



# BHARAT HEAVY ELECTRICALS LIMITED

## TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

|                                                                                                                                                                                                                                                                                                                                           |                                                                             |                                         |        |            |            |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------|--------|------------|------------|----------------|
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|                                                                                                                                                                                                                                                                                                                                           | TYPE OF DOC.                                                                | TECHNICAL SPECIFICATION                 | NAME   | RD         | VK         | AG             |
|                                                                                                                                                                                                                                                                                                                                           | TITLE<br><b>245kV POTENTIAL TRANSFORMER</b>                                 |                                         | SIGN   | Sd/-       | Sd/-       | Sd/-           |
|                                                                                                                                                                                                                                                                                                                                           |                                                                             |                                         | DATE   | 16/05/2020 | 16/05/2020 | 16/05/2020     |
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|                                                                                                                                                                                                                                                                                                                                           | CUSTOMER                                                                    | Indian Oil Corporation Limited (IOCL)   |        |            |            |                |
|                                                                                                                                                                                                                                                                                                                                           | CONSULTANT                                                                  | TATA Consulting Engineers Limited (TCE) |        |            |            |                |
| PROJECT                                                                                                                                                                                                                                                                                                                                   | LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery |                                         |        |            |            |                |

  

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## **SECTION 1**

### **SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES**

#### **1.0 SCOPE**

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 245kV Voltage Transformers/ Potential Transformers **(Tariff Metering PT)** complete with accessories as listed in this specification.

The fitment and equipments offered shall be of approved make of IOCL/ HVPNL or its subsequent approval from IOCL/ HVPNL shall be bidder's responsibility with no commercial implications to BHEL. If any of the make offered by the bidder is not acceptable to M/s IOCL/ HVPNL, the bidder has to supply alternate IOCL/ HVPNL approved make, meeting the specification, with no commercial implications to BHEL.

The specification comprise of following sections:

- Section-1: Scope, Specific Technical Requirements and Quantities
- Section-2: Equipment Specification
- Section-3: Project Details & General Technical Requirements
- Section-4: Guaranteed Technical particulars (GTP)
- Section-5: Checklist

In case of any conflict between various sections, **order of precedence** shall be in the same order as listed above.

**Note:** The terms used in this specification namely, "Employer/Purchaser/Owner" refers to IOCL/ HVPNL & "Contractor/ LSTK Contractor /Sub-contractor/Manufacturer" refers to successful bidder.

#### **1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT**

Name of customer: **Indian Oil Corporation Limited (IOCL)**

Name of consultant: **TATA Consulting Engineers Limited (TCE)**

Name of Project: **LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery**

Refer Section - 3 for Project Details and General Specifications.

## 1.2 SPECIFIC TECHNICAL REQUIREMENTS

### 1.2.1 245 kV VT PARAMETERS:

| SI No. | Parameters                                            | 245 kV VT                                                                                                                   |
|--------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 1      | Nominal voltage (Phase to Phase) [ kVrms]             | 220                                                                                                                         |
| 2      | Max. Continuous voltage Um (Phase to Phase) [ kVrms]  | 245                                                                                                                         |
| 3      | Rated frequency [ Hz ]                                | 50                                                                                                                          |
| 4      | Rated Short Time current for 1 sec [ kA ]             | 50                                                                                                                          |
| 5      | Minimum creepage Distance (phase to ground) [ mm/kV ] | 25                                                                                                                          |
| 6      | Max temperature rise over design ambient temp         | As per Section-3                                                                                                            |
| 7      | Type of Insulation                                    | Class A                                                                                                                     |
| 8      | Number of Terminals                                   | All terminals of control circuits are to be wired upto terminal box plus 20% spare terminals evenly distributed on all TBs. |
| 9      | Terminal Box - Ingress Protection                     | IP 55                                                                                                                       |

### 1.2.2 SECONDARY WINDING PARAMETERS

| Winding No. | Ratio                                                    | Accuracy Class | Burden |
|-------------|----------------------------------------------------------|----------------|--------|
| 1           | $\frac{220/\sqrt{3} \text{ kV}}{110/\sqrt{3} \text{ V}}$ | 0.2            | 25 VA  |
| 2           | $\frac{220/\sqrt{3} \text{ kV}}{110/\sqrt{3} \text{ V}}$ | 0.2            | 25 VA  |

**1.2.3** Offered PT shall be as per IOCL/HVPNL specification (Section-2, 13 pages).

**1.2.4** The successful bidder shall have to extend all possible supports like timely submission/re-submission of drawings, visit to end customer IOCL/ HVPNL to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer (IOCL/ HVPNL) approval. Testing as per HVPNL guidelines, at third party lab, if any, shall be carried out by successful bidder without any commercial implications to BHEL/ IOCL. Arranging and coordinating with HVPNL engineers for witnessing routine/ acceptance/ type tests at manufacturer's

**works or at third party lab is in the scope of bidder, without any commercial implications to BHEL/ IOCL.**

- 1.2.5** Rated VA burdens mentioned above are tentative. This may reduce as per actual connected burdens & HVPNL requirement, without any commercial implications to BHEL/ IOCL. Same shall be informed to the vendor during drawing approval stage i.e. before issuing manufacturing clearance.

### **1.3 TECHNICAL PRE QUALIFYING REQUIREMENTS**

245kV Potential Transformers being offered should be from manufacturer who have manufactured and supplied at least fifteen (15) nos. of single phase Potential Transformers suitable for Air Insulated Substation/ Switchyard of 245kV or above class which should have been in successful operation for minimum two (2) years prior to the date of techno-commercial bid opening.

### **1.4 BILL OF QUANTITY**

| <b>Item No.</b> | <b>Item Description as per Tender BOQ</b>                                                                                               | <b>Detailed Description</b>                       | <b>Quantity (Main)</b> | <b>Quantity (Spare)</b> | <b>Total Quantity</b> |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|------------------------|-------------------------|-----------------------|
| 01              | Supply-Electromagnetic Voltage Transformer : 245kV, 25mm/kV Creepage, 2 Secondary, Single Phase Potential Transformer (Tariff Metering) | Single Phase, 245kV, 2 core Potential Transformer | 6 Nos.                 | 0 No.                   | 6 No.                 |

**Note:**

1. Junction Box for a set of three (3) PTs shall be provided by BHEL.
2. The above quantities are subject to change by  $\pm 20\%$  at contract stage.
3. Hardware (Nut, Bolts and Washers) for Mounting PT on structure – 1set for each PT to be included by bidder in their offer.

### **1.5 TYPE TEST**

All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not prior to **five years from the date of bid opening**. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.

However if contractor is not able to submit report of the type test(s) conducted within last 5 years from the date mentioned above, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

## **1.6 DRAWINGS**

The documentation requirements detailed under Section-3 shall be submitted to BHEL at various stages of contract. Softcopy of the drawings are to be submitted at contract stage. Date of Submission of first lot of drawings will be counted only from the date of submission of reasonably correct drawings.

## **1.7 DOCUMENTS REQUIRED WITH OFFER**

- a) "No Technical Deviation" Certificate
- b) Un-priced schedule
- c) Filled up Checklist
- d) Catalogue and Technical Leaflets for the offered Equipments

## **1.8 WARRANTY**

Refer relevant clauses mentioned elsewhere.

## **1.9 DRAWINGS / DOCUMENTS REQUIRED FOR ENGINEERING MANUFACTURING CLEARANCE**

The minimum drawings/ documents, as follows shall be required for providing engineering manufacturing clearance of the equipment (245kV PTs) and furthermore, it shall be used for delay analysis, if any, on account of the bidder. The schedule for submission and resubmission shall be in line with details provided in section-3.

|   |                                                                                                      |
|---|------------------------------------------------------------------------------------------------------|
| 1 | OGA & Section Drawing, R&D Plate Drawings, BOM/ Component List with Guaranteed Technical Particulars |
| 2 | Type Test Reports                                                                                    |
| 3 | Quality Assurance Plan & Inspection Test Schedule                                                    |

## **1.10 PACKING AND DISPATCH**

The equipment shall be properly packed for selected mode of transportation i.e. sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage. The equipments shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as

'Fragile', 'This side up', 'Weight', 'Owner's particulars\ 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should also be suitable for outdoor storage areas with heavy rains/ high ambient temperature unless otherwise agreed and hence, packing shall be suitable for long duration storage (minimum 1 year).

#### **1.11 QUALITY PLAN**

The successful bidder shall submit Quality Assurance Plan for the equipment with in-process inspection methods, tests, records, etc. for BHEL/ Customer/ HVPNL approval. Customer hold points will also be included in the plan, which shall be mutually agreed by BHEL/ Customer. In case bidder has reference Quality Assurance Plan agreed with BHEL/ Customer/ HVPNL, same shall be submitted for specific project to BHEL/ Customer approval. There shall be no commercial implication to BHEL/ Customer on account of Quality Plan approval.

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of the equipment. All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all tests for the equipment shall be deemed to be included in bidder's scope.

## SECTION-2

### TECHNICAL SPECIFICATION FOR 245kV OUTDOOR ~~CT AND~~ PT FOR METERING PURPOSE

#### 1.0 SCOPE

- 1.1 This specification provides for design, engineering, manufacture, factory testing, transportation, supply, ~~site erection, installation, site testing and commissioning~~ of out-door instrument transformers ~~along with terminal connectors~~ for metering services in proposed 220/33kV S/Stns at IOCL Panipat.

~~The design supply and fabrication of all civil foundation and structural work required for outdoor CT and PTs shall also be in the scope of LSTK contractor. The supply and installation of all accessories associated with CT, PT system shall also be in the scope of contractor. For metering class CT and PTs due compliance of specification and guidelines of HVPNL must be ensured .~~

- 1.2 220 KV outdoor ~~CTs and~~ PTs are required for tariff metering purposes in line with the requirements of HVPNL. ~~The CT shall be a 0.2S class, dual core along with the suitable terminal arrangements in line with the requirements of HVPNL.~~

220 KV Outdoor PT shall be a 0.2 class, dual core along with the suitable terminal arrangements in line with the requirements of HVPNL.

The detailed GTP of ~~CT and~~ PT shall be ~~done~~ specifically done in line with HVPNL required format for open access metering. The preparation of GTP, drawings, and other documents along with its approval from HVPNL shall be in the scope of PT Supplier.

#### 2.0 STANDARDS

Unless otherwise specified elsewhere in this specification the rating as well as performance and testing of the instrument transformers shall conform but not limited to the latest revisions and amendments available at the time of placement of order of all the relevant standards as listed hereunder. (As applicable)

#### 2.1 INSTRUMENT TRANSFORMERS :

| Sr. No.        | Standard No.                               | Title                                                                               |
|----------------|--------------------------------------------|-------------------------------------------------------------------------------------|
| 1.             | IS:2165                                    | Insulation Co-ordination for equipment of 100kV and above.                          |
| <del>2.</del>  | <del>IS:2705</del><br><del>(I to IV)</del> | <del>Current Transformers</del>                                                     |
| 3.             | IS:2099                                    | Bushings for alternating voltages above 1000Volts.                                  |
| 4.             | IS:3347                                    | Dimensions of porcelain transformer bushings.                                       |
| 5.             | IS:2071                                    | Method of High Voltage Testing.                                                     |
| 6.             | IS:335                                     | Insulating oil for transformers Switchgears.                                        |
| 7.             | IS:2147                                    | Degree of protection provided by enclosures for low voltage switchgear and control. |
| 8.             | IS:2633                                    | Method of testing hot dipped galvanized articles.                                   |
| 9.             | IS:4800                                    | Enamelled round winding wires.                                                      |
| 10.            | IS:5561                                    | Terminal connectors.                                                                |
| 11.            | IS:11065                                   | Drawings.                                                                           |
| <del>12.</del> | <del>IEC 44-1</del>                        | <del>Current Transformers</del>                                                     |

## 245kV POTENTIAL TRANSFORMERS

## 1.0 SCOPE :

This specification covers 220 KV Outdoor PT metering 0.2 class, dual core along with the suitable terminal arrangements in line with the requirements of HVPNL.

## 2.0 STANDARDS:

| Sl.No. | Standard No.                      | Title.                                                                              |
|--------|-----------------------------------|-------------------------------------------------------------------------------------|
| 1      | IS : 3156<br>(Part-I to Part-III) | Voltage transformer                                                                 |
| 2      | IS : 3156 (Part-IV)               | Capacitor Voltage Transformer                                                       |
| 3      | IS : 2099                         | High Voltage porcelain bushing.                                                     |
| 4      | IS : 3347                         | Dimensions of porcelain transformer bushings                                        |
| 5      | IS : 2071                         | Method of High Voltage Testing                                                      |
| 6      | IS : 335                          | Insulating oil for transformers and switchgears                                     |
| 7      | IS : 2165                         | Insulation Co-ordination for equipments of 100 kV and above.                        |
| 8      | IS : 2147                         | Degree of protection provided by enclosures for low voltage switchgear and control. |
| 9      | IEC- 186                          | Voltage Transformers                                                                |
| 10     | IEC - 186A                        | First supplement to IEC publication 186                                             |
| 11     | IEC - 270                         | Partial discharge Measurement                                                       |
| 12     | IS - 5561                         | Terminal Connectors                                                                 |
| 13     | IS -4800                          | Enameled round winding wires                                                        |
| 14     | IEC- 44 (4)                       | Instrument Transformer measurement of PDs                                           |
| 15     | IEC-171                           | Insulation Co-Ordination                                                            |
| 16     | IEC - 358                         | Coupling capacitor divider.                                                         |
| 17     | IEC-60                            | High Voltage testing techniques.                                                    |
| 18     | IEC-8263                          | Method for RIV test on high voltage insulators.                                     |
| 19     | IS: 9348                          | Coupling capacitors and capacitor dividers                                          |
| 20     | IS: 2633                          | Methods of testing hot dipped galvanized articles                                   |
| 21     | IS: 11065                         | Drawings.                                                                           |
| 22     |                                   | Indian Electricity Rules 1956                                                       |
| 23     | IS: 5621                          | Hollow porcelain insulators.                                                        |

- 2.2 Equipment meeting with the requirements of other authoritative standards, which ensure equal or better performance than the standards mentioned above, shall also be considered. When the equipment offered by the LSTK Contractor conforms to other standards salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule. Four copies of such standards with authentic translation in English shall be furnished along with the offer.

### 3.0 SERVICE CONDITIONS

**Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions. The ambient conditions have been indicated in Meteorological data attached as Section-3.**

### 4.0 PRINCIPAL PARAMETERS :

The potential transformers covered in this specification shall meet the technical requirements listed hereunder.

#### PRINCIPAL TECHNICAL PARAMETERS:

| Sl. No. | Item                               | Specification                                                           |                 |                 |                |                |
|---------|------------------------------------|-------------------------------------------------------------------------|-----------------|-----------------|----------------|----------------|
|         |                                    | 420kV                                                                   | 245kV           | 145kV           | 72.5kV         | 36kV           |
| 1.      | Type/Installation                  | Single Phase, Oil filled, Self cooled, Hermetically sealed Outdoor type |                 |                 |                |                |
| 2.      | Type of mounting                   | -----Steel structure-----                                               |                 |                 |                |                |
| 3.      | Highest system voltage (kV rms)    | 420                                                                     | 245             | 145             | 72.5           | 36             |
| 4.      | Suitable for system frequency      | 50 Hz                                                                   |                 |                 |                |                |
| 5.      | Rated primary voltage (kV rms)     | 400/ $\sqrt{3}$                                                         | 220/ $\sqrt{3}$ | 132/ $\sqrt{3}$ | 66/ $\sqrt{3}$ | 33/ $\sqrt{3}$ |
| 6.      | No. of Secondary Cores & Secondary |                                                                         |                 |                 |                |                |

|    |                                                                             |                                       |      |      |      |     |
|----|-----------------------------------------------------------------------------|---------------------------------------|------|------|------|-----|
| i) | Voltage (Volts) PT                                                          |                                       |      |      |      |     |
| 7  | Method of earthing the system                                               | Solidly earthed                       |      |      |      |     |
| 8  | 1,2/50 microsecond lightning impulse withstand voltage (kVp)                | 1425                                  | 1050 | 650  | 325  | 170 |
| 9  | 1 Minute dry & wet power frequency withstand voltage primary (kV rms)       | 630                                   | 460  | 275  | 140  | 70  |
| 10 | Min creepage distance of porcelain housing (mm)                             | 10500                                 | 6125 | 3625 | 1815 | 900 |
| 11 | Creepage factor (max.)                                                      | 4.0                                   |      |      |      |     |
| 12 | Rated voltage factor                                                        | 1.2 continuous and 1.5 for 30 seconds |      |      |      |     |
| 13 | One minute power frequency withstand voltage for secondary winding (kV rms) | 3.0                                   |      |      |      |     |
| 14 | Max. temperature rise over ambient of 50°C                                  | As per IS:3156 or equivalent IEC      |      |      |      |     |




## 5.0 GENERAL TECHNICAL REQUIREMENTS:

### 5.1 Common for all PTs

5.1.1 The insulation of the instrument transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric withstand values of external and

internal insulations shall be clearly withstand values specified in this guaranteed technical particulars. The dielectric withstand values specified in this specification are meant for fully assembled instrument transformers.

### 5.1.2 Porcelain Housing :

5.1.2.1 The housing shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength, glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles (fog).

5.1.2.2 Nuts and bolts or screws used for fixation of the interfacing porcelain bushings for taking out terminals, shall be provided on flanges cemented to the bushings and not on the porcelain.

### 5.1.3 METAL TANK:

The metal tanks shall have bare minimum number of welded joints so as to minimise possible locations of oil leakage. The metal tanks shall be made out of mild steel/Stainless steel/aluminium alloy, depending on the requirement. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage. LSTK Contractor has to obtain specific approval from Owner for any horizontal welding used in the bottom tank.

### 5.1.4 Surface Finish:

The ferrous parts exposed to atmosphere shall be hot dip galvanised or shall be coated with atleast two coats of zinc rich epoxy painting. All nuts, bolts and washers shall be made out of stainless steel.

### 5.1.5 Insulating Oil:

Insulating oil required for first filling of the instrument transformer shall be covered in LSTK Contractor's scope of supply. The oil shall meet the requirements of latest edition IS:335 or equivalent IEC.

### 5.1.6 Prevention of Oil leakages and Entry of Moisture:

5.1.6.1 The LSTK Contractor shall ensure that the sealing of instrument transformer is properly achieved.

In this connection the arrangement provided by the LSTK Contractor at various locations including the following ones shall be described, supported by sectional drawings.

- i) Locations of emergence of primary and secondary terminals.
- ii) Interface between porcelain housing and metal tanks.
- iii) Cover of the secondary terminal box.

### 5.1.7 GASKETS:

For gasketed joints, wherever used nitrile butyl rubber gaskets shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

- 5.1.8 **Oil level indicators:**  
Instrument transformers shall be provided with oil sight window (Prismatic Type) at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.
- 5.1.9 **EARTHING:**  
Metal tank of the instrument transformer shall be provided with two separate earthing terminals for bolted connection to 50X8mm MS flat to be provided by the Owner for connection to station earth-mate.
- 5.1.10 **LIFTING & TRANSPORTATION ARRANGEMENTS:**  
Instrument transformer shall be provided with suitable lifting arrangement, to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawings. Lifting arrangement (lifting eye) shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. If necessary, string guides shall be offered which shall be of removable type. The instrument transformers shall be so constructed that it can be easily transported to site within the allowable transport limitation and in horizontal position, if the transport limitations so demand.
- 5.1.11 **NAME PLATE:**  
The instrument transformer shall be provided with non-corrosive, legible name plate with the information specified in relevant standards, duly engraved/punched on it. In addition to these P.O. NO. & Connection diagram shall also be marked in rating plate.
- 5.1.12 **TERMINAL CONNECTORS: (NOT IN BIDDER'S SCOPE)**  
Suitable terminal connectors of type ACSR Moose conductor for 220kV PTs. Suitable terminal earth connectors for earthing connections shall also be provided.
- 5.1.12.1 The terminal connectors shall meet the following requirements:
- 1) Terminal connectors shall be manufactured and tested as per IS:5561 or equivalent IEC.
  - 2) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
  - 3) No part of a clamp shall be less than 10mm thick.
  - 4) All ferrous parts shall be hot dip galvanized conforming to IS:2633 or equivalent IEC.
  - 5) For bimetallic connectors, copper alloy liner of minimum 2mm thickness shall be cast integral with aluminium body.
  - 6) Flexible connectors shall be made from tinned copper/aluminium sheets.
  - 7) All currents carrying parts shall be designed and manufactured to have minimum contact resistance.
  - 8) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS: 5561 or equivalent IEC.
- 5.1.13 **INSULATION:**  
Enamel, if used for conductor insulation, shall be polyvinyl acetate type or amide emide type and shall meet the requirements of IS 4800 or equivalent IEC. Polyester enamel shall not be used. Double cotton cover, if used, shall be suitably covered to ensure that it does not come in contact with oil.
- 5.1.14 **TEMPERATURE RISE:**  
The temperature rise on any part of equipment shall not exceed maximum temperature rise specified in IS:3156 or equivalent IEC. However, the permissible temperature rise indicated is for a maximum ambient temperature of 50°C.
- 5.1.15 **OIL FILLING & DRAIN VALVES:**  
The instrument transformers shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks, sealing type oil filling and/or oil sampling cocks shall be provided with

facility to reseal the same. The method adopted for hermetic sealing shall be described in the offer.

5.2

**PRESSURE RELIEF DEVICE:**

Suitable arrangement shall be made to accommodate the expansion and contraction of oil due to temperature variation. The pressure variation shall be kept within limits which do not impair the tightness of the instrument transformer. A pressure relief device capable of releasing abnormal internal pressure shall be provided.

5.3

**Voltage Transformer (PT):**

5.3.1.

**CORE:**

5.3.1.1

The voltage transformers shall be oil immersed, sealed type and self cooled, suitable for the services indicated & conforming to the modern practices of designs and construction. The core shall be of high grade, non ageing, electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over voltages.

5.3.1.2

The design of PT shall be based on following requirements.

- i) They must transmit sudden drops of primary voltages.
- ii) They must have sufficiently low short circuit impedance as seen from secondary

5.3.2

**SECONDARY TERMINAL BOXES:**

5.3.2.1

The secondary terminals of the PTs (Having two cores) shall be brought out in 2 weather proof terminal box and it shall be provided with a removable gland plate.  
Two separate weather proof terminal boxes shall be provided for both the cores.  
The terminal box shall be provided with a removable gland plate and with proper sealing facility as per HVPNL guidelines and requirements.

5.3.2.2

All the fuses and the links shall be provided at the V.T terminal boxes.

5.3.2.3

The primary winding of voltage transformers will be connected phase to ground.

6.0

**TESTS**

6.1

The equipment offered should be fully type tested. In case, the equipment of the type and design offered has already been type tested, the LSTK contractor shall furnish 4 sets of type test reports during detailed engineering stage.

However, temperature rise test although covered under type tests will be conducted by the LSTK Contractor on one piece of total ordered quantity of each type, at his premises in the presence of the TPI with/without IOCL/HVPNL representatives

6.2

**ACCEPTANCE AND ROUTINE TESTS:**

- i) All acceptance including Tan Delta test and routine tests as stipulated in the relevant standards shall be carried out by the LSTK Contractor in presence of TPI.

**7.0 DOCUMENTATION**

## 7.1

All drawings shall conform to international standards organisation (ISO) 'A' series of drawing sheet/Indian Standards Specification IS:11065. All drawings shall be in ink and suitable for microfilming. If drawings are computerized than all drawings shall be nicely printed. All dimensions and data shall be in S.I.Units.

## 7.2

**List of drawings:**

- a) General outline and assembly drawings of the equipment.
- b) Graphs showing the performance of equipment's in regard to magnetisation characteristics.
- c) ratio & phase angle curves, ratio correction
- i) factor curves. Sectional views showing:
- ii) General Constructional Features.
- iii) Materials/Gaskets/Sealing used.
- iv) The insulation & the winding arrangements, method of connection of the primary / secondary winding to the primary/ secondary terminals etc.
- v) No. of Turns, Cross-Sectional Area, Current density of Primary and secondary
- d) windings. Porcelain used and its dimensions.
- e) Arrangement of terminals and details of connection studs
- f) provided. Name plate.
- g) Schematic drawing
- h) Detailed drawing of pressure release device with detailed literature. Terminal connector drawing

NOTE:-

All above drawings shall be with relevant HVPNL guidelines and applicable standards.

7.3

The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Owner. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the LSTK Contractor's risk.

7.4

Approval of drawings / work by Owner shall not relieve the LSTK Contractor of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of

relevant standards at the time of ordering and Owner shall have the power to reject any work or material which in his judgement is not in full accordance therewith.

NOTE :-

(i) In case the equipment offered by the LSTK Contractor does not meet with the requirement of technical specification the offer of the firm shall not be considered. (ii) LSTK Contractor shall provide special label on the LIVE Tank PTs and its packing for caution in handling the PTs carefully.



0 010

## COREWISE DETAILS OF 245kV POTENTIAL TRANSFORMER (PT)

| Sl. No. | Particulars                                                                                        | Requirement                         |                                     |
|---------|----------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------|
| 1.      | Rated Primary voltage                                                                              | 220/ $\sqrt{3}$ kV                  |                                     |
| 2.      | Type                                                                                               | Single phase                        |                                     |
| 3.      | No. of Secondaries                                                                                 | 2                                   |                                     |
| 4.      | Rated voltage factor                                                                               | 1.2 continuous & 1.5 for 30 seconds |                                     |
| 5.      | Rated voltage (volts)                                                                              |                                     |                                     |
| 6.      | Application                                                                                        | Core 1:<br>Special Metering purpose | Core 2:<br>Special Metering purpose |
| 7.      | Accuracy                                                                                           | 0.2                                 | 0.2                                 |
| 8.      | Output burden (VA)                                                                                 | 25VA                                | 25VA                                |
| 9.      | Percentage voltage error & phase displacement (minutes) for respective specified accuracy classes. | As per ISS/IEC                      |                                     |

**Note:-**

Each winding shall fulfil its respective specified accuracy requirement within its specified output range whilst at the same time the other winding has an output of any value form zero to 100% of the output range specified for the other winding in line with clause 6.2.1 of IS 3156 (Part-2 & Part-3) 1992 or its equivalent IEC.




**HARYANA VIDYUT PRASARAN NIGAM LIMITED**

**GUIDELINES FOR INSTALLATION OF METERING EQUIPMENTS AND ARRANGEMENTS AT THE PREMISES OF OPEN ACCESS CUSTOMERS.**

The following guidelines are to be strictly implemented for installation of Interface metering equipments including ABT compliant special energy meters (SEM) of accuracy class 0.2S and connecting arrangements for metering of open access customers. The location of interface meter shall be at the outgoing feeder (for generator) & at the transmission licensee's sub-station or as agreed with the transmission licensee/distribution licensee. The interface meters conforms to the standards on "installation and Operation of Meters" and as amended from time to time. The supplier or buyer in whose premises the interface meters are installed shall be responsible for their safety.

- i) Open Access Customers injecting power in to HVPNL/DISCOM system shall provide separate line bay with line protection scheme at both ends to take care of any fault on line. At Sub Station end Supply should not be tapped from Bus PT. Exclusive line CTs and PTs are to be installed for at Sub Station end. The Meters are to be installed near line bay in Sub Station Yard
- ii) Meters are to be installed directly on line without any isolator in between line and metering CTs/PTs.
- iii) Metering CTs/PTs should be exclusively for interface metering. Customers may install any additional meter with separate CT/PT for their reference.
- iv) Customers who have interconnection with Inter- State Transmission System or Intra- State Transmission System / Distribution System and have been permitted Open Access shall be provided with interface meters.
- v) The scheme for location of meters shall be submitted to HVPNL or licensee by consumer in advance before installation of the Scheme.
- vi) The meter should be installed nearest to the CT/PT to reduce the potential drop in the secondary circuit with easy/ free access by HVPNL/DISCOM staff for installation, testing, commissioning reading and recording and maintenance of meters. The place of installation of meter shall be such that minimum inconvenience and disruptions are caused to the site owners and the concerned organisation.
- vii) HVPNL/Licensee shall examine, test before installation and only correct meter shall be installed.
- viii) Meter is not to be installed in the control room of consumer's substation.
- ix) The operation, testing and maintenance of meter shall be carried out by the licensee.
- xi) Unique identification code of meter:- Every meter shall have a unique identification code, which shall be marked permanently on the front as well as in its memory. The series of unique identification code of meter shall be provided by HVPNL before installation & testing.
- xii) The calendar & clock of meter shall be correctly set at the manufacture's work.
- xiii) Microprocessor based 3 phase 4 wire meter (Model-A) shall conform to accuracy class 0.2S as per IS 14697 or IEC-62053-22 & HVPNL technical specification No HPD/S-72/HPM-461/Vol-II/Prot (Jan 2012) or amended. The meter is suitable for being connected through TTB to VT having secondary line to line voltage of 110V & to CT having a rated secondary current of 1A.
- xiv) Polarity:- As per HVPNL Technical specification.
- xv) The output data of ABT Compliant Special Energy Meters should be in ASCII as well as Excel format. The Base Computer software (BCS) may be got installed at Energy Centre, HVPNL, Sector-6, Panchkula, at respective sub-station & consumer PC. Suitable MRI be also procured.
- xvi) The meter shall be identical in all respect except for their unique identification codes. They shall also be totally sealed and tamper proof, with no possibility of adjustment at site except for a restricted clock correction.

- xvii) Each meter shall have a test output device (visual) for checking the accuracy of active energy and reactive energy (VARh) measurement using a suitable test equipment. The test output shall be software configurable for active energy import/ export & reactive energy import/ export.
- xviii) All the CT/PT used in conjunction with metering shall also be of accuracy class not inferior to meter & conform to the relevant IEC/ IS & HVPNL/Discom specifications. The rating shall take into account the burdens imposed by lead wires and metering. The existing Consumers who have installed CT of 0.2 Accuracy class shall be replaced the same with 0.2S accuracy class within 60 days.
- iv) CTs of 0.2S with CT output is 1A. However PTs of accuracy class 0.2 of secondary line to line voltage of 110 V shall be used.
- v) Metering CT/PT should be exclusive for metering purpose. These will not be allowed for protection purpose. The main meter & check meter shall be connected to the same core of CTs and VTs
- vii) All connecting cables from CT/PT of 4Cx4 mm<sup>2</sup> to meters should be routed 2.5" dia HDD PVC pipe.
- viii) Un-climbable fencing around metering, CT, PT area is to be provided which will be sealed by DISCOM/HVPNL as the case may be.
- ix) Use of only single ratio metering CTs will be allowed. Multi ratio CTs are not to be used in any case.
- x) Metering CTs/PTs, bottom plate needs to be welded after testing/installation at site.
- xi) Open access customer (non-consumer of DISCOM) is required to provide communication channels at his own cost for communication of metering data to HVPNL if required so.
- xii) Consumers who have already installed CT/PT without witness/checking of DISCOM/HVPNL shall get the same tested in the presence of DISCOM/HVPNL representative. The CT/PT may be got tested from NABL accredited lab.
- xv) Data shall be collected from both the main and check metering schemes.
- xvi) The meter shall operate with the power from the VT secondary circuits, without the need for any auxiliary power supply. The total burden imposed by a meter for measurement and operation shall not exceed 10 VA on any of the phase.
- xvii) Inspection & testing:- The meter shall be fully type tested as per IS 14697 or IEC 62053-xviii). All routine test as per IS shall be carried out by manufacturer on the meters. The Type & Routine test report of Meter & CT/PT as per ISS or IEC shall be submitted by Open Access Customers after taking it from Manufacturer before deputing representative for witnessing site testing/witnessing test as per ISS/technical specification. The HVPNL shall ensure that all type, routine, & Acceptance test are carried out by the manufacturer on metering equipment as per ISS/IEC.
- xix) At the time of commissioning, meter Testing & Commissioning of interface meters may be carried out in the presence of the representative of the parties at site.
- xix) Sealing of meter shall be done at following points:-All meter shall be sealed by the manufacturer at its work. In addition to seal provided by the manufacturer at its work, the sealing of all meters shall be done as at following sealing points:- a) TTB- each Meter test terminal Block shall have the provision for two seal b) Meter body or cover c) meter terminal cover / meter terminal Block including each optical communication port.d) Meter cabinet. Suitable sealing of CT/PT may also be provided to ensure no tampering to be made. Sealing of interface meters, shall be done by both the supplier & buyer.

Meter reading & Recording:- HVPNL or Discom is responsible to take down the meter reading & EAC would verify the correctness of metered data & furnish the same to various agencies

Removal of seals from meters:- When ever seals have to be removed advance notice be given to other party for witnessing the removal of seals and resealing of interface meter. The breaking & re-sealing of the meters shall be recorded by the party, who carried out the work, in meter register, mentioning the date of removal and resealing, serial number of the broken and new seals and the reason for removal of seals.

- xx) The output data of ABT Compliant Special Energy Meters should be in ASCII as well as Excel format. The Base Computer software (BCS) may be got installed at Energy Centre, HVPNL, Sector-6, Panchkula.

Suitable MRI be also procured. The test results duly witnessed by representative of concerned M&P Division of DHBVN and Haryana Vidyut Prasaran Nigam Limited may be submitted to this office for further analysis. A copy of Technical specifications of HVPN for SEM's be refereed

The other commercial terms & condition regarding warranty, etc shall be settled with supplier of equipment by Open Access Consumer.

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**SECTION 3**  
**PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS**

**1. General**

1. This section stipulates the general technical requirements under the contract and will form integral part of the technical specification.
2. The provisions under this specification are intended to supplement requirement for the materials, equipment and services covered under this specification and is not exclusive. However, in case of conflict between requirements specified in this section and requirements specified in other sections the requirements specified under respective sections shall hold good.

**2. Project Details**

Panipat Refinery is a PSU Refinery and is having capacity of 15 MMTPA, catering the customers of northern India and is strategically important as per national interest. The refinery is located at Panipat, Haryana and was commissioned in the year 1998.

Presently 132KV supply to Panipat Refinery is provided from 2 sections of grid (one from PTPS and one from Munak) and point of supply is at Panipat Refinery 132KV switchyard Panipat Refinery complex is consisting of Refinery (will be marked as PR here onwards) and Naphtha cracker complex (will be marked as PNCP here onwards). As a strategic initiative, Panipat Refinery is planning for Bulk power import from HVPNL (Haryana Vidyut Prasaran Nigam Limited) at 220 KV level of 70 MW.

In view of this, Indian Oil Corporation Ltd. (IOCL) - Panipat Refinery is in the process of developing infrastructure to import 70 MW power from grid at 220 KV. Infrastructure development for grid power import at 220KV jobs consists of Inside Battery Limit (ISBL) jobs, Outside Battery Limit (OSBL) jobs.

| Sl. No. | Description          | Particulars                                                                                                              |
|---------|----------------------|--------------------------------------------------------------------------------------------------------------------------|
| 1       | Customer             | Indian Oil Corporation Ltd.                                                                                              |
| 2       | Consultant           | TATA Consulting Engineers Ltd.                                                                                           |
| 3       | Project              | LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery                                              |
| 4       | Project location     | Panipat (City): 16 Km (approx.)<br>Chandigarh Highway: 11 Km (approx.)<br>Noida (Advant)/ Delhi: 150 Km/ 80 Km (approx.) |
| 5       | Transport facilities | Well connected by road, rail & air with other parts of the country.                                                      |

**3. Meteorological Data**

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions,

| Sl. No. | Technical Parameters                    | Unit                    | Particulars |
|---------|-----------------------------------------|-------------------------|-------------|
| 1       | Location                                | Panipat, Haryana, India |             |
| 1.1     | Maximum ambient temperature             | °C                      | 50          |
| 1.2     | Minimum ambient temperature             | °C                      | -5          |
| 1.3     | Average ambient temperature             | °C                      | 35          |
| 1.4     | Design ambient temperature              | °C                      | 45          |
| 2       | Average no. of thunder storm days       | Days                    | 45          |
| 3.1     | Maximum Relative humidity               | %                       | 95          |
| 3.2     | Maximum Relative humidity               | %                       | 26          |
| 4       | Average Annual Rain Fall                | Mm                      | 900         |
| 5       | Maximum Wind Pressure                   | Kg/ sqm                 | 195         |
| 6       | Maximum Altitude above Mean Sea Level   | M                       | 1000        |
| 7       | Isoceraunic Level                       | Days/ Year              | 45          |
| 8       | Seismic Level (Horizontal Acceleration) | Zone                    | 4           |
| 9       | Average no. of rainy day per Year       | Days/ Year              | 120         |

NOTE: Moderately hot and humid tropical climate conducive to rust and fungus growth. The climate conditions are also prone to wide variations in ambient condition. Smoke is also present in the atmosphere. Heavy lightening also occurs during June to October. Switchyard is inside the refinery premise which is also prone to other corrosive gases like sulphur, H<sub>2</sub>S, Chlorine etc.

#### 4. Instruction to Bidders

1. The bidders shall submit the technical requirements, data and information as per the technical specifications provided in the bid documents.
2. The bidders shall furnish catalogues, engineering data, technical information, design document, drawings etc fully in conformity with the technical specification.
3. It is recognised that the Manufacturer may have standardised on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the owner. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously; All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

4. Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the technical specifications unless include in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard shall be deemed to be included in the scope of the specification. All similar standard components/parts of similar standard equipment provided, shall be interchangeable with one another.
5. Unless brought out clearly in the respective schedule of deviations, it will be considered that, the bid proposal scrupulously confirms compliance to the specification. The bidder must bring out all the deviations in the bid proposal.
6. In case there is a discrepancy between the data offered equipment and catalogue furnished, and unless the deviations are brought out clearly in the Technical Deviation Schedule, the equipment will be deemed to conform compliance to the specification scrupulously.

## **5. Standards**

1. The works covered by the specification shall be designed, engineered, manufactured, built tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.
2. The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified of this section as well as under respective Sections/Chapters of the specification.
3. In addition to meeting the specific requirement called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards and shall form an internal part of the specification.
4. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intend to complement each other.
5. The Manufacturer shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall of the specification shall take precedence.
6. When the specific requirements stipulated in the specification exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
7. Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.
8. In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in deviation sheets along with English language version of standard or relevant shall be subject to Owner's approval.

9. Indicative List of Standards and Specifications General Standards Indian Electricity Rules shall be as per **Annexure- A**.

#### **6. Services to be performed by the Equipment being furnished**

1. The 220/33 kV system is being designed to limit the switching surge over voltage and the power frequency over voltage within limits of IEC. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, re-strike etc. under such over voltage conditions and in system where line lengths would extend up to 200 km.
2. All equipment shall also perform satisfactorily under various Electro-mechanical and meteorological conditions of the site of installation.
3. All the Equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, short circuit etc. for the equipment.
4. The bidder shall design the various forces for terminal connectors of the equipment are required to withstand.
5. The equipment shall also comply to the following:
  - All outdoor EHV equipment shall be suitable for hot line washing.
  - To facilitate erection of equipment, all items to be assembled as site shall be "match marked". All piping, if any between equipment control cabinet operating mechanism to marshalling box of the equipment shall bear proper identification to facilitate the connection at site.

#### **7. Engineering Data**

1. The furnishing of engineering data by the Manufacturer shall be in accordance with the schedule for each set of equipment as specified in the technical specifications.
2. The review of these data by the owner will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the owner may not indicate a thorough review of all dimensions, quantities and accuracy of the information submitted. This review and/or approval by the owner shall not be considered by the Manufacturer, as limiting any of his responsibilities and liabilities for mistakes and deviation from the requirements, specified under these specifications and documents.
3. All engineering data submitted by the Manufacturer after final process including review and approval by the owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the owner in Writing.
4. LIST OF DOCUMENTS
  - 4.1 The bidder must furnish a detailed list of drawings/documents along with the bid proposal which he intends to submit to the owner after awarded of the contract.

4.2 The supplier shall necessarily submit all the drawings/ documents unless anything is waived. The supplier shall submit required sets of drawings/design documents/test reports as may be required for the approval of the owner.

4.3 All engineering data submitted by the Manufacturer after final process including review and approval by the Owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the owner in Writing.

## **5. DRAWINGS**

5.1 All drawing submitted by the Manufacturer including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnection between various portions of equipment and any other information specifically requested in the specifications.

5.2 Each drawing submitted by the Manufacturer shall be clearly marked with the name of the Owner, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

5.3 Further work by the Manufacturer shall be in strict accordance with these drawing and no deviation shall be permitted without the written approval of the Owner if so required.

5.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Manufacturer's risk. The Manufacturer may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Owner. Approval of Manufacturer's drawing or work by the Owner shall not relieve the Manufacturer of any of his responsibilities and liabilities under the Contract.

## **5.5 OTHER REQUIREMENTS OF DOCUMENTATION**

5.5.1 One set of soft copy of all drawings, manual, catalogues to be submitted along with 6 sets of hardcopies during submission of as built documents.

5.5.2 6 copies of instruction/operation manuals for complete project shall also be furnished. The instruction Manuals shall contain full details of drawing of all equipment being supplied under this contract, their exploded diagrams with complete instruction for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

5.5.3 If after the commissioning and initial operation of the substation, the

instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manual in the form of one (1) reproducible original and twelve (12) copies shall be submitted by the Manufacturer to the Owner.

The Manufacturer shall furnish to the Owners, twelve (12) sets of spare part catalogue.

#### 5.6 TITLE BLOCK

Title block for project shall be as follows,

|                    |                                                                             |
|--------------------|-----------------------------------------------------------------------------|
| Customer:          | Indian Oil Corporation Ltd.                                                 |
| Consultant:        | TATA Consulting Engineers Ltd.                                              |
| LSTK Manufacturer: | Bharat Heavy Electricals Ltd.                                               |
| Project:           | LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery |

### 8. Colour Scheme and Codes

1. The Manufacturer shall propose parts a colour scheme for those equipment/ Items for which the colour scheme has not been specified in the specification, for the approval of Owner. The decision of Owner shall be final. The scheme shall include,
  - Finishing colour of Indoor equipment.
  - Finishing colour of Outdoor equipment.
  - Finishing colour of all cubicles.
  - Finishing colour of various auxiliary system equipment including piping.
  - Finishing colour of various building items.
2. All steel structures, plates etc. shall be hot dip galvanised or painted with noncorrosive paint on a suitable primer as per the provisions of the respective Section. It may be noted that normally all Owner's electrical equipment in Owner's switchyard are painted with shade 631 of IS-5 and Owner will prefer to follow the same for this project also. All the indoor cubicles shall be of same colour scheme and for other miscellaneous items colour scheme will be approved by the Owner.

### 9. Material/ Workmanship

#### 1. GENERAL REQUIREMENTS

- 1.1 Where the specification does not contain characteristics with reference to workmanship, equipment, materials and component of the covered Equipment, it is understood that the same must be new, of highest, grade of the best quality of their kind, conforming to the best engineering practice and suitable for the purpose for which they are intended.
- 1.2 The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art in accordance with purpose for which they are intended and to ensure satisfactory performance throughout the service life.

- 1.3 In case where the equipment, material or components are indicated in the specification as "similar" to any special standard, the Owner shall decide upon the question of similarly. When required by the specification or required by the Owner the supplier shall submit, for approval, all the information concerning the material or components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Supplier.
- 1.4 The design of the work shall be such that installation, future expansions, replacement and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised; constructed and documented so that the component part shall be accurately positioned and retained to fulfil their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Owner.
- 1.5 Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same material and workmanship as the corresponding parts of the equipment supplied under specification. Where feasible, common component units shall be Employed in different pieces of the equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
- 1.6 All material and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). The erection procedure must be approved by the OEM and erection completion shall be certified by OEM for satisfactory completion. The commissioning of all major equipment as recommended by Engineer in-charge.
- 1.7 Only first-class work in accordance with the best modern practice will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouping, levelling, aligning, coupling of or bolting down to previously installed equipment bases/ foundation, performing the alignment check and final adjusting prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instruction and the specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and/or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated location and tested for healthiness.

1.8 The Supplier shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purpose shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Supplier shall apply all operational lubricants to the equipment installed by him.

1.9 All oil, grease and other consumable used in the Works/Equipment shall be purchased in India unless the Supplier has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Owner in establishing equivalent India make and Indian supplier. The same shall be applicable to other consumable too.

1.10 A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Owner. Each base plate shall support the units and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, if so required.

## **2. PROVISION FOR EXPOSURE TO HOT HUMID CLIMATE**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipment located in non- air conditioned areas shall also be same type.

### **2.1 SPACE HEATERS**

2.1.1 The heater shall be suitable for continuous operation at 240 V as supply voltage. On-off switch and fuse shall be provided.

2.1.2 One or more adequately rated permanently or thermostatically connected heater shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connection shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. This shall be demonstrated by tests.

2.1.3 The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternately, they shall consist of a resistance wire mounted into a tubular ceramic body and embedded in vitreous gale. The surface temperature of the heater shall be restricted wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be

restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

## **2.2 FUNGISTATIC VARNISH**

Besides the space heaters, special moisture and fungus resistant varnish shall be applied to parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

## **2.3 VENTILATION OPENING**

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass or galvanized steel to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

## **2.4 DEGREE OF PROTECTION**

The enclosures of the control cabinets, junction boxes and marshalling boxes to be installed shall provide degree of protection as detailed here under:

- a) Installed outdoor: IP 55
- b) Installed indoor in air conditioned area: IP31
- c) Installed in covered area: IP 52
- d) Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP 41

The degree of protection shall be in accordance with IS: 13947(Part-I) or IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

The above requirement is indicative only. Requirements as provided in respective technical specification shall prevail.

# **10. Rating Plates, Name Plates and Labels**

1. Each main and auxiliary item of substation is to be permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading condition under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Owner. The rating plates of each equipment shall be according to IEC requirement.
2. All such nameplates instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi and the other English Instruction may be provided.

**11. First Fill of Consumable, Oil and Lubricant**

All the first fill consumable such as SF6, AC refrigerant, oil, lubricant, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful operation, shall be supplied by the Manufacturer unless specification excluded under the exclusions in these specifications and documents.

**12. Design Improvements**

1. The bidder may note that the equipment offered by him in the bid only shall be acceptable, however, the Purchaser or the Supplier may propose changes in the specification of the equipment or quality thereof and if the parties agreed upon any such changes, the specification shall be modified accordingly.
2. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of the completion before the Manufacturer proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

**13. Quality Assurance Programme**

1. To ensure that the equipment and services under the scope of this contract whether manufactured or performed within the Manufacturer's Work or at his SubManufacturer's premises or at the Owner's site or at any other place of work are in accordance with the specification, the Manufacturer shall adopt suitable quality assurance programme to control such activities at all points necessary.

Such programme shall be outlined by the Manufacturer and shall be finally accepted by the Owner after discussions before award of contract. A quality assurance programme of the Manufacturer shall be generally covered the following,

- a) His Organization structure for the management and implementation of the proposed quality assurance programme.
- b) Qualification data for bidder's key personnel.
- c) Documentation control System.
- d) The procedure for purchases of material, parts components and selection of subManufacturer's services including vendor analysis, source, inspection, incoming raw material inspection, verification of material purchases etc.
- e) System for shop manufacturing and, site erection control including process controls and fabrication and assembly control.
- f) Control and non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and field activities.
- h) Control of calibration and testing of measuring instruments and field activities.

- i) System for indication and appraisal of inspection status.
- j) System for quality audits.
- k) System for authorising release of manufactured product to the Purchaser.
- l) System for maintenance of records.
- m) System for handling storage and delivery. and
- n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services ordered.

The Owner or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Manufacturer/his vendor's quality management and control activities.

## 2. QUALITY ASSURANCE DOCUMENTS

The Manufacturer shall be required to submit the following quality Assurance Documents within three weeks after despatch of the equipment.

All Non-destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and report including radiography interpretation reports.

Welder identification list, listing welder's and welding operator qualification procedure and welding identification symbols.

Welder and Welding operator qualification certificate.

Raw material test reports on components as specified by the specification and for agreed to in the quality plan.

Stress relief time temperature chart/oil impregnation tile temperature chart.

Factory test results for testing required as per applicable codes/ mutually agreed quality plan/standards referred in the technical specification.

The quality plan with verification of various customer inspection points(CAP) as mutually agreed and methods used to verify the inspection and testing points in the quality plan were performed satisfactory.

## 14. Inspection, Testing and Inspection Certificate

1. The Owner/ his duly authorised representative and/or outside inspection agency acting on behalf of the Owner shall have at all reasonable times free access to the Manufacturer's premises or Works and shall have the power at all reasonable times to inspect and examine the material and the Workmanship of the Works during its manufacture or erection and if part of the works during its manufacturing or erection and if the part of works being manufactured or assembled at other premises or works, the Manufacturer shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the work

were manufactured or assembled on the Manufacturer own premises or works, Inspection may be made at any stage of manufacture, despatch or at site at the option of the Owner and equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

2. All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with relevant standards.
3. The Manufacturer shall give the Owner/Inspector thirty (30) days written notice of any material being ready for testing along with work test certificate. Such tests shall be to the Manufacturer's account. The Owner unless witnessing of the tests is virtually waived, will attend such tests with thirty (30) days of the date of which the equipment is notified as being ready for tests/inspection, the Manufacturer must ensure TPI for all inspections in line with tender documents.
4. The Owner or Inspector shall, within fifteen (15) days from the date of inspection as defined here in give notice in writing to the Manufacturer, of any objection to any drawings and all any equipment and workmanship which in his opinion is not in accordance with the contract. The Manufacturer shall give due consideration to such objections and shall either made the modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.
5. When the, factory tests have been completed at the Manufacturer's or Sub-Manufacturer's Works the Owner/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests. The completion of these tests or the issue of the certificate shall not bind the Owner to accept the equipment should, it, on further tests after erection be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of dispatch clearances in approved by the Owner.
6. In all cases where the Manufacturer provides for tests whether at the premises or at the works of the Manufacturer or of any Sub-Manufacturer. The Manufacturer except where otherwise specified shall provide free of charge such items as labour, material electrically, field water, stores, apparatus and instruments as may be reasonably demanded by the Owner/Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the Manufacturer and shall give facilities to the Owner/inspector or to his authorised representative to accomplish testing.
7. The inspection by Owner and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Manufacturer in respect of the agreed quality assurance programme forming a part of the Manufacturers.
8. The Owner will have the right of having at his own expenses any other test(s) of Reasonable nature carried out at Manufacturer premises or at site of in any other place in addition of aforesaid type and routine tests, to satisfy that the materials comply with the specification.

9. The Owner reserves the right for getting any field tests conducted on the completely assembled equipment at site.

## **15. Tests**

### **1. CHARGING**

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner and the Manufacturer for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed are given in section-7 and shall be included in the Manufacturer's quality assurance programme.

### **2. COMMISSIONING TESTS**

2.1 The available instrumentation and control equipment will be used during such tests shall calibrated. However un-measurable parameters shall be taken into account in a reasonable manner by the Owner for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Owner will apply proper corrections in calculation, to take into account conditions which do not correspond to the specified condition.

2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Manufacturer, free of cost.

2.3 The specified tests to be conducted on equipment have been brought out in the respective chapters of the technical specification.

2.4 The Manufacturer shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However, necessary fee shall be paid by Owner.

## **16. Packing and Shipping**

All the equipment shall be suitably protected, coated, covered or boxes and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account. The Manufacturer shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Owner takes no responsibility of the wagons.

## **17. Protection**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pilings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

## **18. Painting and Finishing of Metal Surfaces**

### **1. GENERAL**

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro-galvanized to service condition. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

### **2. HOT DIP GALVANIZING**

2.1 The minimum weight of the zinc coating shall be 610g/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM.

2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel; The finished surfaces shall be clean and smooth and shall be free from defects like colour patches, are spots, unevenness of coating, plate which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

2.5 Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the standard price test. All other coating shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating
- Uniformity of zinc
- Adhesion test
- Mass of Zinc

2.6 Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

### **3. PAINTING**

3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for

the life of the equipment. The surface which are to be finished painted after installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swart shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

- 3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and over drying. The phosphate coating shall be sealed with application of two coats may be "flash dried" while the second coat shall be stoved.
- 3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 3.4 The exterior colour of the paint shall be as per shade No.:631 of IS-5 and inside shall be glossy white. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipment.
- 3.5 In case the bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc. the procedure shall be submitted along with the bids for Owner's review & approval.

## **19. Handling, Storing and Installation**

1. In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Owner or his representative, the Manufacturer shall unload, store, erect, install, wire test and place into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energization at rated voltage.
2. Manufacturer may engage manufacturer's engineer to supervise the unloading, transportation to site, storing and erection. The Manufacturer shall engage the manufacturer's Engineer's for testing and commissioning of the various equipment being procured by them separately. Manufacturer shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s)/ as per Manufacturer's approved process and shall extend full cooperation to them.
3. In case of any doubt or misunderstanding as to the correct interpretation of manufacture's drawing or instruction, necessary clarifications shall be obtained from the Owner/ Manufacturer. Manufacturer shall be held responsible for any damage to the equipment

consequent to not following manufacturer's drawing/instructions correctly.

4. Where assemblies are supplied in more than one section, Manufacturer shall make all necessary mechanical and electrical connections between section including the connection between buses. Manufacturer shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected during testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Manufacturer at his own expense.
5. Supplier shall be responsible for examining all the shipment and notify the Owner immediately of any damage, shortage, discrepancy etc. for the purpose of Owner's information only. The supplier shall submit to the Owner every week a report detailing all the receipts for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Supplier.
6. The Manufacturer shall be fully responsible for the equipment material unit the same is handed over to the Owner in an operating condition after commissioning. Manufacturer shall be responsible for the maintenance of the equipment material while in storage as well as after erection unit taken over by Owner, as well as protection of the same against theft, element of nature, corrosion, damages etc.
7. Where material/equipment is unloaded by Owner before the Manufacturer arrives at site or even when he is at site. Owner by right can hand over the same to Manufacturer and there upon it will be the responsibility of Manufacturer to store the material in an orderly and proper manner.
8. The Supplier shall be responsible for making suitable indoor storage facilities, to store all equipment which require indoor storage.
9. The words 'erection' and 'installation' used in the specification are synonymous.
10. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
11. The minimum phase to earth, phase to phase and section clearance for the various 132 kV, 66 kV and 33 kV sections of the switchyard are given below,

| Voltage Grade          | 220kV | 132kV | 33kV |
|------------------------|-------|-------|------|
| Phase to earth (mm)    | 2100  | 1300  | 320  |
| Phase to Phase (mm)    | 2100  | 1600  | 350  |
| Section clearance (mm) | 5000  | 4000  | 2800 |

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life.

## **20. Protective Guard**

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

**21. Design Co-ordination**

1. The Manufacturer shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done so that it facilitates easy field assembly and maintenance.
2. The Manufacturer has to coordinate designs and termination with the agencies (If any) who are LSTK vendors/ Manufacturer for the Owner if applicable. The names of agencies shall be intimated to the successful bidders.

**22. Design Co-Ordination Meeting**

The Manufacturer will be called upon to attend design co-ordination meeting with the Engineer, other Manufacturer's and the LSTK vendors of Owner (If any) during the period of Contract. The Manufacturer shall attend such meeting at his own cost as and when required and fully cooperate with such person and agencies involved during those discussions.

**23. Tools and Tackles**

The Manufacturer shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

**24. Equipment Bases**

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Owner. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

**25. Support Structure (*NOT IN BIDDER'S SCOPE*)**

1. The support structures should be hot dip galvanised with minimum 610 gram/m<sup>2</sup> net of Zinc.
2. In case of any deviation in this regard the bid is liable to be rejected.
3. Support structure shall meet the following mandatory requirements.
4. The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 meters or as per applicable standard.
5. The design calculations taking into account the environmental conditions of the substations shall be furnished for sizing of the structures.

**26. Clamps and Connectors including Terminal Connectors (*NOT IN BIDDER'S SCOPE*)**

1. All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below,

|    |                                                                           |                                                                                                                                                                                 |
|----|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a) | For connecting ACSR Conductors                                            | Aluminium alloy casting conforming to designation A6 of IS:617 and shall be tested for all test as per IS:617                                                                   |
| b) | For connecting equipment terminals made of copper with ACSR conductors    | Bimetallic connectors made from aluminium alloy casting, conforming to designation A6 of IS 617 with 2mm thick bimetallic liner and shall tested as per IS:617                  |
| c) | For connecting GI shield wire                                             | Galvanised mild steel                                                                                                                                                           |
| d) | Bolts, nuts & plain washer galvanised Spring washers for items 'a' to 'c' | Electro galvanisation for sizes Plain, washers below M12, for others hot dip galvanised. Electro-galvanised mild steel suitable for at least service condition-3 as per IS:1573 |

2. Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor termination of equipment shall be suitable for Moose ACSR Conductor. The requirement regarding external RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position.
3. Where copper to aluminium connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Owner by the supplier.
4. Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of work.
5. No current carrying part of any of any clamp shall be less than 12 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body for Bi-metallic clamps.
6. Lateral load deflection test shall be carried out as an acceptance test. The test procedure and accepted norms shall be mutually discussed and agreed to.
7. All casting shall be free blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
8. Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
9. All current carrying parts shall be designed and manufactured to have minimum contact resistance.
10. Clamps and connectors shall be designed to be corona controlled. RIV level for 220 kV system shall not be more than 1000/ micro volts respectively at the specified test voltage

as per IS/NEMA.

#### 11. TESTS

Clamps and connectors shall conform to type tests and shall be subjected to routine tests as per IS:5561.

#### 27. Control Cabinets, Junction Boxes, Terminal Boxes & Marshalling Boxes for Outdoor Equipment

1. All type of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS5039/IS-8623, IEC-439, as applicable, and the clauses given below.
2. Control cabinet, junction boxes, marshalling boxes & terminal boxes shall be made of sheet steel or aluminium and shall be dust, water and vermin proof. Sheet used shall be least 2.0 mm cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet of specified thickness.
3. The enclosures of the control cabinets, junction boxes, terminal boxes & marshalling boxes shall provide a degree of protection of not less than IP 55 as per IS: 2147. The bidder shall offer type tested (IP:55) Marshalling kiosk and type test report for degree of protection test each type of box shall be furnished for arrival. After protection degree test of marshalling kiosk, 2.0 kVrms for 1 (one) minute, insulation resistance and functional test should have been conducted. In case these tests have not been carried out during IP55 test, then the Manufacturer shall carry out the IP-55 test along with these tests, at his cost.
4. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.
5. All door, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in the presence of Owners representative. The quality of gasket shall be such that it does not get damaged/ cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced of necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass or GI wires.
6. All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connection. Boxes and cabinet shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel

plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

7. A 240V, single phase, 50Hz, 15amp AC plug and socket shall be provided the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.
8. For illumination of control cabinet, a 7 Watt LED shall be provided.
9. All control switches shall be of rotary switch type and Toggle/piano switches shall not be provided.
10. EARTHING

Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star of self-etching washer. Earthing of hinged door shall be done by using a separate earth wire.

#### 11. TESTS

The marshalling kiosks shall be subject to routine tests as per 18:5039. The following routine tests shall also be conducted:

- Check for wiring
- Visual and dimension check

Marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ferruling by pasting the same on the inside of the door.

#### 28. Auxiliary Switches

The auxiliary switch shall confirm to the following type tests:

- a) Electrical endurance test -A minimum of 2000 operation for 2A DC with a time constant examination of mV drop/visual defects/temperature rise test.
- b) Mechanical endurance test. A minimum of operations as specified in the relevant IS with a subsequent checking of contact pressure test visual examination. Heat run test on contacts.

#### 29. Terminal Blocks and Wiring

1. Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.
2. Terminal blocks shall be 1100 v grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

3. Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
4. The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
5. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.
6. The terminal blocks shall be of extensible design.
7. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
8. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
9. Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

|    |                                  |                                      |
|----|----------------------------------|--------------------------------------|
| a) | All circuits except CT circuits  | Minimum of 2.5 sq.mm copper flexible |
| b) | All CT circuits copper flexible. | Minimum of 4 sq.mm.                  |

10. The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.
11. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.
12. There shall be a minimum clearance of 250 mm between the First bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.  
The Supplier shall furnish all wire, conduits and terminals for the necessary interphase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets. The wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltage either transferred through the equipment or due to transients induced from the EHV circuits.
13. All input and output terminals of each control cubicle shall be tested for surge withstand capability and transverse modes. The supplier shall also provide all necessary to achieve an impulse withstand level at the cable interfaces of equipment.

### 30. Lamps and Sockets

#### 1. LAMPS

All indication lamps shall also be LED based. Socket base shall be as per IS-1258, except in the case of signal lamps.

#### 2. SOCKETS

All sockets (convenience outlets) shall be suitable to accept both 5 A & 15 A pin round

Standard Indian plugs. They shall be switched sockets with shutters.

3. HAND LAMP

A 240 Volts, single phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

4. INTERIOR LIGHTING

Each panel shall be provided with a LED lighting fixture of Standard Indian type rates for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel during maintenance. The Fitting shall be controlled by the respective panel door switch.

5. SWITCHES AND FUSES

5.1 Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch fuse units. Selection of the main and Sub-circuit fuse rating shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by fuses.

5.2 All fuses be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases.

5.3 Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuses carrier base shall have imprints of the fuse rating and voltage.

### **31. Bushings, Hollow Column Insulators, Support Insulators**

1. The bidder shall offer composite silicon rubber polymer insulator for all insulation purpose as per project requirement, conforming to IEC-61109. In case if non-compliance of composite insulators with respect to State/National electricity authorities' guidelines/requirements, the anti-fog type porcelain insulators may be used wherever mandatory. The required deviations with respect to above requirements shall be clearly mentioned in the deviation sheet along with the supporting documents. In absence of such deviations statements, the compliance of this point is mandatory and binding on the vendor.

2. Bushing shall be manufactured and tested in accordance with IS:2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/18 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IEC 273. The Insulators shall also conform to IEC 815 as applicable.

3. Following requirements to be fulfilled if anti-fog porcelain insulators are provided as instructed in point 29.1 of this chapter.

3.1 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from lamination,

cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vilified tough and impervious to moisture.

3.2 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

3.3 Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical and rigidity for the conditions under which they will be used.

3.4 When operating at rated voltage there shall be no electric discharge between the conductors and busing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

3.5 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and support other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal as metal or glazed porcelain.

3.6 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

#### 4. TESTS

Bushing hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS:2099 & IS: 2544.

4.1 Technical parameters of bushing/ Hollow column insulators/ support insulators,

| 11 Technical parameters of bushing, 220kV, 132kV, 66kV, 33kV insulators, support insulators, |                                                                                                           |                                                                                             |                 |                |                |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------|----------------|----------------|
| Sl. No.                                                                                      | Voltage Class                                                                                             | 220kV<br>System                                                                             | 132kV<br>System | 66kV<br>System | 33kV<br>System |
| a)                                                                                           | Rated Voltage (kV)                                                                                        | 245                                                                                         | 145             | 72.5           | 36             |
| b)                                                                                           | Impulse withstand voltage (dry and wet) (kVp)                                                             | 1050                                                                                        | 650             | 325            | 170            |
| c)                                                                                           | Power frequency with stand voltage (dry and wet (kVrms))                                                  | 460                                                                                         | 275             | 140            | 75             |
| d)                                                                                           | Total creepage distance (mm)                                                                              | 25mm/kV                                                                                     |                 |                |                |
| e)                                                                                           | Pollution                                                                                                 | Class – III heavy (as per IEC 71) and as specified in section 2 for all class of equipment. |                 |                |                |
| f)                                                                                           | Insulator shall also meet requirement of and IEC-815 as applicable having alternate long and short sheds. |                                                                                             |                 |                |                |

### **32. Motors**

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and conform to type tests and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

#### **1. ENCLOSURES**

- a) Motor to be installed shall have enclosure equivalent to IP 55 as per IS:4691.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motor weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate lifting.

### **33. Rating Plates, Name Plates and Labels**

Each main and auxiliary item of equipment is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment, type or serial number together with details of loading conditions under which the item of equipment in question has been designed to operate and such diagram plates as may be required by the Owner. The rating plate shall conform to IEC requirement.

All such name plates, instruction plates rating plates etc. shall be in bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi & the other with English inscription may be provided.

### **34. Radio Interference Voltage (RIV) Test**

#### **1. GENERAL**

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for measurement of radio interference voltage (RIV).

#### **2. TEST LEVELS**

The test voltage levels for measurement of external RIV are listed under the relevant clauses of the specification.

#### **3. TEST METHOD FOR RIV**

3.1 RIV tests shall levels for according to measuring as per International Special-Committee on radio Interference (CISPR) Publication 16-1 (1993) Part-1. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No.107-1964, except otherwise noted herein.

3.3 In measurement, RIV, temporary additional external shielding may be provided. In measurements of RIV only standard fitting of identical type supplied with the

- equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.
- 3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing voltages 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipment unless otherwise specified.
- 3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.
- 3.6 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

**Annexure-A:****List of Standards and Specifications/ General Standards/ Indian Electricity Rules**

|                   |                                                                                                             |
|-------------------|-------------------------------------------------------------------------------------------------------------|
| IS-5:             | Colours for Ready Mixed Paints and Enamels IS-335 Insulating Oil for Transformers and switchgear            |
| IS-375:           | Marketing and Arrangement for Bus-bars, Main Connection & Auxiliary Winding                                 |
| IS-617:           | Aluminium and Aluminium alloy & Ingots and Castings for General Engineering Purposes                        |
| IS-1448:          | Methods of Test for Petroleum and its Products.                                                             |
| IS-2071:          | Measuring Devices                                                                                           |
| IS-2147:          | Degree of Protection Provided by Enclosures of for Low voltage switch gear and control Gear                 |
| IS-2165:          | Phase-to-Phase Insulation Co-ordination, Principles and Rules                                               |
| IS-2362:          | Determination of Water by the Karl fisher Method                                                            |
| IS-3043:          | Codes of practice for earthing                                                                              |
| IS-3202:          | Code of Practice for climate proofing of electrical equipment                                               |
| IS-3637:          | Gas Operated Relays                                                                                         |
| IS-6103:          | Methods of Test for specific resistance (Resistivity) of Electrical Insulating Liquids                      |
| IS-6104:          | Method of Test for Interfacial Tension of Oil against Water by the Ring Method.                             |
| IS-6262:          | Method for Determination of Electric strength of insulating liquids.                                        |
| IS-6792:          | Method for Radio Interference Tests on High Voltage Insulators                                              |
| IEC-214:          | On-Load Tap-Changers                                                                                        |
| IEC-289:          | Reactors                                                                                                    |
| IEC-354:          | Loading Guide for Oil Immersed power transformers.                                                          |
| IEC-551:          | Determination of Transformer and reactor Sound levels                                                       |
| ANSI-C57, 12, 80: | General requirements for Distribution, Power and Regulating Transformers.                                   |
| ANSI-C57, 12, 90: | Test Code for Distribution, Power and Regulation Transformers.                                              |
| ANSI-C57, 16:     | Terminology & Test Code for current limiting Reactors.                                                      |
| ANSI-C57, 21:     | Requirements Terminology and Test Code for Shunt Reactors Rates over 500 KVA.                               |
| ANSI-C57, 92:     | Guide for loading Oil-Immersed Power Transformer up to and including 100 MVA with 55oC or 65oC Winding Rise |
| ANSI-CG, IEEE-4:  | Standard Techniques for high Voltage Testing                                                                |
| NEMA-TR-1:        | Transformers, Regulators and Reactors                                                                       |
| IS-4379:          | Identification of the Contents of Industrial Gas Cylinders                                                  |

**1. Current Transformers, Voltage Transformers and Coupling Capacitor Voltage Transformers**

|          |                                          |
|----------|------------------------------------------|
| IS-2705: | Current Transformers                     |
| IS-3156: | Voltage Transformers                     |
| IS-7311: | Coupling capacitor and capacitor divider |
| IEC-185: | Current transformers                     |

|             |                                                           |
|-------------|-----------------------------------------------------------|
| EC-186A:    | Voltage Transformers                                      |
| IEC-186B:   | Coupling capacitors and capacitor dividers                |
| IEC-44:     | Instrument Transformers measurement of Partial discharges |
| IEC-481:    | Requirements for instrument transformers                  |
| ANSI-C93.1: | Requirements for power line carrier coupling capacitor    |

## **2. Bushing Insulators**

|              |                                                                                                                                                                                                       |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IS-2099:     | Bushing for alternating Voltages above 1000V                                                                                                                                                          |
| IEC-137:     | Insulated Bushings for Alternating voltages above 1000 V                                                                                                                                              |
| IEC-61109:   | Composite Silicon Rubber polymer insulators.                                                                                                                                                          |
| IEC-60437:   | Radio Interference Test on High voltage Insulators                                                                                                                                                    |
| IEC-60507:   | Artificial pollution test on high voltage insulators to be used on AC systems                                                                                                                         |
| IEC-60815:   | Guide for the selection of insulators in respect of polluted conditions.                                                                                                                              |
| IEC-61952:   | Insulators for overhead lines, composite line, post insulators for alternative current within nominal voltage greater than 1000 volts upto 245 KV- Definitions, test methods and acceptance criteria. |
| IEC-61466/1: | Composite strings, insulator units for overhead lines for nominal voltage greater than 1 KV-part-1 Standard strength classes and end fittings.                                                        |
| IEC-61466/2: | Composite strings, insulator units for overhead lines for nominal voltage greater than 1 KV-part-2 Dimensional and electrical characteristics.                                                        |

# SECTION-4

0 069

## GENERAL TECHNICAL PARTICULARS

### POTENTIAL TRANSFORMER

1. Manufacturer's type and designation.
2. Type
3. Rated Frequency
4. Rated primary voltage
5. Number of secondary windings
6. Rated secondary windings
  - a) Winding-I
  - b) Winding-II
7. Class of Accuracy
  - a) Winding - I
  - b) Winding - II
8. Limits of errors.
  - a) Winding -I
    - i) Percentage voltage ratio error
    - ii) Phase displacement. (Minutes)
  - b) Winding - II
    - i) Percentage voltage ratio error
    - ii) Phase displacement (minutes)
9. Rated burden
  - a) Winding - I
  - b) Winding -II
10. Rated voltage factor and time
11. Temperature rise at 1.2 times rated rated burden (°C) voltage when applied continuously with
12. Insulation class of
  - a) Primary windings
  - b) Secondary windings
13. One minute power frequency (Dry) withstand Test voltage (kV)
14. One minute power frequency (wet) withstand test voltage (kV)
15. 1 2/50 micro second impulse withstand



test voltage (kV peak)

16. One minute power frequency withstand voltage on secondaries (volts)

17.

a) Creepage

distance c)

Creepage

factor

18. Standard to which the equipment conforms

19. Standard to which the oil conforms

20. Total weight of the P.T.

21. Overall dimensions

22. Mounting details

23. Weight of the oil

24. Total shipping weight.



**Project: LSTK job for ISBL work of 220KV Grid**  
**Power Import at IOCL, Panipat Refinery**  
**Customer: Indian Oil Corporation Limited (IOCL)**  
**Consultant: TATA Consulting Engineers Limited (TCE)**  
**Technical Specification: 245kV Potential Transformer**

**Bharat Heavy Electricals Limited**  
**Document No. TB-411-510-102**

**SECTION 5**  
**CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER**  
**RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED**

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

**BHEL ENQUIRY. NO:**

**BIDDER: OFFER REFERENCE:**

**A)**

| Sl. No. | Parameters                                                              | Data                                                     | Yes / No | Remarks |
|---------|-------------------------------------------------------------------------|----------------------------------------------------------|----------|---------|
| 1.      | Applicable Standard                                                     | IEC: 61869, IS-3156                                      | Yes      |         |
| 2.      | Type                                                                    | Outdoor Single Phase Electromagnetic VT                  | Yes      |         |
| 3.1     | Earthing Conditions                                                     | Effectively Earthed                                      | Yes      |         |
| 3.2     | Rated Frequency                                                         | 50 Hz                                                    | Yes      |         |
| 3.3     | System Voltage                                                          | 220 kV                                                   | Yes      |         |
| 3.4     | Highest System Voltage                                                  | 245 kV                                                   | Yes      |         |
| 3.5     | Voltage Ratio                                                           | $\frac{220/\sqrt{3} \text{ kV}}{110/\sqrt{3} \text{ V}}$ | Yes      |         |
| 3.6     | Voltage Factor                                                          |                                                          |          |         |
|         | - Continuous                                                            | 1.2                                                      | Yes      |         |
|         | - 30s                                                                   | 1.5                                                      | Yes      |         |
| 3.7     | One minute power frequency withstand voltage secondary terminal & earth | 3 kV (rms)                                               | Yes      |         |
| 3.8     | Minimum Creepage Distance                                               | 25 mm/kV                                                 | Yes      |         |
| 3.9     | a) One minute dry and wet power frequency withstand voltage             | 460 kVrms                                                | Yes      |         |
|         | b) 1.2/ 50 micro sec Lightning Impulse withstand voltage (Peak Value)   | $\pm 1050 \text{ kVp}$                                   | Yes      |         |

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**Document No. TB-411-510-102**

| Sl. No. | Parameters                                                                            | Data                                                                 | Yes / No | Remarks |
|---------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------|---------|
| 4       | VT Secondary Winding Parameters                                                       | As per Table given in Clause 1.2.2 of Section 1                      | Yes      |         |
| 5       | VT supplied Suitable for operation in the Climatic conditions                         | Suitable for Climatic and Meteorological Data Specified in Section 3 | Yes      |         |
| 6       | Oil filling & Drain Plug and Oil Sight glass                                          | Provided                                                             | Yes      |         |
| 7       | Max. Temperature rise over design ambient temperature                                 | As per Section-3                                                     |          |         |
| 8       | External surface                                                                      | As per Section-2                                                     | Yes      |         |
| 9       | Two Nos. Separate weather-proof secondary terminal boxes provided for separate cores. |                                                                      | Yes      |         |

## B) TYPE TESTS

i) Whether type test reports of the tests as per relevant IS/IEC and additional type tests as per technical specification Section-1 & 2, conducted earlier on identical or similar material are available (test reports should be of the tests conducted not earlier than **five years from the date of bid opening**). **(YES)**

ii) If type test reports are not acceptable to BHEL/Customer then above tests shall be conducted by the bidder free of cost. **(YES)**

**Date:**

**Signature of the authorized representative of Bidder**

**Company Seal**