4.THE MAIN TANK   
The transformer's outer body is called a tank, which holds the core, windings, and insulating fluid (which is used for insulation and cooling). It's composed of steel. This tank contains the insulating oil that cools and insulates the transformer and serves the primary purpose of shielding the internal components from mechanical harm.

5. OLTC   
OLTC stands for on load tap changer, which is used to adjust the transformer windings' tap position while the transformer is operating. aids in keeping the output voltage steady. It can be controlled manually or by remote tap changer control, or RTCC. In order to modify the output voltage, the winding's number of turns is changed.

6. THE BUCHHOLZ RELAY

The safest method for identifying internal problems in oil-immersed power transformers is the Buchholz relay. It is installed between the conservator and the transformer's main tank. The relay works on the premise that any internal transformer malfunction, like insulation failure or a short circuit, causes gases to be released as a result of transformer oil breaking down. It recognizes an abrupt shift in oil from the transformer main tank to the conservator tank.

7. THE CONSERVATOR TANK

An essential part of oil-immersed power transformers is the conservator tank. It is a cylindrical tank that is partially filled with transformer oil and is positioned above the main transformer tank. Its main purpose is to allow the transformer oil to expand and contract as a result of temperature changes that occur during operation. Excess oil enters the conservator tank as it heats up and expands, then returns to the main tank when it cools and compresses. By keeping the oil level and pressure steady, this method helps avoid spills and the creation of vacuums. Additionally, a breather (silica gel unit) is attached to the conservator tank to remove moisture from the air entering the tank and maintain the oil's insulating qualities.

1. THE BREATHER   
   The transformer's conservator tank is attached to the breather. It is used for air inhalation and exhalation. Because of the silica gel it contains, moisture from the air entering the conservator tank is absorbed. When the silica gel is soaked with moisture, it turns from blue to pink. Its goal is to prevent contamination of the oil and guarantee that moisture-free air enters the transformer.
2. BUSHING

Current-carrying wires can safely travel through the transformer tank without coming into touch with it thanks to bushings, which are insulated devices. They are filled with insulation and composed of composite or porcelain. Its purpose is to provide electrical insulation between the earthed transformer tank and the.

live conductor, as well as to link LV and HV lines to the transformer windings.

* + 1. **CT, CVT, and PT instrument transformers**

The purpose of the current transformer (CT) is   
High current in a power system can be measured by stepping it down to a lower, quantifiable value using a Current Transformer (CT). Additionally, it supplies protective relays with input for fault detection.  **Function:**

Produces low secondary current (usually 1 A or 5 A) from high line current (in kA).   
CT ratio of 132KV: Accessible The modified version of 1200-800/1-1-1 800/1-1-1   
33KV CT ratio: Accessible 100/1-1-1 is the modified version of 400-200-100-50/1-1-1.   
contributes to:

Relays for ammeter protection (such as differential and overcurrent) Energy meters   
  
guarantees that high-voltage wires and measuring devices are electrically isolated.   
Position within the Substation:   
Installed on: 132 kV feeders; transformers' LV and HV sides; 33 kV outgoing feeders; and capacitor banks   
Building:   
consists of a magnetic core, secondary windings (to meters or protective devices), and a primary winding (high current line).   
Substation Importance:   
• Essential for system safety, management, and monitoring; • Makes safe current measurement possible; • Turns on protection systems during malfunctions

1. **Potential Transformer (PT):** PTs are used to reduce high voltage in the power system to a measured, lower voltage that is safe for protection and metering devices, typically 63.5 V.

**Function:** Produces a proportionately low voltage, such as 110V, from a high voltage, like as 132kV or 33kV.   
132KV: There is 132kv/sqrt available. The adjusted value for root 3 is 110/sqrt. Root 3 33KV: 33000/sqrt is available. Root 3: Adapted: 110/square foot. Third Root   
provides voltage signals to energy meters, protection relays (such as over-voltage and under-voltage), voltage meters, and measuring/control devices. It also offers electrical isolation between high-voltage lines.   
Positioning in the Substation: Parallel to the Bus (either line-to-line or line-to-ground)   
Substation Importance:   
• Provides inputs to protective relays for system safety; permits precise voltage monitoring.

**3.Capacitive Voltage Transformers (CVTs):**

In high-voltage substations, a CVT is a type of voltage transformer that steps down extremely high voltages (such as 132 kV) to low, measurable voltages (such as 110 V) for communication, protection, and metering.

The primary functions include:

1. Voltage measurement, which supplies protection relays, energy meters, and voltmeters with low-voltage signals (such as 110 V).   
2. Carrier Communication: High-frequency signals are coupled to the transmission line to enable Power Line Carrier Communication (PLCC).   
3. Isolation: This technique electrically separates high-voltage connections from control and protective equipment.

Construction:

A CVT is made up of the following parts:  
• Capacitor Divider: This device uses a number of capacitors to reduce voltage.   
  
The electromagnetic unit further reduces voltage and supplies output to the secondary. The intermediate inductor and tuning circuit are used to resonate and balance voltage.   
High-frequency communication signals are prevented from entering the substation by the Wave Trap, which is coupled to the CVT in the PLCC.   
Benefits of CVTs:   
• Compact and appropriate for EHV substations;

• Economical for high-voltage systems (in contrast to electromagnetic PTs);

• Allows for long-distance protection and control via PLCC

**3.2.3. Circuit Breakers (CBs):** During failures such short circuits, overloads, or equipment failure, a Circuit Breaker (CB), a high-voltage switching device, immediately stops current flow. It guarantees the substation's and the power system's security and safety.  
Key Roles:  
Turning the circuit on and off in both normal and abnormal circumstances; swiftly cutting off fault currents to avoid damaging equipment; and isolating problematic system components to keep the power supply in

**Protection schematic diagram:**

Components:

SF gas or vacuum as the arc quenching medium; contacts, both stationary and movable, that open and close the circuit   
  
Protection relays control the trip coil and close coil. The operating mechanism is either spring- or motor-operated.   
Substation importance: • Prevents significant equipment damage during malfunctions; • Facilitates safe maintenance by separating problematic areas   
• Guarantees the power supply's dependability and continuity

**3.2.4. Arrestors for Lighting:**   
In substations, a Lightning Arrester (LA) is a protection device that shields equipment from high-voltage surges brought on by switching or lightning strikes. It transfers surge energy to the ground in a safe manner.

Principal Role:

• Guards against overvoltages in power system components (transformers, circuit breakers, CTs, and PTs).   
  
It prevents insulation breakage by diverting transient high voltages to ground. It also automatically resets once the surge has passed (non-disruptive protection).   
It is constructed using metal oxide varistors (MOVs), usually zinc oxide.   
Encased in a housing made of ceramic or polymer; featuring gapless design in more recent models or spark gaps in previous models   
Concept of Operation:   
Normal circumstances: fails to conduct, functioning as an open circuit.   
Throughout a surge: turns conductive, sending surge current to the ground.

**Surge monitor:**  
  
• Charger failure, undervoltage, and overvoltage alerts.   
  
Information   
  
• Manufacturer: Amara Raja   
  
The voltage is 220V.   
  
Rated at 220V, 10A FC, and 16A FCBC

Batteries Used Types:

• Lead acid

• Maintenance-free VRLA (Valve Regulated Lead Acid)   
  
• Ni-Cd (for settings with high temperatures)

At 132kv ss pithapuram ,we use lead acid bateries.

**3.4.3. The DCDB (Direct Current Distribution Board)**

Transfers DC that is received from the battery set or charger to:  
Panels of controls   
  
Protection relays

MCBs or fuses installed for branch circuit protection

announcement systems

CB coils that trip and close.

Contemporary DCDBs offer:   
• Status indicators on LEDs   
• Remote monitoring; modular design

**3.5. C&R (Control and Relay) Panels**   
For system control, monitoring, and protection, C&R panels are crucial.  
There are control and relay panels specifically for each circuit (feeder or transformer).   
  
There are two types of feeder control and relay panels:

132kV and 33kV.   
• Control and Relay Panels for PTR (132/33kV Transformer)   
• We are able to supply the C&R panel with both AC and DC power.   
Essential Roles:   
Detection and isolation of faults; SCADA integration; switching control (CB trip/close); and real-time monitoring

Components include:

digital meters; an announcement panel   
  
Switches with push buttons; TNC switch for CB trip/close control; voltage and current Phase selector switches: To monitor the voltage and current of a certain phase.   
• Energy meter: To determine MWH and MVARH   
• Master trip relay circuit; • Backup relay; • Distance protection relay; • Test block: To use test kits to check the operation of relays.   
Multi-function meters (MFMs) are used to show the following: active power in MW, reactive power in MVAR, voltage in kilovolts, and current in amps.   
  
**3.5.1. Relay Panel & Feeder Control 132kV**   
Both control and relays are housed in a single 132kv feeder panel.

ANNUNCIATION PANEL 132KV:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DISTANCE PROTN. OPTD. | PSB/BRC ALARAM | VT FUSE FAILURE ALARAM | OVER VOLTAGE PROTN. OPTD. | DIR. OVER CURRENT PROTN. OPTD. | DIR. EARTH FAULT PROTN. OPTD. |
| MAIN RELAY FAULTY  (REL 650) | 3-PH  MASTER TRIP  RELAY FAULTY | BACK UP RELAY FAULTY  (REF 615) | CB SF6 GAS LOW PR.  ALARAM | 3-PH MASTER TRIP RELAY OPTD. | AC MCB TRIP |
| CB SF6 GAS  PR. LOCK OUT | CARRIER FAIL  OUT OF SERVICE | LBB PROTN. OPTD. | DIRECT TRIP RECEIVED | UNDER VOLTAGE RELAY OPTD. | DC MCB TRIP |
| CB TC-1  FAULTY | CB TC-2  FAULTY | LBB TRIP RELAY FAULTY | SPARE | ANNUN. DC FAIL | ANNUN. AC FAIL |

The 132kv feeder defects and alarms are listed in the above table. The buttons on the announcement panel are as follows:  
There are three buttons:

ANNUN reset

ANNUN lamp test

ANNUN DC fail

ANNUN DC fail reset.

|  |  |
| --- | --- |
|  |  |

**3.5.2. Twin Feeder Panel at 33kV**   
Two 33KV feeders and a 33KV control and relay panel can be accommodated by the 33KV feeder twin feeder panel.   
  
• One of our five 33kv feeders is the Chirala feeder, one is the Vetapalem feeder, one is the ILTD feeder, one is the Parchur feeder, and one is the Uppugunduru feeder.

**ANNUNCIATION PANEL 33KV**

|  |  |
| --- | --- |
| FDR-1 O/C PROTN OPERATED | FDR-1 E/F PROTN OPERATED |
| FDR-1 PROTN RELAY UNHEALTHY | UPPUGUNDURU RU FEEDER TRIPPED |
| FDR-1 ANNOUNCIATOR AC FAIL | FDR-1 ANNOUNCIATOR DC FAIL |

switch with a push button

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accept | Rest | Func Test | Lamp Test | mute |

**3.5.3. 132/33 kV PTR Panel**   
Typically, a control panel and a relay panel are supplied for every PTR.   
PTR control panel   
  
PTR relay panel

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| LV CB TROUBLE | HV-OVER CURRENT PROTN.OPTD. | HV-EARTH FAULT PROTN.OPTD. | UNDER VOLTAGE PROTN.OPTD. | HV OVER FLUXING OPTD. | TRANS. BUCH. ALARM |
| HV- WINDING TEMPERATURE ALARM | LV- WINDING TEMPERATURE ALARM | OIL TEMPERATURE ALARM | LOW OIL LEVEL ALARM | BCHT/HVWDGT LVWDGT | (OTT/PRV)/OLTC BCHT |
| LV OVER FLUXING OPTD. / U/F RELAY OPERATED | HV TC-1/TC-2 FAULTY | LV-OVER CURRENT PROTN.OPERATED | LV-EARTH FAULT PROTN.OPERATED | LV TC-1/TC-2 FAULTY | HV/LV MCB TRIPPED |
| SF6 GAS LOW | 7HV CB TROUBLE | DIFFERENTIAL PROTN.OPERATED | PROTECTION RELAY UNHEALTHY | AC FAIL |  |

Press buttons

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accept | Rest | Func Test | Lamp Test | mute |

This relay panel has a voltage relay for monitoring the voltage of a three-phase supply, a differential trip relay for LV DF/DT trips, and a frequency relay that allows it to measure frequency.

For TRAFO TROBLE FUN (30DEF), TRAFO TROBLE FUN (30GHJ), and TRAFO TROBLE FUN (30KLKM), it can include an aux relay.