil | 3 |
| 5 | 72.5 KV Capacitive Voltage Transformer | Nos. | 6 | Nil | Nil | 6 |
| 6 | 36 KV (3 Core) Current Transformer (Ratio 800/400/1 A) with Junction Box | Nos. | 2 | 1 | Nil | 3 |
| 7 | 36 KV (3 Core) Current Transformer (Ratio 400/200/1 A) with Junction Box | Nos. | 1 | 2 | 2 | 5 |
| 8 | 36 KV Potential Transformer (1 Phase) | Nos. | 2 | 3 | 2 | 7 |
| | **Total** | | **20** | **14** | **7** | **41** |

**Pre Qualifying Criteria**

**(A) Technical Qualifying Requirement**

1. The bidder should have successfully completed similar nature of work/supply **(145 kV or above voltage level)** within last Seven Years (07 Years) as on the originally scheduled date of Bid opening.
2. The Bidder/Collaborator/JV Partner must have executed similar supply i.e. he must have "supplied 145KV or above voltage level in the last seven years as per above condition and these work should be working satisfactorily. Certificate of completion, Agreement no./PO, Amount of work done and schedule time completion versus actual time of completion work, not less the rank of Executive Engineer of similar work should be submitted.
3. The bidder must comply the technical specification & GTP of instruments with vendor name for supply of items from the approved vendor in PTCUL and an undertaking must be submitted with the bid.
4. The Bidder/Collaborator/JV Partner should be manufacturer/authorized dealer or should have executed successfully the similar supply.
5. Copies of Supply Orders (as per above criteria) from the Govt. Power Utilities/PSUs/Govt. Organizations/Other Govt. Department for similar supply is required to be submitted along with the bid.
6. MSME rules will be applicable as per Uttarakhand Government. The contractor should submit valid certificate.

**(B) Financial Qualifying Requirement**

1. Minimum Average Annual Turnover:- The minimum average annual turnover for the preceding best three years (36 months) out of last five financial years should not be less than 68.09 Lacs

(Balance sheet/Documentary proof for last five years should be enclosed). The balance sheet and all other financial documents attested/certified by CAs to substantiate fulfilment of FQR should be with UDIN.

2. Experience of having successfully completed similar works/supplies during last 7 years lending last day of month previous to the one in which applications are invited should be either of the following;
   (a) Three similar completed works costing not less than the amount equal to Rs. 18.16 Lac.
   OR
   (b) Two similar completed works costing not less than the amount equal to Rs. 22.70 Lac.
   OR
   (c) One similar completed work costing not less than the amount equal to Rs. 36.31 Lac.
3. The bidder have to submit affidavit of all ongoing projects which are not completed and Net worth of the ongoing project which are not completed at the time of bidding. (Not completed project means project in Government, Government undertaking or Private sector also include the LOA/ Agreement which are allotted/ executed but work has not started at the time of bidding.
4. The bidder has to submit the latest Balance sheet and CA Certificate (along with the UDIN No.) for the Net Worth at the time of bidding.
5. Experience certificate should be issued by an officer not below the rank of Executive Engineer mentioning nature of work, Agreement No., Amount of work, Scheduled time of completion of work and Actual time of completion etc. Completion certificate from officer shall be enclosed by contractor.

**(C) Additional Documents**

1. Copy of PAN No. of the firm/Company or PAN No. of all its partner's in case of partnership firm or PAN No. of the individual, in case of proprietorship.
2. The Tenderers should have submitted copy of Goods l& Service Tax (GST) Registration.
3. RTGS/NEFT Details of the bidder is to be submitted.
4. Latest Solvency certificate not more than 3 months old issued by bank (20% of bid value) should be submitted..
5. The balance sheet and all other financial documents attested/certified by CA's to substantiate fulfilment of FQR should be with UDIN, failing which the tender will be summarily rejected without any further reference.
6. GST Registration/Issuing authority.
7. Details of Partners/Directors of the Firm/Company.
8. Experience record and details of other works pending/executed for various utilities.
9. Last year audited Accounts.

# TECHNICAL SPECIFICATIONS FOR INSTRUMENT TRANSFORMERS

## 1.0 GENERAL

**1.1** The instrument transformers and accessories shall conform to the latest version of the standards specified below except to the extent explicitly modified in the specifications and shall be in accordance with requirements in Chapter-GTR
Current transformers IEC: 44-1 (or IS: 2705)
Voltage transformers IEC: 186/358 (or IS: 3156)

**1.2** The instrument transformers shall be complete with its terminal box and a common marshalling box for a set of 3 instrument transformers.

**1.3** The instrument transformer tank alongwith top metallics shall be hot dip galvanized.

**1.4** The instrument transforms shall be designed for use in geographic and meteorological conditions as given in Chapter: GTR.

## 2.0 CONSTRUCTION FEATURES:

The features and constructional details of instrument transformers shall be in accordance with requirements stipulated hereunder:

### 2.1 Bushing/ Insulators :

a) Instrument transformers shall be of 145kV/72.5kV/36kV class, oil filled/SF6 gas filled, with shedded porcelain/composite bushing/Insulators suitable for outdoor service and upright mounting on steel structure.
b) Bushing/Insulators shall conform to requirements stipulated in Chapter-GTR. The bushing/insulator for CT shall be one piece without any metallic flange joint.
c) Bushing shall be provided with oil filling and drain plugs, oil sight glass of CT and for electromagnetic unit of CVT, etc. The bushing/insulator of instrument transformer shall have cantilever strength of not less than 350 kg OR as per the value obtained vide Chapter-GTR, whichever is higher. Oil filling and drain plugs are not required with SF6 gas filled CT.
d) Instrument transformers shall be hermetically sealed units. Bidder/Manufacturer shall furnish details of the arrangements made for the sealing of instrument transformers alongwith the bid.
Bidder/Manufacturer shall also furnish the details of site test to check the effectiveness of hermetic sealing for approval
e) Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

### 2.2 Terminal box/Marshalling box :

Terminal box shall conform to the requirements of Chapter-GTR.

### 2.3 Insulating Oil :

a) Insulating oil to be used for instrument transformers shall be of EHV grade and shall conform to IS: 335 (required for the first filling).
b) The SF6 gas shall comply with IEC-60376, 60376A and 60376 B and shall be suitable in all respects for use in the switchgear under operating conditions.

### 2.4 Name Plate :

Nameplate shall conform to the requirements of IEC incorporating the year of manufacture. The rated current, extended current rating in case of current transformers and rated voltage, voltage factor in case of voltage transformers shall be clearly indicated on the Nameplate. The rated thermal current in case of CT shall also be marked on the nameplate.

The intermediate voltage in case of capacitor voltage transformer shall be indicated on the name plate.

## 3.0 CURRENT TRANSFORMERS :

**3.1** Current transformers shall have single primary either ring type, or hair pin type and suitably designed for bringing out the secondary terminals in a weather proof (IP-55) terminal box at the bottom. These secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box. In case “Bar primary” inverted type current transformers are offered the manufacturer will meet following additional requirements :

a) The secondaries shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.

b) The lowest part of the insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.

c) The upper part of insulating assembly resting on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulating assembly & top dome.

d) Nitrogen if used for hermetic sealing (in case of live tank design should not come in direct contact with oil.

e) Bidder/Manufacturer shall recommend whether any special storage facility is required for spare CT.

**3.2** Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.

**3.3** Core lamination shall be of cold rolled gain oriented silicon steel or other equivalent alloys. The cores used for protection shall produce undistorted secondary current under transient condition at all ratio with specified CT parameters.

**3.4** The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.

**3.5** Facilities shall be provided at terminal blocks in the marshalling box for star deltaformation, short circuiting and grounding of CT secondary terminals.

**3.6** Current transformer’s guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

**3.7** The rated extended primary current shall be 120% (or150% if applicable) on all cores of the CTs.

**3.8** Characteristics shall be such as to provide satisfactory performance of burden ranging from 25% to 100% of rated burden over a range of 10% to 100% of rated current in case of metering CTs and up to the accuracy limit factor /knee point voltage in case of relaying CTs.

**3.9** The current transformer shall be suitable for horizontal transportation. It shall be ensured that the CT is able to withstand all the stresses imposed on it while transporting and there shallbe no damage in transit. The Contractor shall submit the details of packing design to the Purchaser for review.

**3.10** Instruments security factor at all ratios shall be less thanfive (5) for metering core. If any auxiliaryCTs / reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs / reactor shall preferably be inbuilt construction of the CTs. In case

these are to be mounted separately these shall be mounted in the central marshalling box suitably wired upto the terminal blocks.

**3.11** The wiring diagram plate for the interconnections of three single phase CTs shall be provided inside the marshalling box.

**3.12** The current transformation should be suitable for mounting on lattice support structure to be provided by the Contractor in accordance with stipulations of Chapter-GTR.

**3.13** The CT shall be designed as to achieve the minimum risks of explosion in service.Bidder/Manufacturer shall bring out in his offer, the measures taken to achieve this.

**3.14** 145 kV current transformers shall be suitable for high speed auto reclosing.

## 4.0 VOLTAGE TRANSFORMERS :

**4.1** 145kV/72.5kV Voltage transformer shall be capacitor voltage divider type with electromagnetic units and shall be suitable for carrier coupling.

**4.2** Voltage transformers secondaries shall be protected by HRC cartridge type fuses for all the winding. In addition fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the CVTs shall be terminated to the stud type non-disconnecting terminal blocks in the individual phase secondary boxes via the fuse.

**4.3** CVTs shall be suitable for high frequency (HF) coupling required for power line carrier communication. Carrier signal must be prevented from flowing into potential transformer (EMU) circuit by means of a RF choke/reactor suitable for effectively blocking the carrier signals over the entire carrier frequency range i.e 40 to 500 KHz. Details of the arrangement shall be furnished along with the bid. H.F. terminal of the CVT shall be brought out through a suitable bushing and shall be easily accessible for connection to the coupling filters of the carrier communication equipment, when utilized. Further, earthing link with fastener to be provided for HF terminal.

**4.4** The electromagnetic unit comprising compensating reactor intermediate transformer and protective and damping device should have separate terminal box with the entire secondary terminal brought out.

**4.5** The damping device which should be permanently connected to one of the secondary winding should be capable of suppressing the Ferro-resonance oscillations.

**4.6** The accuracy of 0.2s on secondary III should be maintained throughout the entire burden range upto 100 VA for 145 kV/72.5 kV CVTs and upto 40VA for 33kV PTs on all the windings without any adjustments during operation.

**4.7** CVTs/PTs shall be suitable for mounting on tubular GI pipe in accordance with stipulations of Chapter-GTR.

**4.8** It should be ensured that access to secondary terminals is without any danger of access to high voltage circuit.

**4.9** A protective surge arrester shall be provided to prevent breakdown of insulation by incoming surges and to limit abnormal rise of terminal voltage of shunt capacitor/primary winding, tuning reactor/RF choke etc. due to short circuit in transformer secondaries. In case of an alternate arrangement, bidder shall bring out the details in the bid.

**4.10** The wiring diagram for the interconnection of the three single phase CVTs/PTs shall be provided inside the marshalling box in such a manner that it does not deteriorate with time.

## 5.0 TERMINAL CONNECTORS :

The terminal connector shall meet the requirement as given in Chapter-GTR.

## 6.0 TESTS :

**6.1** In accordance with the requirements in Chapter-GTR, Current and Voltage Transformers should have been type tested and shall be subjected to routine tests in accordance with IEC: 44-1/IS:2705 and IEC: 186/IS:3156 respectively.

**6.2** The test report of the type tests and following additional type test shall be also be submitted for the Purchaser's review.

a) **Current Transformers :**

i) Radio interference test as per Annexure-A of Chapter-GTR.

ii) Seismic withstand test as per Annexure-B of Chapter-GTR

iii) Thermal stability test, i.e. application of rated voltage and rated extended thermal current simultaneously by synthetic test circuit.

iv) Thermal co-efficient test i.e measurement of tan delta as a function of temperature (at ambient and between $80^0$ C & $90^0$ C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um/$\sqrt{3}$)

v) The current transformer shall be subjected to Fast Transient test by any one of the following two methods given below to assess the CT performance in service to withstand the high frequency over voltage generated due to closing & opening operation of isolators. Alternatively, method as per IEC: 44-1 may be followed :

**Method I :** 600 negative polarity lightning impulses chopped on crest will be applied to current transformer. The opposite polarity amplitude must be limited to 50% of crest value when the wave is chopped. Impulse crest value will be 1000kVp of 420 kV CTs. One impulse per minute shall be applied and every 50 impulse high frequency currents form the windings and total current to earth will be recorded and be compared with reference currents recorded applying one or more (max 20) reduced chopped impulses of 50% of test value.
Oil samples will be taken before and 3 days after the test. Gas analysis must not show appreciable rate of increase in various gases related with the results of the analysis performed before test. Total sum of crest values of current through secondaries must not exceed 5% of the crest value of total current to earth.
CTs must withstand dielectric tests after this test to pass the test.

**Method II :** 100 negative polarity impulses with a rise and fall time of less than 0.25 microsecond having 950 kV for 420 kV CT corrected to atmospheric condition shall be applied at one minutes interval and total current through insulation of earth will be recorded. The amplitude of first opposite polarity should be limited to 50% of the chopped impulse crest value. Voltage and total current wave shapes shall be recorded after every 10 impulses and will be compared with reference wave recorded before test at 50% of test values.
Oil samples will be taken before and 3 days after the test and CT shall be deemed to have passed the test if the increase in gas content before and after test is not appreciable.

b) **Voltage Transformers :**

i) High frequency capacitance and equivalent series resistance measurement (as per IEC-358).
ii) Seismic withstand test (as per Annexure-B of Chapter-GTR).
iii) Stray capacitance and stray conductance measurement of the low voltage terminal (as per IEC-358).
iv) Determination of temperature coefficient test (as per IEC-358).
v) Radio interference test as per Annexure-A of Chapter-GTR.
vi) The Ferro-resonance type test shall be carried out on the complete CVT

**6.3** The current and voltage transformer shall be subjected to the following routine/site tests in addition to routine test as per IEC/IS.

**a) CURRENT TRANSFORMERS :-**

ROUTINE TESTS :-

i) Measurement of Capacitance.
ii) High voltage power frequency withstand test on Secondary winding.
iii) Over-voltage inter turn test (as per BS-3938).
iv) Oil leakage test.
v) Measurement of tan delta at 0.3, 0.7, 1.0, and 1.1 Um/√3.
vi) Measurement of partial discharge shall be carried out as per IEC.

Dissolved gas analysis to be carried out at the time of commissioning. CTs must have adequate provision for taking oil samples from the bottom of the CT without exposure to atmosphere. Bidder/Manufacturer shall recommend the frequency at which oil samples should be taken and norms for various gases in oil after being in operation for different durations. Bidder/Manufacturer should also indicate the total quantity of oil which can be withdrawn from CT for gas analysis before refilling or further treatment of CT becomes necessary.

**b) VOLTAGE TRANSFORMERS :**

i) Capacitance and loss angle measurement before and after voltage test (as per IEC-358).
ii) Partial discharge test on capacitor dividers (as per IEC-358).
iii) Sealing test (as per IEC-358).

## 7.0 SPARE PARTS AND MAINTENANCE EQUIPMENT :

The Bidder shall include in his proposal a list of spare parts to be required.

## 8.0 TECHNICAL PARAMETERS :

### 8.1 Current Transformer

| Sl.No. | Details | Unit | 132 KV system | 66 KV system | 33 KV system |
|---|---|---|---|---|---|
| 1 | Nominal/rated voltage | KV | 132 | 66 | 33 |
| 2 | Highest system voltage | KV | 145 | 72.5 | 36 |
| 3 | No. of cores | Nos. | 5 | 3 | 3 |
| 4 | Rated primary current | A | 800/400<br>200/100 | 400/200 | 800/400<br>400/200 |
| 5 | Rated transformation ratio | | | | |
| 5 (a) | Protection | | | | |
| | - Bus differential | A | 800/400/1<br>400/200/1 | 400/200/1<br>400/200/1 | 800/400/1<br>400/200/1 |

| | | | | | |
|---|---|---|---|---|---|
| | - other | A | as required/1 | as required/1 | as required/1 |
| **5(b)** | Metering | A | as required/1 | as required/1 | as required/1 |
| **6** | Rated fault current and duration | KA | 31.5 (1 sec.) | 31.5 (1 sec.) | 25 (3 sec.0 |
| **7** | Rated dynamic short circuit current | KAp | 78.75 | 78.75 | 62.5 |
| **8** | Lightning (full wave) impulse withstand voltage (1.2/50 micro sec.) | | | | |
| | - between line terminal and ground | KVp | 650 | 350 | 170 |
| **10** | One minute power frequency withstand voltage: | | | | |
| | -Between line terminal and ground | $KV_{rms}$ | 275 | 140 | 75 |
| **11** | One minute power frequency withstand voltage of secondary winding | KV | 5 | 5 | 5 |
| **12** | Minimum corona extinction voltage | $KV_{rms}$ | 105 | - | - |
| **13** | Maximum radio interference voltage for frequency between 0.5 to 2 MHz | micro – volt | 500 (at 92 $kV_{rms}$) | - | - |
| **14** | Maximum partial discharge level | pC | 10 | 10 | 10 |
| **15** | Cantilever strength | Kg | 350 | 350 | 350 |

***** CT ratios specified above are tentative actual CT ratio to be supplied shall be decided during detail engineering.

## 8.2 Voltage Transformer/ Potential Transformer

| S.No | Details | Unit | 132 KV system | 66 KV System | 33 KV system (PT) |
|---|---|---|---|---|---|
| **1** | Nominal/rated voltage | KV | 132 | 66 | 33 |
| **2** | Highest system voltage | KV | 145 | 72.5 | 36 |
| **3** | Fault current and duration | KA | 31.5 (1 sec.) | 31.5 (1 sec.) | 25 (3 sec.) |
| **4** | Rated primary voltage | KV | 145/√3 | 72.5/√3 | 36/√3 |
| **5** | Rated secondary voltage | V | 110/√3 | 110/√3 | 110/√3 |
| **6** | Accuracy class | | | | |
| | - Protection | | 3P | 3P | 3P |
| | - Metering | | 0.2s | 0.2s | 0.2s |
| **7** | Lightning (full wave) impulse withstand voltage (1.2/50 micro sec.) | | | | |
| | - between line terminals and ground | KVp | 650 | 350 | 170 |
| **9** | One minute power frequency withstand voltage: | | | | |
| | - between line terminals and ground | $KV_{rms}$ | 275 | 140 | 75 |
| **10** | Minimum corona extinction voltage | $KV_{rms}$ | 105 | - | - |
| **11** | Maximum radio interference voltage for frequency between 0.5 to 2 MHz | micro – volt | 500 (at 92 $kV_{rms}$) | 500 (at 92 $kV_{rms}$) | - |
| **13** | High frequency capacitance for entire carrier frequency range | % | 80 to 150 % of rated capacitance | 80 to 150 % of rated capacitance | NA |
| **14** | Equivalent resistance over entire | Ohms | < 40 | < 40 | - |

| | | | | | |
|---|---|---|---|---|---|
| | carrier frequency range | | | | |
| **15** | Stray capacitance and stray conductance of LV terminal over entire carrier frequency range | | As per IEC-60358 | As per IEC-60358 | - |
| **16** | One minute power frequency withstand voltage (LV side): | | | | |
| **16 (a)** | Between LV (HF) terminal and earth | | | | |
| | - for exposed terminals | $KV_{rms}$ | 10 | 10 | 10 |
| | - for terminals enclosed in weather proof enclosure | $KV_{rms}$ | 4 | 4 | 4 |
| **16 (b)** | For secondary winding | $KV_{rms}$ | 3 | 3 | 3 |
| **17** | Rated voltage factor | | | | |
| | - continuous | | 1.2 | 1.2 | 1.2 |
| | - for 30 sec. | | 1.5 | 1.5 | 1.5 |
| **18** | Maximum partial discharge level | pC | 10 | 10 | 10 |
| **19** | Rated capacitance | pF | 4400 (+10, -5%) | 4400 (+10, -5%) | - |
| **20** | Cantilever strength | Kg | 350 | 350 | 350 |

## 9.0 TESTING & COMMISSIONING

**9.1** An indicative list of test is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P/Instructions of the equipment Supplier or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests along calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

**9.2 Current Transformers**

a) Insulation Resistance Test for primary and secondary.
b) Polarity test.
c) Ratio identification test-checking of all ratios on all cores by primary injection of current.
d) Dielectric test of oil (wherever applicable)
e) Magnetising Characteristics test.
f) Tan delta and capacitance measurement
g) Secondary winding resistance measurement.

**9.3 Voltage Transformers/Capacitive Transformers :**

a) Insulation Resistance test for primary (if applicable) and secondary winding.
b) Polarity test
c) Ratio test
d) Dielectric test of oil (wherever applicable)
e) Tan delta and capacitance measurement between:-
   i) HV – HF Point
   ii) HF Point-Ground point of Intermediate Transformer.
   iii) HV-Ground point of Intermediate Transformer primary winding
f) Secondary winding resistance measurement.