

**Ministry of Health & Family Welfare  
(GOVERNMENT OF INDIA)  
Ministry of Health & Family Welfare  
Nirman Bhavan, Maulana Azad Road  
New Delhi – 110011**

**Tender for  
Supply, Installation, Testing &  
Commissioning of Substation Equipment for  
Housing Complex for AIIMS-like-Institution at  
Raipur under PMSSY**

**Volume - IV  
TECHNICAL SPECIFICATIONS**

**Tender No. HSCC/PMSSY/RAIPUR/SS/2010**

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**Consultant**

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## **1.0 HIGH VOLTAGE PANEL:**

The HV panel board shall be metal clad, indoor, floor mounting, free standing type. It shall be totally enclosed dust, damp and vermin proof having incoming and out going feeders as per bill of quantity.

Separate earthed compartments shall be provided for circuit breakers, bus bars, relay and instruments, CT & PT and cable boxes, fully and effectively segregating these from one another so that fault in any one compartment do not cause damage to equipment(s) in other compartment(s).

The housing shall be of bolted construction to ensure compact and rigid structure. The sheet steel used shall not be less than 2 mm thick.

The panel shall be bolted together to form a continuous flush front switch gear suitable for front operation of board and for extension at both ends.

The HV panel board shall be designed such that the switchgear, instrument, relays, bus bar, wiring etc are arranged and mounted with due consideration for the following:

- i) Facility for inspection, maintenance and repairs of testing terminals and terminals boards for ease of external connection
- ii) Minimum noise and vibrations
  - Risk of accidental short circuits and open circuits
  - Secured and vibration proof connections for power and control circuits
- iii) Risk of accidental contact and danger to personnel due to live connections.
- iv) Mountings at approachable height.

### **1.1 Circuit Breaker:**

The circuit breaker shall be complete with the following:

- a) Racking-in/ Racking-out mechanism.
- b) Isolating plug and sockets.
- c) Mechanical interlocks and safety features.
- d) Mechanical ON/ OFF indicators.
- e) Minimum of 4 NO and 4 NC auxiliary contacts directly operated by the circuit breaker. Additional NO & NC contacts can be provided with auxiliary contacts.
- f) Auto condensation space heaters suitable for operation on 240 V , 1 phase, 50 Hz A.C. for each panel wherever needed.
- g) Suitable tripping arrangement.
- h) Mechanical counters to assess the total number of operations of the breaker.

The circuit breaker shall be horizontal isolation, horizontal draw out pattern.

The breaker carriage shall be fabricated from steel, providing a sturdy vehicle for the circuit breaker. The carriage shall be mounted on the wheels, moving on guides, designed to align correctly and allow easy movement of the circuit breaker.

### **1.2 Current transformer:**

Dual ratio CT of suitable burden shall be provided with 5 amp secondary current. The ratio will be 50/5-5 for incoming circuit breaker and 25/5-5 for out going feeders.

The CTs shall conform to relevant Indian Standards. The design and construction shall be robust to withstand dynamic stresses during short circuit. Secondary terminals shall be brought out suitably to a terminal block which will be easily accessible for testing and terminal connections. The protection CT shall be of accuracy class 5 P 10.

The metering CT shall conform to the metering ratio and accuracy class 0.5.

### **1.3 Voltage Transformer:**

A voltage transformer of burden not less than 100 VA and of proper ratio as specified and shall be provided at the incoming panel. The accuracy class of VT shall be 0.5.

The transformer shall be of cast epoxy resin construction. HRC fuses/ MCBs shall be provided on both HV and LV sides.

### **1.4 Wiring:**

Wiring shall be carried out with minimum 1.5 Sq. mm FRLS/HFFR insulated copper conductor cables. CT wiring shall be done with minimum 2.5 sq. mm wires with colour code: RYB, gray for auxiliary DC circuit and black for auxiliary AC circuits. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification tags shall be fitted to all wires terminals to render identification easy and to facilitate checking in accordance with IS 375. Necessary terminal blocks and cable entries shall be provided for RTD relay wiring, power supply etc.

### **1.5 Installation:**

The installation work shall cover assembly of panels lining up, grouting the units etc. In case of multi panels switch board after connecting up the bus bar all joints shall be insulated with HV insulation tape or with approved insulation compound. A common earth bar shall be run preferably at the back of the switch board connecting all the sections for connecting the earth system. All protection, indication & metering connections and wiring shall be completed. All relay instruments and meters shall be mounted and connected with appropriate wiring. Calibration checks of units as necessary and required by the licensee like CTs, PTs, energy meters etc shall be completed before pre-commissioning checks are undertaken.

## **1.6 Testing and commissioning:**

Procedure for testing and commissioning of relay shall be in general accordance with good practice.

### **1.6.1 Factory Tests**

The circuit breakers panel shall be subjected to routine tests at manufacturer's works in accordance with the details specified in the relevant IS specifications. These shall however necessarily comprise of the following.

- a. Power frequency voltage test on the main power circuit.
- b. Verification of the correct wiring/Functional Test.
- c. Dielectric test at 1.5kV on the control circuit. Apart from above, the vendor shall submit the routine test certificates for the following equipment.
  - i. Circuit Breakers
  - ii. Current Transformers
  - iii. Voltage TransformersThe vendor shall submit the type test certificate for following along with the offer.
  - a. Temperature rise test.
  - b. Impulse & power frequency voltage test
  - c. Short time current test on circuit breaker.

### **1.6.2 Site Test**

#### **1.6.2.1 General**

1. Verification for completion of equipment, physical damage/deformities.
2. Alignment of panel, interconnection of busbars & tightness of bolts & connection etc.
3. Interconnection of panel earth busbar with plant earthing grid.
4. Inter panel wiring between transport sections.
5. Cleanliness of insulators and general Cleanliness of panel to remove traces of dust, water etc.

#### **1.6.2.2 Circuit Breaker & Panel**

1. Check for free movement of circuit breaker, lubrication of moving part & other parts as per manufacturers manual.
2. Manual/Electrical operations of the breaker and Functional test as per drawings.
3. Meggar before the Hi Pot test.
4. H.T. Test - Hi Pot test (Power frequency withstand test for one minute at 28kV RMS). At site Hi Pot test is carried out at 80% of 28kV RMS value.
5. Meggar after the Hi Pot test.
6. CT/PT ratio/polarity primary injection test.
7. Secondary injection test on relays to practical characteristics.

## **2.0 TRANSFORMER:**

Transformer shall be suitable for operating at rated capacity continuously at any of the taps under ambient conditions and with the voltage and frequency variations indicated without exceeding permissible temperature rise and without any detrimental effect to any part.

Transformer shall be designed to be loaded as per IS:6600.

On Load tap changer shall be provided in the transformer with RTCC panel. The range of OLTC will be -10% to +5% in the steps of 1.25% as per BOQ.

All windings shall have uniform insulation resistance to earth.

Disconnecting chamber shall be air filled. Suitable cable end box shall be provided for termination of cables. Gland plate for single core cables shall be non-magnetic.

Transformer shall be able to withstand electrodynamic and thermal stresses due to terminal short circuit of the secondary, assuming the primary side is being fed from an infinite bus. All leads and windings in cores shall be properly supported. Short circuits withstand and duration shall be 2 secs. As per IS: 2026.

Short circuit test results for similar transformers shall be furnished.

There shall be a marshalling box for gathering all alarm signals. All alarm shall be wired up to terminal strip provided in marshalling box. 20% spare terminals shall be provided. Armoured cable of 2.5 sqmm cu shall be provided along with suitable size glands for terminating these contacts in marshalling box.

Guides shall be provided to facilitate tanking and untanking of the core with the coil assembly. The details of anchoring of core and coils assembly of tank shall be furnished.

Radiators shall be provided on the tank to facilitate cooling. These shall be detachable type and shall be provided with isolating valves at ends, drain plugs and air release plug. Radiators of 1.2 mm thickness seamless steel tubing or pressed sheet steel.

Means for lifting and jacking of transformer shall be provided.

Class-A insulating material specified in IS:1271 shall be used. Paper insulation shall be new and free from punctures. Wood insulation, wherever used, shall be well seasoned and treated.

The mineral oil shall comply with IS: 335. 10% extra oil in seal tins/ drums shall be supplied.

All valves shall be of globe type. Valve body of carbon steel and trim of 135 cr. Steel.

Oil temp. Indicator for measuring top oil temp. Shall comprise 150mm dial type thermometer pocket and capillary tube jacketed with PVC sleeve. Thermo-meter shall have 2 sets of contacts, one for alarm and the other for trip, and set points can be set by hand. Contacts shall be wired up to marshalling box.

Buchholz relay shall be provided as per IS: 3637. It shall be double float type with two sets of contacts for alarm and trip with facility for testing by injection of air by hand pump and with cock for draining and venting of air. Relay shall be provided with shut off valves on conservator side as well as on tank side.

Alarm and trip contacts shall be suitable for 1A 230 AC.

A marshalling box shall be provided to accommodate all auxiliary devices except those which are to be located directly on transformer. It shall be of dust, weather and vermin proof type of sheet steel 2mm thick and shall have sufficient space for ease of cabling. 20% extra terminals shall be provided.

All steel surfaces exposed shall be treated with suitable anti –rust, anti –corrosive paints

Bushing insulator shall be rated for max. System voltage and shall be as per IS. Bushing shall be enclosed in terminal box and shall be detachable from outside the tank. Separate neutral bushing shall be provided for earthing the neutral. When LT cable box is provided, a neutral bushing shall be brought out for solid earthing.

Transformer efficiency shall not be less than 98% at full load.

Both transformers shall have same percentage impedance & other characteristics with foundation plan parallel operation as per IS: 10028

## **2.1 List of fittings:-**

Oil sampling valves.

Filter valves with plug

Radiator shut off valves on top and bottom.

Buchholz relay shut-off valves

Oil temp. indicator and alarm.

Magnetic oil level gauge with min.&max. marking and shall have contact for low level.

Oil conservator complete with drain plug and oil filling hole with cover.

Buchholz relay with air release device and alarm and trip contacts.

Silica gel breather with oil seal and connecting pipe.

Explosion vent

Bidirectional rollers

Marshalling box

Rating plate

Diagram& terminal; marking plate

Lifting & Haulage lugs

Jacking pad

Earthing terminals

Air release device

Base channel with towing holes \*(39 mm dia holes)

Off circuit tap changer with locking device .

Air filled disconnecting chambers.

Top filter valve with blanking plate.

Winding temperature alarm.

Neutral CT.

### **2.3 SOAK PIT**

Soak pit for oil filled transformer shall be made as per IS 10028 (Part II) 1981 with up to dated amendments. Sump shall be formed in the transformer room and shall be connected to soak pit outside the transformer room with a pipe. All the civil works required for the

soak pit shall be done by the contractor and the cost shall be deemed to be included in quoted rates of the transformer item.

#### **2.4 INSPECTION**

- i) The transformer shall be inspected on arrival as per the inspection manual of the supplier
- ii) Shall be examined of any sign of damage and special attention shall be given to the following parts.

Oil tank and cooling tubes  
Bushes cracks or broken  
Oil sight glass

#### **2.5 INSTALLATION**

- i) The transformer shall be installed as per transformer manual of the transformer supplier and conforming to Indian standards.
- ii) The transformer is to be erected on suitable size M.S channels embedded in the cement concrete flooring including providing & fixing the channel. The transformer supplied shall be lifted by all lifting lugs for the purpose of avoiding imbalance in transit.
- iii) The transformer wheels shall be locked by suitable locking arrangement to avoid accidental movement of the transformer.
- iv) The transformer cable end boxes shall be sealed to prevent absorption of moisture.
- v) The transformer natural earthing and body earthing shall conform to Indian Standard.

#### **2.6 FACTORY TEST**

The transformer shall be subjected to test as laid down in IS 2026 at factory / manufacturing unit prior to dispatch of the transformer to the site.  
All original test certificates shall be furnished.

#### **2.7 TESTING AT SITE**

Prior to commissioning of the transformer the following tests shall be performed

- i) Insulation resistance of the winding between phases and earth of H.V and M.V side.
- ii) Winding resistance of all the winding on all tap positions shall be taken.
- iii) Di-electric strength of the transformer oil shall be checked in accordance with India standards. In case the test is not satisfactory, the oil shall be filtered till proper dielectric strength of oil is obtained.

- iv) The supplier gives sufficient advance information about the test schedule to enable the owner to appoint his representative.

### **3.0 HIGH SPEED RESISTOR ON LOAD TAP CHANGER**

#### **3.1 GENERAL**

High speed resistor on load tap changer shall be provided with the transformer wherever specified. The high speed resistor OLTC shall be for rated voltage & current, conforming to Indian standard with AVR & RTCC panel.

#### **3.2 TYPE AND CONSTRUCTION**

OLTC shall be a compact unit for use with three phase distribution transformer. It shall be completely self contained and designed to bolt directly to a part flange on the transformer.

The assembly comprise of

1. Tank
2. Selector Switch
3. Driving Mechanism
4. Barrier Board
5. Local control Gear
6. Control cable Terminations
7. AVR & RTCC panel

#### **3.3 TANK**

The complete tap changer shall be housed in a single tank of welded sheet steel construction. The tank shall be divided into two separate compartments to house the selector switch, driving mechanism and Local control gear. Access to the compartments shall be made easy by means of removable covers and a weather proof door. Anti- condensation heater shall be provided in the compartment which houses driving mechanism and control gear.

#### **3.4 SELECTOR SWITCH**

The three phase of the tap changer shall be adequately spaced for full interphase insulation but mounted as a common assembly using vertical synthetic resin bonded insulating boards, each carrying a circle of fixed contacts. Insulating rods and tubes shall be used for the horizontal spacing of the phases and the fixed contacts shall be connected via the barrier board to appropriate trappings in the transformer winding. Each phase shall have a single rotary contacts support ring with sliding contact take off connection. This ring carries separately insulated spring loaded snap connected by a non inductive resistance unit accommodated on the contact carrier. One main moving contact shall be connected directly to the

center boss take off point, the second; transition moving contact shall be connected to the resistor. The three contact support rings shall be attached to the central insulating drive shaft, which rotates in self aligning ball bearings in the two outer phase boards. This center shaft shall be of glass reinforced synthetic resin construction .access to the selector switch shall be via removable cover on the top of the tank.

### **3.5 DRIVE MECHANISM**

Operation of the selector switch shall be by means of a stored energy spring device having appositive snap- action for rotating the moving contacts quickly through the angle required for each tap change. The driving mechanism compartment shall be external to the oil filled switch tank. The rotary drive from the driving mechanism to the selector switch shall passes through a frictionless positive oil tight gland. The angular movement of selector switch shaft shall be controlled by an indexing wheel which shall positively locked by the periphery of the operating cam except during the actual time of tap – change operation. The operating cam shall be freely mounted on its shafts, rotation being imparted to it by means of tension springs attached radially between the operating cam hub and the periphery of a concentric spring carrying gear wheel. The spring carrying gear wheel shall be rotated by a driving motor through cam. When the drive pin on the operating cam enters the slot in the indexing wheel the lock shall disengaged but rotation shall be prevented by the bcking arm pawl engaging in other slot of indexing wheels. The spring carrying gear wheel continuous to rotate thus charging the springs. When sufficient energy has been stored a trip pin on the gear wheel shall lift the rocking arm restrng the indexing wheel and the spring energy shall be released to move the tap selector switch one position the cam locking coming in operation accurately controlling the angular movement.

The operation of the selector switch shall be thus the positively assured and shall be dependent only upon the quick release of the spring energy. It shall be thus independent of the motor drive. The tap changing sequence shall now complete and the driving motor shall brought to rest by the resetting of auxiliary switches and mechanical friction device. For protective purpose automatic declutching by shear pins shall be incorporated in the drive. The mechanism shall be provided with the auxiliary switches necessary for its operation. A step by step switch for position indication shall also be fitted and additional paralleling & out of step switches provided. A tap change mechanical counter, mechanical tap position indicator, mechanical end stops and electrical limit switch shall be provided. A detachable handle for hand operation shall be provided. The fittings of this handle shall automatically disconnects the motor drive shaft by the operation of a simply spring loaded dog clutch and at the same time isolates the electrical control supply.

### **3.6 BARRIER BOARD**

The connections from the transformer winding shall be taken through an insulating terminal barrier board, which shall be supplied loose for the clamping to the transformer port flange. Thus the transformer shall be treated and filled with oil before the tap changer is fitted. This arrangement allows the tap selector switch contacts to be inspected or the complete tap changer to be handled separately without disturbing the oil level in the transformer.

### **3.7 LOCAL CONTROL GEAR**

The motor reversing contactors and associated local control gear shall be housed in the same compartment as the driving mechanism with a common hinged weather proof door. Weather proof local control switches when required shall be mounted in an accessible position below the door.

### **3.8 OPERATION MECHANISM**

An impulse is received either from a remote control panel or from a local manual operation switch, which energizes the appropriate raise/lower contactor to initiate a tap changer in the required direction. The contactor when energized seals itself via its own contact and the driving motor commences to run. At a predetermined point a directional sequence switch closes, taking over the handling duties of the contactor whose original hold circuit shall be isolated. At the completion of the tap changer the directional sequence switch opens and de-energizes the driving motor. The arrangement ensures that a short period initiating pulse shall be accepted by the control gear.

### **3.9 CONTROL CABLE TERMINATION**

A detachable undrilled gland plate and the terminal station for all the external connections shall be provided in the driving mechanism compartment of the tap changer.

### **3.10 AUTOMATIC VOLTAGE REGULATOR**

Solid state automatic voltage regulator shall be provided for the regulation of the secondary voltage of the power transformer with on load tap changer (OLTC). The band width control shall allow the dead band to be set in the terms of upper (LOWER VOLTS) and lower (RAISE VOLTS) voltage limit around a particular nominal value with a specified sensitivity. AVR shall be provided with time delay control to allow the regulator to respond only to voltage fluctuations lasting for period greater than a selected time delay. Where the voltage correction requires more than one tap change, the time delay shall be reinitiated before further tap changes. Regulations shall reset automatically after voltage correction. Solid state lamps (LED) shall be provided to indicate voltage outside the preset limit & control relay operation.

### **3.11 RTCC PANEL**

RTCC panel shall be provided to operate OLTC from control room located in substation. RTCC shall be provided with main switch, a sequence selector switch. RTCC shall be provided with lower push button & raise push button, tap change in progress & complete. A.C supply ON/OFF lamp indicator & AVR relay operated operation indication. Cubical panel shall be totally enclosed, floor mounting and fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness. All the sheet steel work forming the exterior of RTCC panel shall be smoothly finished and all steel work used in construction of RTCC panel shall undergo a rigorous metal treatment process consisting of effective cleaning by hot alkaline degreasing solution followed by the cold water rinsing, pickling in dilute sulphuric acid to remove scales and rust formation, a recognized phosphating process, passivating in deoxidize to retain & augment the effects of phosphating, drying with compressed air and dust free atmosphere, primer coating with two coats of highly corrosion resistant primer applied under strictly controlled conditions and finished coat of stoving synthetic enameled paint of grey color.

#### **4.0 Battery charger:**

The battery charger panel of 110 V DC with SMF batteries of suitable ampere hour (AH) rating with all necessary control etc to be provided for HT panel.

#### **5.0 Double Pole Structure:**

Supply, erection testing and commissioning of two pole structure with suitable SMB structure with ISA bracing etc suitable for installing AB switches, lightning arrester, drop out fuses etc as per requirement of state electricity board. This includes supply of above items with pin/ disc insulators etc as per the requirements of State Electricity Board.

Copper earthing, GI plate earthing, 33KV433V danger notice plate, Rubber mat, Fire bucket, Shock treatment chart, First Aid box, Fire extinguishers, Hand gloves etc are also in the scope.

#### **6.0 DATA MANUAL AND DRAWINGS TO BE FURNISHED BY THE TENDERER:**

The successful tenderer would be required to submit the following drawings with in 15 days of award of work for approval before commencement of installation:

- a) General arrangement drawings of equipment like HT panel, transformers
- b) Details of foundations for the equipments and the weight of assembled equipments.

- c) Cable layout between HT panel board and transformers & LT panel etc.
- d) Any other drawings necessary for the job.

## **6.1 INSTRUMENTATION MANUL**

The successful bidder shall submit three copies of manual of complete instructions for the installations, operations, maintenance including preventive maintenance 7 trouble shooting together with all the relevant data sheets, spare part catalogue etc.

## **7.0 INSPECTION AND TESTING:**

All major equipments i.e. HT Panel, transformers, HT cables shall be offered for initial inspection at manufacturer's works before dispatch. The successful tenderer shall give advance notice of minimum two weeks regarding the dates proposed for such tests to the HSCC. The equipment will be inspected at the manufacturer's premises, before dispatch to site. The testing of equipments will be done based on BIS/ CPWD requirements.

Copies of all documents of routine and type test certificates of the equipment, carried out at the manufacturer's premises shall be furnished to the Engineer-in-charge.

After completion of work in all respects the contractor shall offer the installation for testing and operation.

## **8.0 COMPLIANCE WITH REGULATIONS AND INDIAN STANDARDS:**

All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:

- i) Indian Electricity Rules
- ii) B.I.S. and CPWD standards as applicable
- iii) Workmen's compensation Act
- iv) Statutory norms prescribed by local bodies, Power supply company, CEA etc.

After completion of the installation, the same shall be offered for inspection by the representative of Central electricity Authority/ state Electricity Authority as the case may be. The Contractor will extend all help including test facilities to the representative of the Authority. The observations of the Authority will be attended by the Contractor. The installation will be commissioned only after getting clearance from Authority.

Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable regulations and safety codes.

**9.0 List of Approved manufacturers:**

1. 33 KV VCB Panel Board: Siemens/ Voltas/ Crompton Greaves/ Alsthom/  
Easun./ Areva
2. Transformer: Crompton Greaves/ GEC Alsthom/ Kirloskar/  
Areva
3. 33 KV XLPE Cable: Universal/ NICCO/ CCI/ Incab
4. LT Cables: Universal/ NICCO/ CCI/ Incab/ Rallison/ KEI