**Annexure-‘B’**

## GENERAL TECHNICAL REQUIREMENTS OF 33 KV 1250 amp outdoor type VCB

# Technical Specification for 33KV Outdoor Vacuum Circuit Breakers

## Scope

This specification covers design, engineering, manufacture, testing, inspection before dispatch packing, forwarding, transportation, insurance during transit, delivery to site/ stores of 33kV Outdoor Vacuum Circuit Breakers for outdoor use.

The circuit breakers shall conform in all respects to the highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the purchaser shall have the power to reject any work or materials, which, in his judgement, is not in full accordance therewith.

## Service Conditions

Equipment/Material to be supplied against this specification shall be suitable for satisfactory continuous operation under the Tropical Conditions given below:

Table 1.1: Tropical conditions for continuous operation

|  |  |  |
| --- | --- | --- |
| S.No. | Particulars | Value |
| **1** | Maximum ambient temperature (Deg. Celsius) | 50 |
| **2** | Minimum temperature (Deg. Celsius) | 0 |
| **3** | Relative humidity range (%) | 10 to 95 |
| **4** | Maximum annual rainfall (mm) | 1450 |
| **5** | Maximum wind pressure (kg/sq m) | 150 |
| **6** | Wind speed zones (m/s) | 47 & 39 |
| **7** | Maximum altitude above mean sea level (m) | 1000 |
| **8** | Isoceraunic level (days/year) | 50 |
| **9** | Seismic level (Horizontal acceleration) (g) | 0.3 |

## Standards

Expect where modified by this specification, the circuit breakers and the accessories shall be designed, manufactured and tested in accordance with latest editions of the following standards.

Table 1.2: Standards of compliance

| **S.No.** | **IEC / ISO / BS** | **Indian Standard** | **Title** |
| --- | --- | --- | --- |
|  | IEC56 IEC 62271-100 & 200 | IS 13118 | High voltage alternating current circuit breakers general requirement |
|  | IEC 694 | IS 12729 | Common clauses of high voltage switch-gear and control gear standards (for voltage exceeding 1000 V) |
|  | IEC 60 | IS 9135 | High Voltage testing techniques |
|  | IEC 427 | IS13516 | Method of synthetic testing of HV AC circuit breakers |
|  | IEC 1233 |  | HV. AC. Circuit breakers- inductive load switching |
|  | IEC 17A/CD 474 |  | HV. AC. Circuit breakers- capacitive switching |
|  | IEC 529 | IS 13947 | Degree of protection provided by enclosure |
|  | IEC137 | IS 2099 | Insulating bushing for A.C. voltages above 1000V |
|  | IEC233 | IS 5621 | Hollow insulators for use in electrical equipment & testing |
|  | IEC273 | IS 5350 | Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V |
|  | IEC815 | IS 13134 | Guide for selection of insulators in respect of polluted conditions |
|  | IEC 34 | IS 996 | A.C motors |
|  | ISO1460 BS729 | IS2629 | Hot dip galvanizing |
|  |  | IS2633 | Method of testing uniformity of zinc coated articles |
|  |  | IS 5 | Colour for ready missed paints and enamels |
|  |  | IS 6005 | Code of practice for phosphating or iron and steel |
|  | IEC 227 | IS1554 | P.V.C Insulated cables for voltages up to and including 1100 Volt |
|  | IEC269 | IS13703 | Low voltage fuses for voltages not exceeding 1000 volt |
|  | ISO800 | IS1300 | Phenolic molding materials |
|  |  | IS13118 | Guide for uniform marking and identification of conductors and apparatus terminals |
|  | IEC 185 | IS 2705 | Current transformers |
|  | IEC 296 | IS 335 | Specification for unused insulating oil for transformer and switchgear |
|  | IEC186 | IS 3156 | Potential transformers |
|  | CBIP Technical Report No. 88 revised July, 1996 read with amendment issued (April, 99, September, 99 and also any other amendment thereafter) | | Specification for AC Static Electrical Energy Meter |

This list is not to be considered exhaustive and reference to a particular standard or recommendation in this specification does not relieve the Supplier of the necessity of providing the goods and services complying with other relevant standards or recommendations.

## Basic Technical Requirements

The circuit breakers to be supplied against this specification shall be required for Feeder Protection and Transformer Protection.

The circuit breakers shall be suitable for 3 phase 50Hz solidly grounded neutral system and shall have normal current carrying capacity and symmetrical short circuit current breaking capability as mentioned hereunder.

The supplier should be an OEM (Original Equipment manufacturers) of the relay, make and break pot and VCB.

The vacuum circuit breakers are required to meet the following basic technical requirements. (Reference standards IEC56, IEC 62271 – 100, IS13118 and associated standards listed in this Specification).

Table 1.3: Basic Technical Requirements

| **S.No.** | **aParticulars** | **Requirements** |
| --- | --- | --- |
|  | Service type | Outdoor |
|  | No. of Poles | 3 |
|  | Mechanical Endurance Class (as per relevant IEC) | M2 |
|  | Electrical Endurance Class (as per relevant IEC) | C2 |
|  | Nominal system voltage | 33kv |
|  | Highest system voltage | 36kv |
|  | Interrupting Capacity at nominal system voltage | 1500 MVA |
|  | Rated normal current at 500C | 1250 A |
|  | Rated short circuit breaking current (rms) | 25 kA |
|  | Rated short circuit making current (peak) | 62.5 kA |
|  | Rated short time current withstand capability | 25 kA for 3 sec |
|  | No of Interruptions | 10,000 |
|  | **Rated insulation level** |  |
| One minute power frequency withstand voltage to earth (wet and dry) rms | 70 kV |
| Impulse withstand voltage to earth with 1.2/50µsec, wave of +ve and -ve polarity (Peak) | 170kV |
|  | First - pole - to clear factor | 1.5 |
|  | Rated operating duty cycle | O-0.3 Sec- CO-3 min- CO |
|  | Rated operating sequence (for auto reclosing) | 3 cycles (60 ms) |
|  | Maximum break time | 3 cycles (60 ms) |
|  | Rated out of phase breaking current | 25% of the symmetrical short circuit breaking current |
|  | Rated Auxiliary supply for spring charge motor, lamp & heater circuit | 230V A.C. |
|  | Rated supply voltage for trip/close coil | 30V or 110 V DC |
|  | Minimum creepage distance (mm) | 900mm |
|  | Minimum protected creepage distance | 300mm |

### General

The circuit breakers shall be structure mounted open type with vacuum as interrupting media, incorporating separate interrupters for each phase mounted on single frame. There shall be a common drive mechanism actuating the interrupters, which must work in synchronism. These breakers shall be provided with suitable local control while provision shall be made for remote control. The Design life of the circuit breaker should be 100 nos. operation at rated short circuit level.

The circuit breakers shall be fitted with spring mechanism type.

The design of the circuit breakers shall be such that inspection and replacement of contracts, coils, vacuum bottles and any worn or damaged components can be carried out quickly and this ease. The contract gaps shall be adjustable to allow for wear.

The mechanism and the connected interrupters shall satisfy the mechanical endurance requirements of IEC56, IEC 62271 – 100, IS13118 and all additional requirements specified herein.

### Porcelain Insulator

External parts of the circuit breakers, which are under continuous electrical stress, shall be of hollow porcelain. The creepage and flashover distance of the insulators shall be dimensioned and the type and profile designed in accordance with IEC815 or IS 13134 and shall be suitable for the worst environmental conditions specified in this specification. The creepage distance across the interrupting chambers shall suite the outdoor service conditions mentioned in the relevant standards for heavily polluted atmosphere and shall be not less than 900 mm with protected creepage distance 50 percent of the total. Internal surfaces of hollow insulators shall also be glazed. The insulators shall comply with IS5621 and tested in accordance with IEC233.

All porcelain whether, used on the interrupting chamber or on the support insulator shall have the following properties

Higher strength, homogeneity, uniform glaze, free from cavities and other flaws and high quality uniform finish porcelain components and shall withstand the maximum expected static and dynamic loads to which the circuit breakers may be subjected during their service life.

### Interrupting Media- Vacuum

In vacuum circuit breakers, facilities shall be provided for monitoring the contract erosion and any change in contact gap. The vacuum bottles shall be easily replaceable on site and the mechanism shall be conveniently adjustable to permit resetting the contact gap.

The vacuum circuit breaker poles shall be sealed to prevent contamination of the spaces surrounding the interrupters. The Bidder shall demonstrate how this is achieved by supplying technical details with the bid.

### Auxiliary Contacts

20 auxiliary contacts (10N.O.+ 10N.C.) of 30 or 110 Volt D.C grade and 10 amps DC rating shall be provided in each circuit breaker. and if the IS mentioned is upgraded then the latest version of IS shall be applicable

### Indication

A mechanically operated circuit breaker position indicator of non-corroding material shall be provided in a location visible from the operating side of the breaker without the necessity to open the mechanism door. The word “OFF” in white letter on green background shall be used to indicate that the breaker is in the opening position and the word “ON” in white letters on a red background to indicate that the breaker is in the closed position. The drive for the device shall be positive in both directions and provision shall be made for local and remote electrical indication.

Indication of spring charging condition shall be provided as mentioned in this specification. Mechanical counters to record the number of closing operations shall be provided for each circuit breaker mechanism.

### Take Off Terminal Pads

Terminal pads shall be provided with silver plating of at least 25 microns thickness if these are made of metal other than Aluminium. No such plating shall be required if the terminal pad is made out of Aluminiium. The pads shall be suitably designed to take the approximate terminal loads, specified below.

The breaker shall be designed to withstand the rated terminal load, wind load/Earth quake load and short circuit forces. The short circuit forces to be considered for the design shall be based on length of bus bars consisting of conductors and phase to phase spacing.

The current density adopted for the design of the terminal pad shall in no case exceed 1.6A/sq.mm for copper pad and 1.0 A/ sq. Mm for pad made of other material.

### Operating Mechanism

**General**

The operating mechanism of the circuit breaker shall be motor wound spring charged type. It shall be electrically and mechanically trip free with anti-pumping device (as per IEC694 definition). All working parts in the mechanism shall be of corrosion resistant material. Self-lubricating, wearing resistant bearings shall be provided in the mechanism.

The mechanism shall fully close the circuit breaker and sustain it in the closed position against the forces of the rated making current and shall fully open the circuit breaker without undue contact bounce at a speed commensurate with that shown by tests to be necessary to achieve the rated breaking capacity in accordance with IEC56 / IEC 62271 – 100 or IS13118. The mechanism shall be capable of being locked in either the open or closed position. The mechanism shall be capable of fully closing and opening again after the auto-reclose time interval specified as 0.3 second in this specification.

**Spring Mechanism**

The spring operating mechanism shall be with spring charging motor, opening and closing springs with limit switches and all accessories necessary for automatic charging. In normal operation, recharging of the operating springs shall commence immediately and automatically upon completion of the closing operation so that a complete sequence of closing and opening operation should be possible.

It shall be possible to hand charge the operating spring with the circuit breaker in either the open or closed position conveniently from the ground level. Closure whilst a spring charging operation is in progress shall be prevented and release of the springs shall not be possible until they are fully charged.

The state of charge of the operating springs shall be indicated by a mechanical device showing ‘SPRING CHARGED’ when closing spring is fully charged and operation is permissible and ‘SPRING FREE’ when closing spring is not fully charged and the operation is not possible. Provision shall be made for remote electrical indication of “Spring Charged‟ and “Spring Free‟ conditions.

The operating mechanism shall be such that the failure of any auxiliary spring shall not cause tripping or closing the circuit breaker but shall not prevent tripping against trip command.

Closing action of the circuit breaker shall charge the opening spring ready for tripping. From the close position with spring charged, one open-close-open operation shall be possible without recharging the spring.

### Motor

The motor for spring charging shall be single phase 230 Volt A. C motor. Continuous motor rating shall be at least ten percent above the maximum load demand of the driven equipment. It shall remain within its rated capacity at all operating points that will arise in service. It shall be protected by H.R.C cartridge fuses or MCB. The motor shall comply with IEC34 or IS996.

### Interlocks

The circuit breaker shall be capable of being mechanically and electrically interlocked with the associated line isolator so that the isolator cannot be operated with the breaker in the closed position.

All doors or shutters which give access to live parts shall be interlocked in such a way that these cannot be opened unless the circuit breaker is in the open position.

Other interlocks shall be provided as deemed necessary for safety.

### Terminal Connectors

Suitable terminal connectors of bi-metallic type suitable for both horizontal and vertical connection shall be provided on the terminal pad both on the incoming and the outgoing side for connection of jumpers of ACSR or AAAC conductor. The size of the conductor may vary between 50mm2 and 232mm2 depending upon the location of the circuit breaker. The terminal connection drawing and details are to be approved by the Purchaser before fabrication. The terminal connectors shall be bi-metallic type to avoid bi-metallic corrosion.

### Insulation and Clearance

* The insulation to ground, the insulation between open contacts and insulation between phases of the circuit breaker shall be capable of satisfactorily withstanding dielectric test voltages.
* The minimum clearance in open air shall be as follows

Between poles - 400 mm

Ground clearance for live part - 3700 mm

### Temperature Rise

The maximum temperature attained by any part of the equipment when in service at site and under continuous full load conditions and exposed to the direct rays of the sun shall not exceed the permissible limits fixed by IEC. When the standards specify the limits of temperature rise these shall not be exceeded when corrected for the difference between ambient temperatures specified in the approved specification.

The limits of temperature rise shall also be corrected for altitude as per IEC and stated in the bid.

### Local Control Cabinet of VCB

The operating mechanism, local controls and monitoring shall be provided in a metal clad control cabinet fitted to the same structure supporting the breaker and mounted at a convenient height for safe operation from ground level or from platform to be supplied under the contract.

### Cabinet

The cabinet shall be made of minimum 3 mm sheet steel and shall be constructed as a dust, weather and vermin proof outdoor housing with protection of IP-55 class. It shall have single door and transparent windows for reading the circuit breaker ON or OFF position and spring charge position without opening the door. The door and any removable covers shall be gasket all round with neoprene bonded gaskets. A ventilating louver shall be provided with fine wire non-ferrous metal or stainless steel screen and filter. A 230V AC heather with auto temperature control shall be provided in the cabinet to prevent moisture condensation and also a 230 volt lamp for internal illumination with door operated switch. The local control cabinet shall be subjected to surface treatment and painting as per clause on surface treatment of this specification.

### Wiring and Cabling

1. Unless otherwise specified control wire shall be stranded tinned copper switchboard wire with 1.1 KV PVC insulation conforming to the requirements of IS-1554.
2. All the control circuit and secondary wiring shall be wired completely and brought out preferably to a vertical terminal block ready for external connections in the control cabinet. The control wire shall not be of cross- section less than 2.5 mm2 copper.
3. All spare auxiliary contacts of the circuit breaker shall be supplied wired up to terminal block. Each terminal in terminal block shall be suitable for at least 2 x 2.5 mm copper conductor.
4. At least 20 number spare terminals shall be provided over and above the number required.
5. All wiring termination on terminal blocks shall be made through lugs. For current and DC supply circuits disconnecting stud type terminal blocks will be provided. For other control circuits, non-disconnecting snap on type terminal blocks shall be provided.
6. All wires shall be identified with non-metallic sleeve or tube type markers at each termination.
7. Terminal blocks shall be made up of moulded non-inflammable plastic material with blocks and barriers moulded integrally have white marking strips for circuit identification and moulded plastic covers.

### Grounding

A ground bus of copper bar not less than 6 mm by 25 mm shall be provided along the inside of the front or rear of the each cubicle and equipment rack. The ground bus shall be bolted to the frame of each panel in such a way as to make good electrical contact with each panel or section. Earth terminals at two ends of the cabinet shall be provided for connection of the ground bus to the station earth mat.

### Tripping/Closing Coils

The circuit breakers shall be provided with two trip coils and one closing coil per breaker. First trip coil shall be utilized for tripping the breaker on main protection fault detection. Second trip coil shall be used to trip the breaker when first trip coil fails to trip the breaker and backup protection comes into operation and shall also be used to trip the breaker on command. The trip coils shall be suitable for pre-closing and after closing trip circuit supervision.

All the breakers shall have provision for independent electrical operation of trip coils from local as well as remote through local/remote selector switch. The breaker shall be provided with suitable protection device against discrepancies in the operation of individual pole.

### Trip Free and Anti Pumping Features

The trip free mechanism shall permit the circuit breaker to be tripped by the protective relay even if it is under the process of closing. An anti- pumping device to prevent the circuit breaker from reclosing after an automatic opening shall be provided to avoid the breaker from pumping i.e., anti-pumping relay should interrupt the closing coil circuit.

### Controls

1. The circuit breaker shall be controlled by a control switch located in the control room. The control arrangement shall be such as to disconnect the remote control circuits of the breaker, when it is under test. Local/remote selector switch shall be provided for all breakers for selection of “Local” control/remote control.
2. Provision shall be made for local manual, closing, tripping and spring charging controls. Necessary equipment’s for local controls shall be housed in the circuit breaker cabinet of weather-proof construction.
3. Each circuit breaker shall have a mechanical open/closed and spring charge indicator Lamps for indicating, ‘close, open and spring charged’ position of the breaker shall also be provided.
4. Mechanical indicator, to show the `open’ and `close’ position of the breaker shall be provided in a position where it will be visible to a man standing on ground with mechanism housing open. An operation counter, visible from the ground even with the mechanism housing closed, shall be provided. Electrical tripping of the breaker shall be performed by shunt trip coils.
5. Closing coil shall operate correctly at all value of supply voltage between 85% and 110% of the rated voltage. Shunt trip coils shall operate correctly under all operating conditions of circuit breaker up to the rated breaking capacity and at all values of supply voltage between 85% and 110% of rated voltage. Bearings which require grease shall be equipped with pressure type fillings.
6. Bearing pins, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the circuit breaker. It shall be possible to trip the circuit breaker even in the event of failure of power supply.
7. Operating mechanism and all accessories shall be enclosed in control cabinet. A common marshalling box for the three poles of the breaker shall be provided, along with supply of tubing, cables from individual pole operating boxes to the common marshalling box, local.
8. The circuit breaker shall be able to perform 10,000 operating cycles at no load in accordance with IEC17A/474/CD for circuit breakers for auto reclosing duties.

### Supporting Structure

The circuit breakers shall be supplied complete with hot dip galvanized steel supporting structures, foundation and fixing bolts, etc. The structure shall be made of steel MS angle section conforming to IS 226. The galvanizing shall be as per IS. The mounting of the breaker shall be such as to ensure the safety of the operating staff and should conform to Indian Electricity Rules, 1956. Minimum ground clearance of live part from ground level shall be 3700 mm.

The bidder shall submit detailed design calculations and detailed drawings in respect of supporting structures suitable for the equipment offered. The tenders shall specify the loads which shall be transmitted to the equipment foundation under most adverse operating conditions of the breaker.

All material for making connections between the circuit breaker and its control shall also be included in the scope of supply. Facility to earth the circuit breaker structure at two points shall be provided.

### Surface Finish

All interiors and exteriors of control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter.

All metal surfaces exposed to atmosphere shall be phosphated as per IS 6005 and thereafter given two primer coats of zinc chromate and then two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped on otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

All external paintings shall be as per shade No.631 of IS5.

All ferrous hardware, exposed to atmosphere, shall be hot dip galvanized.

### Performance Requirements

The supplier shall declare the circuit breaker opening and closing times at 120 percent, 100 percent and 70 per cent of the rated voltage of the opening and closing devices when measured at the terminals of the trip and closing coils. The minimum make break time at rated voltage and total break time of the CB shall be stated. The total break time must not exceed 60 m sec.

### Earthing

All metal parts not intended for carrying current or not alive shall be connected to duplicate earthing system and suitable electroplated brass earthing terminals shall be provided on each circuit breaker in conformity with IEC56 / IEC 62271 – 100 or IS13118. Suitable identification mark for the earth terminals shall be provided adjacent to the terminal.

Earth continuity conductors shall be provided down to the ground level for earth connection to purchaser’s earthing grid. It shall have sufficient cross sectional area to afford a low resistance path for the full fault current envisaged. Such conductor shall also be provided for the cts up to the ground level.

The size of the earth continuity conductor shall be large enough to reduce the potential rise of the metal frame of the breaker in the event of fault to minimum but in any case not more than 10V. The size of the conductor shall also be adequate to restrict the temperature rise without causing any damage to the earth connection in the case of fault. No riveted joints in the earth conducting path shall be permissible and only bolted joints of adequate size shall be provided with nuts, bolts and plain and spring washers. The surfaces to be jointed shall be perfectly flat without any unevenness to ensure that there is no contact resistance.

### Galvanizing

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS2629 or any other equivalent authoritative standard.

### Auxiliary Power Supply

The operating mechanism shall be suitable to operate with the following auxiliary power supplies.

1. 230V, 50Hz Single phase A.C- For spring charging motor
2. DC supply 30 Volts- For close and open coils, indication & Alarm

The DC supply shall be provided by JBVNL at substation.

1. Voltage and frequency variation

* AC supply (Voltage) From 110% to 85% of normal voltage
* Frequency From plus/minus 3% of normal frequency
* Combined From 115% to 85% of normal
* DC supply (Voltage) From 110% to 85% of normal voltage

### Name Plate

Equipment should be provided with name plate giving full details of manufacture, capacities and other details as specified in the relevant IS.

### Site Tests on Control and Auxiliary Circuit

The following tests shall be conducted at site before commissioning.

1. Voltage tests on control and auxiliary circuit.
2. Measurements of resistance of the main circuit.
3. Mechanical operation tests.
4. Insulation Resistance test

### Spares for 33KV VCB

Manufacturer shall furnish list of (a) mandatory and (b) recommended spares for VCB’s indicating quantity and unit rate. Value of mandatory spares would be considered for the purpose of bid evaluation. Quantity of recommended spares to be procured would be decided before placement of order.

In addition to above, the manufacturer shall supply following list of spares free of cost:

* Trip coil and closing coil (1 no.)
* Spring charging motor (1 no.)
* Interrupters (1 set for supply of every 4 sets of VCB)
* Supporting insulators (2 sets for supply of every 10 sets of VCB)
* Good quality tools & plants suitable to dismantle the breaker (1 set)

### Training to Utility Staff

The supplier shall provide training to utility staff on operation and maintenance of VCB’s free of cost at manufacturer’s facility. Duration of training and number of staff to be trained shall be decided mutually.

### Commissioning of VCB’s

The supplier shall commission at least xxx numbers (quantity to be decided based on order quantity) of VCB’s at purchaser’s site free cost, so as to demonstrate the pre-commissioning tests to be carried out etc.

### Interconnection Drawings

The VCB supplier shall provide five copies of interconnection drawings for interconnection between VCB and Control and Relay (CR) Panel. Technical specifications for CR Panel shall be provided to the VCB supplier.

## Tests

### Type Tests

Type test reports (should be less than five years old as on due date of tender) of tests carried out on 33 kV breakers at CPRI/ ERDA/NTH accredited laboratory shall be furnished by the bidder along with offer otherwise offer shall be rejected. Provisional report will not be acceptable. Type test carried out at the factory/ in house premises will not be accepted.

The circuit breakers shall be subjected to routine and type tests in accordance with the following standards with the latest amendments

1. Circuit breaker IEC56 and IS13118 and relevant other standards
2. Porcelain insulator IEC233 and IS5621 and relevant other standards

The tests shall include but not limited to the following

1. **Short Circuit Tests**

The circuit breaker shall satisfactorily perform the out of phase and short circuit duties [T10, T30, T60, T100a, T100s & single phase] specified in IEC 62271-100.

1. **Capacitive Current Switching**

Capacitive current switching shall be performed on following duties in accordance with IEC 62771 -100.

1. Single Capacitor bank switching test
2. Cable charging current breaking test.
3. **Dielectric Tests**

At zero gauge loss of vacuum inside the interrupter chamber, the open contracts shall withstand continuously, the rated phase to ground voltage and it shall be possible to break normal current in these conditions. During the dielectric type tests, no flashover external or internal shall be acceptable.

The circuit breakers shall be subjected to a power frequency AC voltage test for one minute in dry and wet conditions and lightening impulse voltage withstand test and there shall be no external flash over to earth.

1. **Mechanical Endurance**

In addition to the requirements of IEC56 / IEC 62271 – 100, an extended mechanical endurance test is required to show that the circuit breaker is capable of at least 10,000 operations at no load in accordance with IEC17A/474/CD. Between the specified test series in IEC17A/474/CD, some maintenance such as lubrication and mechanical adjustment is allowed and shall be performed in accordance with manufacturer’s instructions. Change of contracts is not permitted.

1. **Duty Requirement Tests**

Apart from auto-reclosing and the other duties mentioned above, the breakers shall be able to perform the following duties for which type tests are to be conducted as per IEC56 or IS13118.

1. Short time withstand current test and peak withstand test
2. Degree of protection test [IP 55]
3. Cable charging breaking current.

Test for the resistance of the main circuit shall also be conducted.

1. **Temperature Rise Test**

Temperature rise test is to be conducted on the circuit breaker and the accessories in accordance with IEC56 or IS13118. The temperature rise shall be limited as per this specification.

1. **Routine Tests**

Following shall constitute routine tests:

1. Power frequency voltage withstand dry tests on the main circuit
2. Voltage withstand tests on control and auxiliary circuits
3. Measurement of the resistance of the main circuit
4. Mechanical operating tests
5. Design and visual checks

## Pre-Delivery Inspection at Manufacturer’s Works

1. All acceptance Tests, length and mass verification etc shall be witnessed and certified by purchaser’s representative at manufacturer’s works. The vendor shall give at least 10 days advance intimation to the purchaser to enable them to depute their representative for witnessing the Tests. The said representative shall have full facilities for unrestricted inspection of supplier’s works, raw materials, manufacturing processes and conducting necessary Tests.
2. The said representative shall verify the calibration seals provided by the calibrating agency on testing equipments/ meters.
3. Test reports of routine Tests carried out by the manufacturer shall be submitted to the inspecting authority at the time of inspection for his approval.
4. Acceptance of any quantity of materials shall in no way relieve the supplier of his responsibility for meeting all requirements of the specification and shall not prevent subsequent rejection, if such materials are later found to be defective.
5. In case of waiver of inspection, vendor shall carry out all (i) routine and (ii) acceptance Tests and submit test reports for approval of the purchaser, before dispatch of material.
6. The entire cost of testing for acceptance & routine rests and checking of length etc shall be borne by the supplier.
7. The purchaser reserves the right to select sample from any material offered for inspection /inspected and dispatched, which will be got type tested at any NABL accredited laboratory. The results of this type-tested sample shall be applicable for the entire quantity of the particular lot offered or supplied by the supplier. The Purchaser shall bear the testing charges, if sample passes all the Tests and if sample fails in any one of the Tests, supplier shall have to bear testing charges, same are recoverable from the supplier’s any pending bill, security deposit, Bank Guarantee or by any suitable means, whichever deem fit by the Purchaser. In case of sample failing in aforesaid type Tests, supplier shall have to replace the whole lot materials, which should pass through the type Tests, the re-testing charges will have to be paid by supplier. If any quantity against the particular lot is consumed by the Purchaser, the supplier will agree for any penalty/deduction in price as may be mutually agreed.

## Quality Assurance Plan & Material Quality Plan

Following quality plans shall be submitted within 30 days from the date of placement of contract.

1. Quality Assurance Plan (QAP) to be adopted by manufacturer in respect of raw materials and bought out items, including source and test reports of (i) important raw materials and (ii) bought out items.
2. Material Quality Plan (MQP) to be adopted by manufacturer in respect of manufacturing process.

The QAP & MQP shall be approved by the purchaser within 15 days from the receipt of compliance, if any. The vendor shall follow the approved QAP & MQP in true spirit. If desired by the purchaser, he shall give access to all the documents and materials to satisfy the purchaser that QAP & MQP are being properly followed.

## Guarantee

The equipment/material shall be guaranteed for a period of 24 months from the date of commissioning or 30 months from the date of dispatch whichever is earlier.

## Drawings and Instruction Manuals

Within 30 days after the award of the contract, the contractor shall supply six sets of drawings which will describe the equipment in details, for the approval of Purchaser. All the drawings and manuals should be in English Language and dimensions and weights shall be in MKS units.

Following drawings and documents for each item are to be supplied as part of the contract.

1. General outline drawings, showing dimensions, front and side elevations and plan of the circuit breaker and its local control panel.
2. Outline drawing of support insulators showing dimensions and number of sheds and creepage distance.
3. Assembly and sub-assembly drawings with numbered parts.
4. Sectional views showing the general constructional features, operating mechanism and are extinguishing chamber, etc.
5. Dimension and assembly of important auxiliaries.
6. Detailed drawings of operating mechanism.
7. Test certificates and oscillographs.
8. Detailed drawings of mounting structure.
9. Spare parts and catalogue
10. Wiring diagram showing the local and remote control scheme of breaker.
11. Write up on working of control schematic of breaker.
12. Foundation plan including weights of various components and impact loadings for working foundation design.
13. Three copies for each sub-station of the above drawings and instruction manuals covering instructions for installations, operation and maintenance shall be supplied by the contractor(s) without any extra cost.

## Packing & Forwarding

### Packing

Supplier shall pack or shall cause to be packed all items in such a manner as shall be reasonably suitable for shipment by road to JBVNL without any risk of damage in transit. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit, and open storage.

### Packing List

One copy of the packing list shall be enclosed in each package delivered. There shall also be enclosed in one package a master packing list identifying each individual package, which is part of the shipment. If, on any package, it is not possible to place packing list inside the container, all pertinent information shall be stenciled on the outside and will thus constitute a packing list.

## Schedules

### Schedule - I [Guaranteed Technical Particulars 36 kV Out Door Vacuum CIRCUIT BREAKERS]

Table 1.4: Schedule I

| **S. No.** | **Description** | **Desired Values** | **Offered** |
| --- | --- | --- | --- |
|  | Rate voltage (kv rms) | 36 kV |  |
|  | Rated frequency (Hz) | 50 |  |
|  | System neutral earthing | Solidly grounded system |  |
|  | Type of arc quenching medium | Vacuum |  |
|  | Rated normal current at site conditions | 1250 Amps |  |
|  | Number of poles | 3 |  |
|  | Installation | Outdoor type |  |
|  | Temperature rise | As per IEC 62271 - 100 |  |
|  | **Rated short circuit** |  |  |
| A) Interrupting capacity at 36 kV | 25 kA |  |
| B) The percentage DC components | As per IEC 62271 - 100 |  |
|  | Rated short circuit making | 62.5 kA |  |
|  | First pole to clear factor | 1.5 |  |
|  | Rated short time current | 25 kA |  |
|  | Rated duration of short circuit | 3 Seconds |  |
|  | Total break time for any current up to the rated breaking current with Limiting condition of operating and quenching media. Pressure (ms) | < 60 ms |  |
|  | Closing time (ms) | < 150 ms |  |
|  | No. of interruptions | 50,000 |  |
|  | Mounting | Hot dip galvanized lattices steel support structured bolted type |  |
|  | Phase to phase spacing in the switch yard i.e. Inter-pole spacing for breaker (Min) | 400 |  |
|  | Required ground clearance from the lowest line terminal if both the Terminals are not in same horizontal plane (cum) | 3700 |  |
|  | Height of concrete plinth (mm) | 150 |  |
|  | Minimum creepage distance of support insulator (mm) | 900 |  |
|  | Standard value of rated transient recovery voltage for terminal fault | As per IEC-56 |  |
|  | Standard value of rated line | RRRV |  |
|  | Characteristics | Surge peak factor K=1.6 A  For short line faults KV /ms=0.214  Impedance Factor Z(ohms) = 450 |  |
|  | **Rated operating** |  |  |
| A) Duty cycle | 0-0.3s- CO – 3min- CO |  |
| B) Auto reclosing | Suitable for three phase Auto reclosing duty |  |
|  | Rated insulation level under heavy Pollution condition 1.2/50 micro second lightening Impulse withstand voltage (KV peak)to earth | 170 kV |  |
|  | Power frequency withstand voltage (rms) to earth (kv rms) | 70 kV |  |
|  | Rated characteristic for out of Phase Breaking |  |  |
| A) Out of phase breaking capacity | 25% of rated breaking capacity |  |
| B) Standard values of transient | As per IEC-56 recovery |  |
| C) Operating mechanism | Spring operated, Anti pumping and Trip free mechanism |  |
|  | A) Rated supply voltage of closing & operating devices and auxiliary circuits | 1) 110 V DC/30 V DC 2) Series Trip Type system requiring no DC supply. Closing in this case shall be operating on 240 Volts AC 50 C/S single phase 3) 430 volts 50 Hz three phase |  |
| B) Permissible voltage variation | 1) In case of DC Power supply voltage variation shall be Between 85% & 110% of normal voltage. 2) In case of AC power supply voltage variation shall be of the normal voltage as per IS-15% to +10%. |  |
| C) Permissible frequency | ± 3% from normal 50 Hz as per IS 2026 part-I 1977 Para 4.4 |  |
| D) Combined variation of frequency and voltage | ± 15% |  |
|  | Number of auxiliary contacts | 10 NO and 10 NC on each pole Continuous current Rating 10 Amps, DC at 110/30 volts DC or 240 V AC |  |
|  | Number of coils | 2 (Two) trip coils and 1 close coil |  |
|  | Rated terminal load | 100 kg. Static  The breaker shall be designed to withstand the rated terminal load, wind, load, earthquake load and short circuit forces |  |

# Technical Specification for 33 kV Outdoor Type Current Transformers

## Scope

The specification covers the design, manufacture, testing at manufacturer’s works and supply of 33 kv Single phase, Outdoor, oil filled hermetically sealed Current Transformers with dead tank, all accessories and spares suitable for outdoor use.

## Service Conditions

Equipment/material to be supplied against this specification shall be suitable for satisfactory continuous operation under the tropical conditions as follows.

Table 2.1: Tropical conditions for continuous operation

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Particulars** | **Value** |
| 1 | Maximum ambient temperature (Deg. Celsius) | 50 |
| 2 | Minimum temperature (Deg. Celsius) | 0 |
| 3 | Relative humidity range (%) | 10 to 95 |
| 4 | Maximum annual rainfall (mm) | 1450 |
| 5 | Maximum wind pressure (kg/sq m) | 150 |
| 6 | Wind speed zones (m/s) | 47 & 39 |
| 7 | Maximum altitude above mean sea level (m) | 1000 |
| 8 | Isoceraunic level (days/year) | 50 |
| 9 | Seismic level (Horizontal acceleration) (g) | 0.3 |

## Standards

Unless otherwise modified in this specification, the Current Transformer shall comply with the latest version of relevant standards (IS 2165, IS 2705(I-IV), IS 2099, IS 5621, IS 2071, IS 335, IS 13947(part I), IEC 185, IEC 270, IEC 44(4), IEC 171, IEC 60, IEC 8263, IEC 815, Indian electricity Rules 2003) or better international standards. This list of standards is for guidance only. The contractor shall be solely responsible to design & manufacture the CT suitable for 33kV & /11 kV systems.

## General Technical Requirements

Table 2.2: General Technical requirements

| **S. No.** | **Item** | **Specification** | | | |
| --- | --- | --- | --- | --- | --- |
|  | Type of CT/ Installation | Single phase, Outdoor, oil filled hermetically sealed with dead tank | | | |
|  | Type of mounting | Pedestal type | | | |
|  | Suitable for system frequency | 50 Hz | | | |
|  | Ratio taps | Achievable by secondary side reconnection | | | |
|  | Method of earthing system to be connected to | Solidly Effectively earthed | | | |
|  | Rated continuous thermal current (A) | 120% of the rated primary current | | | |
|  | Acceptable limit of temperature rise above the specified ambient temperatures for continuous operation at rated current | As per IS 2705 (Part-I) /1992. | | | |
|  | Current Ratio for Nominal system Voltage of 33KV | 800-400-200/1-1-1A, (3 Core) or  800-400-200/5-5-5A, (3 core)  800-400-200/1-1A, (2 Core) or  800-400-200/5-5A, (2 core) | | | |
|  | Rated Voltage / HSV (kv rms) | 33kV / 36 kV | | | |
|  | Lightning Impulse Withstand Voltage(kv p) | 170 | | | |
|  | One minute dry /wet power frequency withstand voltage primary (kv rms) | 70 | | | |
|  | Rated dynamic withstand current (KA rms) | 62.5 | | | |
|  | One minute power frequency withstand voltage between Secondary terminal & earth | 3 kV | | | |
|  | Rated short time withstand current for 3 second Duration (ka rms) | 25 | | | |
| Duration (for primary current of 150amps and above) | 3 sec | | | |
| Duration (for primary current below 150amps) | 1 sec | | | |
|  | Minimum creepage distance of porcelain housing (mm) | 900 | | | |
|  | Power frequency over voltage withstand requirement for Secondary winding (kv rms) | As per clause 9.4 and 9.5 of IS 2705 (part-I) | | | |
|  | Type of oil compensation provided. | Nitrogen cushion or SS Bellow | | | |
|  | **Core details (3 core)** |  | | | |
| Core no. | **I** | **II** | | **III** |
| Purpose | Protection | Protection | | Metering |
| Burden (VA) | -- | -- | | 20 |
| Class of Accuracy | 5P10 | 5P10 | | 0.2 |
| Instrument security Factor | - | - | | ≤5 |
| Accuracy Limit Factor | ≤10 | ≤10 | | - |
|  | **Core details (2core)** |  | | | |
| Core no | **I** | | **II** | |
| Purpose | Protection | | Metering | |
| Burden (VA) | -- | | 20 | |
| Class of Accuracy | 5P10 | | 0.2 | |
| Instrument security Factor | - | | ≤5 | |
| Accuracy Limit Factor | ≤10 | | - | |

Current transformers, three per circuit breaker, shall be of outdoor, single phase oil immersed dead tank type and shall comply with IEC185 and IS2705, suitable for operation in hot and humid atmospheric conditions described in service condition. They shall be mounted on the bracket. The CT tank should be Hot Dip galvanized as per relevant ISS to prevent corrosion of all exposed metal parts.

3 core CTs will be provided for 10 MVA Power Transformers having differential protection and 2 core CTs will be provided for 33KV Feeder, incomer & 5MVA Power Transformers where differential protection is not provided.

### Core

High grade non- ageing cold rolled grain oriented silicon steel of low hysteresis loss and permeability shall be used for the core so as to ensure specified accuracy at both normal and over currents. The flux density shall be limited to ensure that there is no saturation during normal service.

The instrument security factor of the metering core shall be low enough so as not to cause damage to the instruments in the event of maximum short circuit current.

The protection core to be used for earth fault and over current protection shall be designed for minimum saturation factor of 20 for the highest setting. The magnetizing curves for the core shall be furnished.

CT core to be used for differential protection shall be of PS class.

### Windings

**Primary Winding**

It shall be made of high conductivity rigid copper wire. The primary winding current density shall not exceed the limit of 1.6 Amp per sq. mm for normal rating.

The design current density for short circuit current as well as conductivity of metal used for primary winding shall be as per IS 2705. The calculation for the selection of winding cross section shall be furnished by contractor.

The primary terminal shall be of standard size of 30 mm dia x 80 mm length of heavily tinned (min. thickness 15 micron) electrolytic copper of 99.9 % conductivity.

The continuous current rating of the primary winding shall be one hundred and fifty percent of the normal rated current.

**Secondary Winding**

The secondary windings shall be made of electrolytic copper with suitable insulation. The conductor shall be of adequate cross-section so as to limit the temperature rise even during short circuit conditions. The insulation of windings and connections shall be free from composition liable to soften, shrink or collapse during service.

For multi ratio design, the multi ratio will be achieved by reconnection of the primary winding or secondary winding. The excitation current of the CT shall be as low as possible. The contractor shall furnish the magnetization curves for all the cores.

The terminal box shall be dust free & vermin proof. The size of the terminal box shall be big enough to enable easy access and working space with the use of normal tools.

The secondary terminals studs shall be provided with at least 3 nuts and two plain washers, these shall be made of brass duly nickel plated. The min. stud outer dia shall be 6 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 time the outer dia of the stud.

Secondary windings of current transformers shall be used for metering, instrumentation and protection and shall be rated for continuous current of one hundred and fifty percent of normal rated current of primary winding.

### Marking

Polarity shall be indelibly marked on each current transformer and at the lead and termination at associated terminal blocks. CTs with multi ratio winding shall be clearly tabulated to show the connections required for different ratios. Similar numbers shall be marked on terminal block arrangement and wiring diagram. Apart from the above marking and those to be provided as per IEC 185 or IS 2705, other markings shall be provided in consultation with owner.

### Enclosure

The current transformer enclosures shall be made of high quality steel and shall be hot dip galvanized and shall be able to withstand and stresses occurring during transportation and the terminal and mechanical stresses resulting from maximum short circuit current in service. The primary winding and terminals shall be in a tank and supported by a hollow porcelain insulator. The secondary connection shall be conducted through the hollow insulator and terminated in a terminal box mounted on the base plate.

### Sealing

Each current transformer shall be supplied filled with insulating oil complying with IEC296 or IS335 and shall be hermetically sealed to prevent atmosphere coming in contact with oil, avoiding frequent filtration and change of oil. The current transformers shall have provision for draining and re-filling insulation oil after drying.

### Insulating Oil

The current transformer shall be complete with new insulating oil. The quantity of insulating oil for first filling of the equipment and complete specification of oil proposed to be used shall be stated in the bid. The oil shall conform to the requirements of latest issue of IEC296 or IS335.

To ensure prevention of oil leakage, the manufacturer will give following details supported by drawings:

* Location of emergence of Primary & Secondary terminals
* Interface between porcelain & metal tanks
* Cover of the secondary terminal box

Any nut & bolt and screw used for fixation of the interfacing porcelain bushing for taking out the terminals shall be provided on flanges cemented to the bushings & not on the porcelain.

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be machined with adequate space for accommodating gasket under pressure.

The CT shall be vacuum filled with oil after processing. It will be properly sealed to eliminate breathing & to prevent air & moisture from entering the tank. The sealing methods/arrangement shall be described by the contractor & be approved by the owner

### Earthing

Two earthling terminals shall be provided on the metallic tank of size 16 mm dia & 30 mm length each with one plain washer & one nut for connection to the station earth mat

### Fittings and Accessories

Fittings and accessories listed below shall be supplied with each current transformer

* Oil level gauge
* Oil filling hole and cap; o Pressure relief device; o HV terminal connectors;
* Two earthing terminals and strips with necessary nut, bolts and washers; o Name and rating plate;
* Terminal box with LV terminal connections; o Mounting nuts, bolts and washers;
* Any other fittings deemed essential by the Supplier shall also be supplied with each current transformer.

The oil level gauge shall be mounted in such a way that the oil level can be clearly seen from ground level.

A dust, vermin and weather proof terminal box shall be provided at the lower end of the current transformer for terminating the secondary windings. The box shall have a bolted cover plate complete with gaskets. The terminal box shall have terminal blocks, cable gland plate and cable glands with shrouds suitable for different sizes of PVC insulated control cables 650/1100V grade as per IEC227 or IS1554. The terminal blocks shall have covering of moulded insulation materials complete with brass studs, washers, nuts and lock nuts suitable for termination of 2X2.5 sq mm wires. The termination shall be made by crimping lugs or bare wire with insulating sleeves at ends.

The terminal box enclosure shall have protection as per class IP 55 as defined in IEC529 or IS13947.

### CT Junction Box/Console Box

Each set of 3 current transformers for three phase shall be provided with a common junction box mounted on the circuit breaker supporting structure at a convenient position to accommodate the secondary wire of CT and other control cables of Purchaser. Separate terminals for testing the relays and instruments and short circuiting of each current transformer secondary wires shall be provided in it. The junction box enclosure shall have the same protection features as for the terminal box. It shall be provided with terminal blocks, gland plates and glands suitable for different sizes of cables. Facilities shall be provided for earthing the CT secondary wires in the junction box.

### Bushings

**General**

Oil filled/condenser type, porcelain bushing shall be used on the current transformers. The porcelain shall be homogenous thoroughly verified and impervious to moisture. The blazing of porcelain shall be uniform brown colour free from blisters, burns and other similar defects. Bushing shall have ample insulation, mechanical strength and rigidity for the purpose for which they will be used. There shall be no undue stressing of any part of bushings due to temperature changes and adequate means shall be provided to accommodate conductor expansion. The bushings shall be so designed that when operated at highest system voltage specified in clause 3.3, there will be no electric discharge in between the conductors and the bushings. No corrosion or injury shall be caused to conductor insulation or supports by the formation of substances produced by chemical action. The insulation on bushings shall be co-coordinated with that of the current transformer such that the flash over if any, will occur only external to the current transformers. The bushings should not cause radio interference when operated at rated voltage .In general the bushings shall conform to the latest issue of IS 2099 or equivalent.

**Hollow Porcelain Insulators**

The insulators of the current transformers shall conform to latest edition of IS5621 and shall be subjected to and successfully pass the tests listed in this standard and in IEC233. The hollow porcelain insulators shall be brown glazed and shall meet the requirements indicated in this specification. The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.

Each of the bushings shall be complete with the following-

* Bio-metallic expansion type terminal connector
* Oil level side gauge and convenient means of filling, sampling and draining of oil
* Adjustable arcing horns

### Insulation Level

The current transformers shall be designed to withstand impulse test voltages and power frequency test voltages as specified in this specification.

### Terminal Connections

The CTs shall be provided with bi-metallic solder less clamp and rigid type terminal connectors on the top tank for connection to the HV terminals. They shall be universal type suitable for both horizontal and vertical connections.

Two earthing terminals complete with necessary hardware shall be provided on each CT for connecting to earth continuity conductor to be provided. The earthing terminals shall be identified by means of appropriate symbol marked in a legible and indelible manner adjacent to the terminals. The terminals shall be adequately sized to meet the full earth fault current envisaged. Suitable terminal connector for earth connection shall also be supplied size of Terminal connectors however shall be confirmed at the time of approval of drawing.

### CT Mounting Bracket

The supporting structure shall be fitted with a bracket for supporting the three oil filled 33KV single phase current transformers. The support bracket shall be provided opposite the circuit breaker poles and shall ensure adequate clearance between the breaker poles and the cts. The drawings of the structure with bracket shall be subject to Purchaser’s approval before fabrication.

### Galvanization

All the ferrous parts including nuts bolts etc shall be hot dip galvanized as per IS 2629-1966 (As amended up to date).

### Spare Parts

The tenderer shall quote separately for spares recommended by them for five years operation of equipment covered by this specification. The purchaser will decide the actual quantity of spare parts to be ordered on the basis of the list and the item wise prices for spares called for in the price schedule.

### Completeness of Equipment

Any fitting accessories or apparatus which may not have been specifically mentioned in this specification but are usual or necessary in the equipment for satisfactory functioning shall be deemed to be included in the contract and shall be supplied without any extra cost. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not.

### Type Test Reports

Type test reports (less than five years old as on due date of tender) of tests carried out on 33 kv CT’s at CPRI/ NABL accredited laboratory shall be furnished by the bidder along with offer otherwise offer shall be rejected.

## Tests

The CTs shall be tested in accordance with the requirements of the type tests and routine tests as per the latest issues IEC185 or IS2705.

### Type Tests

* Lightning impulse voltage;
* Power frequency wet withstand voltage;
* Temperature rise;
* Short time current; o Composite error;
* Accuracy test (for measuring core);
* Instrument security current (for measuring core);
* Current error and phase displacement (for protection core)

### Routine Tests

* Verification of terminal marking and polarity;
* Power frequency dry withstand test on primary windings; Power frequency dry withstand test on secondary windings; Power frequency dry withstand test between sections;
* Over voltage inter-turn test;
* Composite error;
* Turn ratio;
* Accuracy test (for measuring core);
* Current error and phase displacement (for protection core);
* Knee point voltage and magnetizing current test (for PS class);
* Secondary winding resistance (for PS class).
* Insulation Resistance Test

## Guarantee

The material will be guaranteed against defective materials, bad workmanship and unsatisfactory performance for a period of 30 months from the date of delivery. If during the guarantee period, the materials are found defective or sub-standard, the same will have to be replaced/repaired free of cost by the supplier within 30 days of intimation.

## Drawings and Instructions Manual

The tenderer shall submit with the tender the following drawings to enable the purchaser to assess the suitability of the equipment.

* General layout and assembly drawings of the equipment
* Arrangement of terminal equipment
* Schematic drawings of electric power to control circuit
* Graph showing the performance of the equipment
* Drawings necessary to demonstrate compliance with any critical, dimensional requirements such as for transportation, fitting within the restricted space, clearance required etc.

These drawings shall show sufficiently over all dimensions clearance and space requirements of all apparatus to be furnished to enable the purchaser to determine the design and layout of the installation.

Chief Engineer (Stores & Purchases), JBVNL will be the final authority for approving the drawings submitted by the tenderer.

Soon after the award of the contract the manufacturer shall submit the drawing duly describing the equipment in detail for approval.

The following drawings are to be supplied as part of the contract-

* Outline dimension drawings
* Assembly drawings
* Cross sectional view of the instrument transformer
* Foundation diagram
* Wiring diagram with polarity marks
* Magnetization curves

Seven copies of the instructions manual covering instructions for installation and maintenance check test shall be supplied by the contractor as a part of the contract.

## Schedule

### Schedule – I [Guaranteed Technical Particulars for 36 KV Current Transformers]

Table 2.3: Guaranteed Technical Particulars for 36 KV Current Transformers

| **Sr. No.** | **Particulars of GTP Parameter** | **Offered** |
| --- | --- | --- |
|  | Manufacturers name & Type |  |
|  | Manufacturer's type Designation. |  |
|  | Whether Conforming to standards |  |
|  | Rated Voltage in kv |  |
|  | Rated primary current (Amps) |  |
|  | Rated Secondary current (Amp) |  |
|  | Whether conforming to Details of Cores |  |
|  | Secondary resistance corrected to 75ºc (in Ohm) |  |
|  | Magnetizing current (in ma) |  |
|  | Rated dynamic withstand current (kap) as per Annexure- I at |  |
|  | Rated short time withstands current for 1 sec. Duration |  |
|  | One minute dry power frequency withstand voltage |  |
|  | One minute wet power frequency withstand voltage |  |
|  | 1.2/50 micro-second impulse withstand voltage (kv P) |  |
|  | The die-electric withstand values(kv p) of external and  Internal insulation |  |
|  | One minute power frequency withstands voltage of secondary winding (kv rms) |  |
|  | Minimum creepage distance in mm |  |
|  | Weight of oil (kg). |  |
|  | Total Weight (kg). |  |
|  | Mounting details |  |
|  | Overall dimension. |  |
|  | Magnetization curves |  |
|  | Type of winding |  |
|  | Cross section area of primary winding |  |
|  | Cross section area of secondary winding |  |
|  | No. Of Primary turns |  |
|  | No. Of secondary turns |  |
|  | Current density of primary winding |  |
|  | Primary terminal |  |
|  | Type of insulation & Temperature rise limits applicable |  |
|  | Whether Current transformer conforms to the Temperature rise limits |  |
|  | Whether Type test reports (within five years) are submitted along with the offer? |  |
|  | Type of oil compensation |  |
|  | Whether Experience sheet is submitted along with the offer? |  |
|  | Whether Two year continuous servicing performance certificate is submitted along with the offer? |  |
|  | Whether Turn over sheet is submitted along with the offer? |  |
|  | Whether Drawings are submitted along with the offer? |  |
|  | Whether Test tap is provided? |  |
|  | Type of Pressure release device provided? |  |
|  | Partial discharge level |  |
|  | Rated continuous thermal current |  |
|  | Current security factor |  |
|  | Type of insulation material used |  |

# Technical Specification for 33KV Outdoor type Potential Transformer

## Scope

The scope of this specification covers design, manufacturing, testing, supply, transportation, insurance (transit and storage), erection, site testing & commissioning of 33 kv Potential Transformer suitable for outdoor service.

## Service Conditions

Equipment/Material to be supplied against this specification shall be suitable for satisfactory continuous operation under the Tropical Conditions given below:

Table 3.1: Tropical conditions for continuous operation

| Sr. No. | Particulars | Value |
| --- | --- | --- |
| **1** | Maximum ambient temperature (Deg. Celsius) | 50 |
| **2** | Minimum temperature (Deg. Celsius) | 0 |
| **3** | Relative humidity range (%) | 10 to 95 |
| **4** | Maximum annual rainfall (mm) | 1450 |
| **5** | Maximum wind pressure (kg/sq m) | 150 |
| **6** | Wind speed zones (m/s) | 47 & 39 |
| **7** | Maximum altitude above mean sea level (m) | 1000 |
| **8** | Isoceraunic level (days/year) | 50 |
| **9** | Seismic level (Horizontal acceleration) (g) | 0.3 |

## Standards

Table 3.2: Reference standards

| **S. No.** | **IS** | **IEC** | **Item** |
| --- | --- | --- | --- |
|  | IS 3156 | IEC 186 | Voltage transformers |
|  | IS 2099 |  | Bushings for alternating voltages above 1000 Volts |
|  | IS 3347 |  | Dimensions for Porcelain Transformer Bushings |
|  | IS 335 |  | New insulating oils |
|  | IS 13947(part I) |  | Glossary of terms relating to metal containers |
|  | Indian electricity Rules 1956/ CEA regulations, 2010 |  | Indian electricity Rules 1956/ CEA regulations, 2010 |
|  |  | IEC 815 | Guide for the selection of insulators in respect of polluted condition |

## Basic Technical requirements

The 33KV outdoor voltage transformers are required to meet the following basic technical requirements (Reference standards IEC186, IS3156 and associated standards listed in the specification)

Table 3.3: Basic Technical Requirement

| **Sr. No.** | **Particulars** | **Requirements** |
| --- | --- | --- |
|  | Type | Single phase |
|  | Nominal/ Highest system voltage, phase to phase | 33kv / 36 kV |
|  | Instrumentation, Metering and Protection Application |  |
|  | Number of secondary windings | 1 |
|  | Rated normal burden (minimum acceptable) | 200 VA |
|  | Rated primary voltage | 33 kV |
|  | Rated secondary voltage | 110 V |
|  | System neutral earthing | Solidly earthed |
|  | System fault level | 25 kA for 3 sec. |
|  | Class of accuracy | 0.5 |
|  | Rated insulation level (Primary winding) (Phase to earth) |  |
| * 1. One minute power frequency withstand voltage to earth (wet and dry) rms | 70 kV |
| * 1. Impulse withstand voltage to earth with 1.2/50 sec wave of +ve and -ve polarity (peak) | 170 kV |
|  | Rated insulation level (Secondary winding) (Phase to earth) for one minute power frequency withstand voltage to earth (wet and dry) rms | 36 kV |
|  | One minute power frequency withstand voltage of secondary winding (rms) |  |
| * 1. Between phase to earth | 3 kV |
| * 1. Between sections | 3 kV |
|  | Rated voltage factor |  |
| a) Continuous | 1.2 |
| b) For 30 seconds | 1.5 |
|  | Creepage distance to earth (in mm per KV) of highest phase to phase system voltage | 25 |
|  | Accuracy of Secondary core | 0.5 |
|  | Burdan (VA) for secondary core | 100 |

## General Technical Requirements

The Design of the VCB shall conform to M2 class The voltage transformers to be supplied under this specification shall be of outdoor, single phase dead tank double wound, oil immersed type, complying with IEC185 and IS3156 suitable for operation in hot and humid atmospheric conditions described in this document. To prevent corrosion of the exposed surfaces, the tank should be hot dip galvanized. They shall have separate HV and LV windings and shall be suitable for use as bus PTs in 33/11 kV substations.

### Duty Requirement

33KV Voltage transformer for all the indicating instruments and measuring meters in the substation on 33KV side.

### Porcelain Insulator

External parts of the voltage transformers which are under continuous electrical stress shall be of hollow porcelain insulators complying with latest edition of IS6521 tested as per IEC233. The creepage and flashover distance of the insulators shall be dimensioned and the type and profile designed in accordance with IEC815 or IS13134 and shall be suitable for the worst environmental conditions for heavily polluted atmosphere and shall be not less than 25mm per KV of highest phase to phase system voltage with protected creepage distance minimum 50 percent of the total. Internal surfaces of hollow insulators shall also be glazed.

The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.

All porcelain used on the voltage transformers shall have the following properties high strength, homogeneity, uniform glaze, free from cavities and other flaws and a high quality uniform finish porcelain components shall withstand the maximum expected static and dynamic loads to which the voltage transformers may be subjected during their service life. The clear height of porcelain housing shall be at least 300 mm.

The insulation of the hollow porcelain insulators shall be coordinated with that of the voltage transformers to ensure that any flash over occurs only externally.

### Core

High grade non-ageing cold rolled grain oriented silicone steel of low hysteresis loss and permeability shall be used for core so as to ensure accuracy at both normal and or over Voltages. There shall be no saturation at any stage during operation.

The instrument security factor of the core shall be low enough so as not to cause damage to the instruments in the event of maximum short circuit current or over voltages.

### Windings

**Primary Winding**

It shall be made of insulated electrolytic copper wire and covered with double paper insulation. The insulation of windings and connections shall be free from composition liable to soften, looze, shrink or collapse during service. The neutral end of the winding shall be brought outside for earthing.

The conductor shall be of adequate cross-section so as to limit the temperature rise even during maximum over voltages. The primary terminal shall preferably be of standard size of 30 mm dia x 80 mm length of heavily tinned (min. thickness 15 micron) electrolytic copper of 99.9 % conductivity.

The current rating of the primary winding shall be one hundred and fifty percent of the normal rated burden and the windings shall be suitable to withstand continuously the maximum system voltage.

**Secondary Winding**

It shall be made of insulated copper wire of electrolytic grade and covered with double paper insulation. The terminal box shall be dust free & vermin proof. The size of the terminal box shall be big enough to enable easy access and working space with the use of normal tools.

The secondary winding of the voltage transformers shall also be suitable for continuous over voltage corresponding to the maximum system voltage at the primary winding. The winding supports shall be suitably reinforced to withstand normal handling and the thermal and dynamic stresses during operation without damage.

The voltage transformer secondary circuits will be taken out to form the star point and earthed at one point outside the voltage transformers. The secondary terminals studs shall be provided with at least 3 nuts and two plain washers. These shall be made of brass duly nickel plated. The min. stud outer dia shall be 10 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 time the outer dia of the stud.

### Marking

Both primary and secondary winding terminals shall be clearly and indelibly marked to show polarity in accordance with IEC186. The connections required for different secondary windings in case of multi- winding voltage transformers shall be clearly indicated in terminal blocks and the wiring diagrams.

### Tank

Both expansion chamber and tank of the voltage transformers shall be made of high quality steel and shall be hot dip galvanized and shall be able to withstand the stress occurring during transit and all thermal and mechanical stresses resulting from maximum short circuit current during operation. It shall be fabricated of MS steel sheet of min. 3.15 mm thickness for sides & 5 mm for top & bottom.

### Insulating Oil

The voltage transformers shall be supplied filled with new insulating oil. The oil shall conform to the requirements of latest issue of IEC296 of IS335. The quantity of insulating oil for first filling of the equipment and complete specification of oil proposed to be used shall be stated in the bid.

The manufacturer will give following details supported by drawings:

* Location of emergence of Primary & Secondary terminals
* Interface between porcelain & metal tanks
* Cover of the secondary terminal box

Any nut & bolt and screw used for fixation of the interfacing porcelain bushing for taking out the terminals shall be provided on flanges clamped to the bushings & not on the porcelain directly.

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be in machined with adequate space for accommodating gasket under pressure.

The PT shall be vacuum filled with oil after processing. It will be properly sealed to eliminate breathing & to prevent air & moisture from entering the tank. The sealing methods/arrangement shall be described by the contractor & be approved by the owner.

### Sealing

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be machined with adequate space for accommodating gasket under pressure. The voltage transformers shall be supplied filled with insulating oil and shall be hermetically sealed to prevent atmosphere coming in contact with oil, avoiding filtration and change of oil.

### Fitting and Accessories

Fittings and accessories listed below shall be supplied with each voltage transformer

* Oil level gauge.
* Oil drain, sampling and filling hole with cap;
* Pressure relief device;
* HV terminals;
* Two earthing terminals with necessary nuts, bolts and washers; viz. Name and rating plate;
* Secondary terminal box with LV terminal connections; viii. Mounting nuts, bolts and washers;
* L.V HRC cartridge fuses for the protection of secondary winding;

Any other fitting deemed essential by the contractor shall also be supplied along with each voltage transformer

The oil level gauge shall be mounted in such a way that the oil level can be clearly seen from the ground level.

The name and rating plate shall contain all the particulars as provided in IEC186 and also the name of the employer and year of manufacture. They shall comply with the clause termed label in this specification.

### Secondary Terminal Box

A dust, vermin and weather proof terminal box shall be provided at the lower end of each voltage transformer for terminating the secondary windings. The box shall have a bolted removable cover plate complete with gaskets. The terminal box shall have cable gland plate and cable glands with shrouds suitable for entry of 4 core x2.5mm2 PVC insulated control cables as per IEC227 or IS1554.

The terminal box enclosure shall have protection of class IP 55 as defined in IEC529 or IS13947 and shall be painted or galvanized in accordance with specification of Surface Treatment.

### Terminal Blocks

Terminal blocks of brass studs rated for 10 Amps continuous current, 650 Volt grade enclosed in moulded insulating materials shall be provided with adequate electrical clearance for terminating the secondary wiring and outgoing connections. The terminal blocks shall be suitable for termination of 2.5mm2 wires. The termination shall be made by crimping Jugs or bare wire with insulating sleeves at ends. All terminals must be marked with numbers and wire termination provided with numbered ferrules for identification.

### Fuse Protection

The secondary windings shall be protected by HRC cartridge fuses in fuse holder consisting of carriers and bases. The carriers and bases shall be of high grade flame retarding and non-hygroscopic moulded insulating materials with hard glass surface. Each fuse shall be identified with engraved plastic label.

### Circuit Diagram

A durable copy of the circuit wiring diagram shall be affixed to the inner side of the terminal box cover. Labels shall be provided inside the cover to describe the functions of various items of equipments.

### Termination

The equipment shall be supplied with HV electrical connection terminals of a size and rating appropriate for all the duties, including overload duty specified for the equipment. The terminals shall be of the bi-metallic type, suitable for connection of all aluminium alloy conductor (AAAC) or aluminium conductor steel reinforced (ACSR). In general connections using palm type solder-less sockets shall be preferred. The proposed method of connections shall be stated in the offer and shall be subject to approval by the Purchaser. Where the terminals are of the clamp type, they shall be suitable for taking a range of conductors appropriate to the rating of the equipment.

All nuts, bolts, washers and spring washers required to complete the connection shall be supplied with the equipment.

The primary terminal shall be of standard size of 30 mm dia. X 80 mm length of heavily tinned (min. Thickness 15 micron) electrolytic copper of99.99 % conductivity.

The secondary terminals studs shall be provided with at least 3 nuts and two plain washers, these shall be made of brass duly nickeled. The min. Stud outer dia. shall be 10 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 times the outer dia. Of the stud.

### Polarity

The polarity shall be marked on each PT at the secondary terminals in the terminal box. There shall be MCB of suitable rating at secondary terminals.

### Earthing Terminal

Two earthing terminals complete with necessary hardware shall be provided on each voltage transformer for connecting to earth continuity conductors of the Employer. They shall be of electroplated brass and of adequate size to carry the earth fault current.

Two earthing terminals shall be provided on the metallic tank of size 16 mm dia. & 30 mm length each with one plain washer & one nut for connection to the station earth mat. The earthing terminals shall be identified by means of appropriate symbol marked in a legible and indelible manner adjacent to the terminals.

## Test and Inspections

The voltage transformers shall be tested in accordance with the requirements of the type tests and routine tests as provided in the latest issues of IEC186 or IS3516.

### Type Tests

Type test reports (less than five years old as on due date of tender) of tests carried out on 33 kv PT’s at CPRI/ NABL accredited laboratory shall be furnished by the bidder along with offer otherwise offer shall be rejected.

The tests to be conducted shall include;

* Lightning impulse voltage test;
* High voltage power frequency wet withstand voltage;
* Temperature rise test;
* Short circuit withstand capability test;
* Determination of limits of voltage error and phase displacement

### Routine Tests

* Verification of terminal marking and polarity;
* Power frequency withstand tests on primary winding;
* Power frequency dry withstand tests on secondary winding;
* Power frequency withstand tests between sections;
* Determination of limits of voltage errors and phase displacement;
* Partial discharge measurement.
* Insulating Resistance measurement.

### Temperature Rise Test

The temperature rise of any part of the voltage transformer under continuous operating and exposed in the direct rays of the sun shall not exceed the permissible limits as provided in IEC publication 186 or IS3156. These shall not be exceeded when corrected for the difference between the ambient temperature at site and the ambient temperature specified in the standard. The correction proposed shall be stated in the bid.

## Drawings and Instructions Manual

The tenderer shall submit with the tender the following drawings to enable the purchaser to assess the suitability of the equipment.

* General layout and assembly drawings of the equipment
* Arrangement of terminal equipment
* Schematic drawings of electric power to control circuit
* Graph showing the performance of the equipment
* Drawings necessary to demonstrate compliance with any critical, dimensional requirements such as for transportation, fitting within the restricted space, clearance required etc.

These drawings shall show sufficiently over all dimensions clearance and space requirements of all apparatus to be furnished to enable the purchaser to determine the design and layout of the installation.

Soon after the award of the contract the manufacturer shall submit the drawing duly describing the equipment in detail for approval.

Following drawings are to be supplied as part of the contract:

* Outline dimension drawings
* Assembly drawings
* Cross sectional view of the instrument transformer
* Foundation diagram
* Wiring diagram with polarity marks
* Magnetization curves
* Seven copies of the instructions manual covering instructions for installation and maintenance check test shall be supplied by the contractor as a part of the contract.

Chief Engineer (Stores & Purchases), JBVNL will be the final authority for approving the drawings submitted by the tenderer.

## Schedule

### Schedule – I [Guaranteed Technical Particulars for 36 KV Potential Transformers]

Table 3.4: Guaranteed Technical Particulars for 36 KV Potential Transformers

| **S. No.** | **Parameter** | **Offered** |
| --- | --- | --- |
|  | Manufacturers name & Type of PT |  |
|  | Manufacturer's type Designation. |  |
|  | Whether Conforming to standards |  |
|  | Rated Primary Voltage in kv |  |
|  | Number of secondary windings |  |
|  | Rated secondary voltage (Volts) |  |
|  | Rated burden (VA) |  |
|  | Accuracy class |  |
|  | Highest system voltage (kv ) |  |
|  | Quantity of oil ( Liters ) |  |
|  | Type of insulation & Temperature rise limits applicable |  |
|  | Whether Potential transformer conforms to the Temperature rise limits |  |
|  | Rated voltage factor & time |  |
|  | One minute power frequency withstand voltage test (dry) (kv rms) |  |
|  | One minute power frequency withstand voltage test (wet) (kv  Rms) |  |
|  | 1.2/50 microsecond impulse wave withstand test voltage (kv P) |  |
|  | One minute power frequency withstand voltage on secondary  (kv rms) |  |
|  | Minimum Creepage distance (mm) |  |
|  | Weight of oil (kg) |  |
|  | Total weight (kg) |  |
|  | Overall dimensions |  |
|  | Mounting details |  |
|  | Primary terminals |  |
|  | Whether Type test reports (within 5 years) are submitted along with the offer? |  |
|  | Type of oil compensation |  |
|  | Whether experience sheet is submitted along with the offer? |  |
|  | Whether two year continuous servicing performance certificate is submitted along with the offer? |  |
|  | Whether Turn over sheet is submitted along with the offer? |  |
|  | Whether Drawings are submitted along with the offer? |  |
|  | Whether Pressure release device is provided? |  |
|  | Type of insulation material used for PT |  |
|  | Actual Clearance between live part and ground (mm) |  |