SARVAJANIK COLLEGE OF ENGINEERING & TECHNOLOG

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INDUSTRIAL VISIT REPORT

Host Industries:

1. Hitachi Energy India Ltd., Maneja Plant, Vadodara

2. Volta Transformers Ltd., POR Plant, Vadodara

Date of Visit:

11th August, 2025

Visiting Group:

29 Students (3rd & 4th Year – Electrical Engineering)

Faculty Coordinators:

- Prof. Sharad B. Patel
- Prof. Aditi R. Hajari

Institution:

Electrical Engineering Department, Sarvajanik College of Engineering & Technology.

1. OBJECTIVE OF THE VISIT

The industrial visit aimed to enhance the technical knowledge of students in the domain of high-voltage equipment, transformer manufacturing, protection systems, and testing practices. It further aimed to bridge theoretical learning with practical industrial exposure.

2. COMPANY PROFILES

2.1 Hitachi Energy India Ltd. (Maneja Plant)

The Maneja facility was earlier operated by ABB India and transitioned to Hitachi Energy in 2020 after Hitachi acquired ABB's Power Grids business. The plant now focuses on high-voltage equipment above 33 kV including transformers, protection systems, and grid automation technologies.

2.2 Volta Transformers Ltd. (POR Plant)

Volta Transformers Ltd., part of the Pooja Group of Industries, is a Vadodara-based company engaged in manufacturing power and distribution transformers. The POR plant is equipped with facilities for winding, assembly, and rigorous testing of transformers as per IS/IEC standards.

3. ITINERARY

Time	Activity
07:00 hrs	Departure from Surat
10:15 hrs	Arrival at Hitachi Energy, Maneja
10:30 – 13:00 hrs	Safety briefing, virtual orientation, and Training Centre walkthrough
13:00 – 13:45 hrs	Lunch break
14:00 hrs	Arrival at Volta Transformers, POR plant
14:00 – 16:30 hrs	Factory floor visit – materials, winding, assembly, testing
16:30 hrs	Departure from Vadodara

4. VISIT OBSERVATIONS

4.1 Hitachi Energy, Maneja

The visit to **Hitachi Energy's Maneja facility** began with a **comprehensive safety briefing** conducted by the site coordinators. Since this plant deals with **high-voltage equipment (above 33 kV)**, strict adherence to industrial safety standards is critical. The session covered electrical hazards, restricted areas, the importance of personal protective equipment (PPE), and behavioral protocols within high-voltage installations.

Following the safety session, students were escorted to the **Training and Experience Centre (TEC)**, which is designed to provide practical demonstrations of grid equipment in a controlled learning environment. Due to operational safety concerns, access to the live factory floor was not granted; however, the TEC offered technical exposure through real-scale cross-sections and models:

- **Power Generator Cross-Section**: Students observed the **stator windings, rotor assembly, and insulation layers** of a synchronous generator. This helped visualize how mechanical energy is converted into electrical energy and how insulation and cooling systems are integrated into generator design.
- **Current Transformers (CTs) and Potential Transformers (PTs)**: The working principle of instrument transformers was explained, particularly their role in **scaling down high currents and voltages** to measurable levels for metering and protection. Different construction types of CTs and PTs were also discussed, along with insulation requirements in high-voltage systems.
- **Switchgear and Protection Equipment**: Demonstrations were provided on **circuit breakers, isolators, and relays**. The role of protective relaying schemes (overcurrent, differential, and distance protection) was explained, highlighting their function in fault isolation and maintaining grid stability.
- **Virtual Orientation of HVDC Systems**: The session included an overview of **High Voltage Direct Current (HVDC) transmission technology**, one of Hitachi Energy's flagship domains. The importance of HVDC for **long-distance bulk power transfer**.

This segment of the visit provided **conceptual clarity on power system building blocks**, as well as exposure to global practices in **grid modernization, automation, and digital protection systems**.

4.2 Volta Transformers, POR Plant

The afternoon session at **Volta Transformers' POR plant** provided a contrasting experience, offering **direct hands-on exposure** to the transformer manufacturing process. Unlike Hitachi's virtual orientation, students were taken to the factory floor, where various stages of transformer construction and testing were observed.

a) Raw Material Stores:

The visit began with an introduction to the **stores section**, where critical raw materials are stocked. Students were familiarized with:

- **Insulation Paper & Pressboard**: Used to insulate windings and prevent short-circuits between turns. Different grades of Kraft and Nomex paper were shown.
- **Bushings**: High-voltage bushings made of porcelain/composite materials, designed to safely carry conductors through transformer tanks without electrical breakdown.
- **Conductors**: Copper and aluminum conductors (strip and wire) were displayed, including their insulation coatings.
- **Valves, Gaskets, and Ancillary Hardware**: Used in transformer oil circulation, sealing, and maintenance.

b) On-Load Tap Changer (OLTC) Mechanism:

A detailed demonstration of an **OLTC** was provided. The mechanism enables variation of the transformer's turns ratio under load, thus regulating the output voltage without interrupting supply. The **selector switches, diverter switches, and transition resistors** were explained, along with their importance in **grid voltage stability**.

c) Winding Fabrication and Electromagnetic Design:

Students observed the **winding process** carried out on specialized machines.

- The differences between **cylindrical, helical, and disc windings** were explained in relation to current rating, mechanical strength, and short-circuit withstand capacity.
- The concept of **magnetic circuits** (flux path in the transformer core) and **electrical circuits** (series/parallel connection of windings) was described, showing how both must be balanced to ensure efficiency and reliability.

d) Transformer Assembly and Fitting:

The assembly line included:

- Core assembly (laminated CRGOS steel sheets).
- Mounting of LV and HV windings onto the core limbs.
- Fitting of tank and ancillary components (radiators, bushings, OLTC, and cooling fans). Students observed the precision required in insulation placement and oil-tight sealing to ensure dielectric reliability.

e) Testing Section:

Before dispatch, every transformer undergoes **routine and type tests** to confirm performance and safety. Students observed and were briefed on:

- **Turns Ratio Test**: Verifying the designed voltage ratio between primary and secondary windings.

- **Insulation Resistance (Megger) Test**: Measuring the insulation integrity of windings, ensuring dielectric safety.
- **Buchholz Relay Demonstration**: Operation of the gas-actuated relay for oil-filled transformers, used to detect incipient faults like insulation breakdown or short circuits. The relay's ability to generate an alarm and trip the circuit during severe faults was explained.

This practical exposure helped students correlate **design theory with manufacturing practice**, gaining an understanding of the **end-to-end transformer production cycle**.

5. KEY LEARNINGS

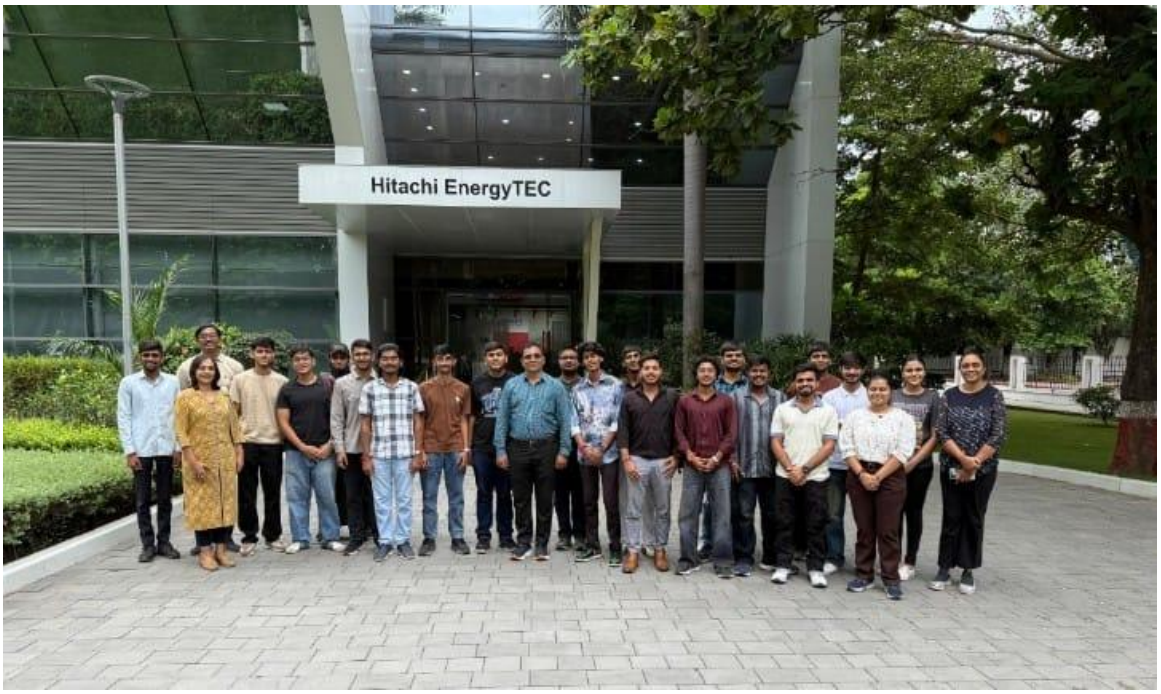
1. Importance of safety in high-voltage environments.
2. Practical exposure to transformer components and processes.
3. Understanding OLTC and winding methods in transformer manufacturing.
4. Knowledge of standard testing procedures prior to commissioning.
5. Comparative exposure to advanced grid technologies (Hitachi) and hands-on manufacturing (Volta).

6. CONCLUSION

The visit provided students with a comprehensive overview of the power industry. Hitachi Energy presented advanced grid and protection technologies through its Training Centre, while Volta Transformers allowed students to observe and understand transformer manufacturing and testing at the factory floor. Together, these visits enriched academic learning with valuable industrial exposure.

7. PHOTOGRAPHS

7.1 Hitachi Energy India Ltd., Maneja



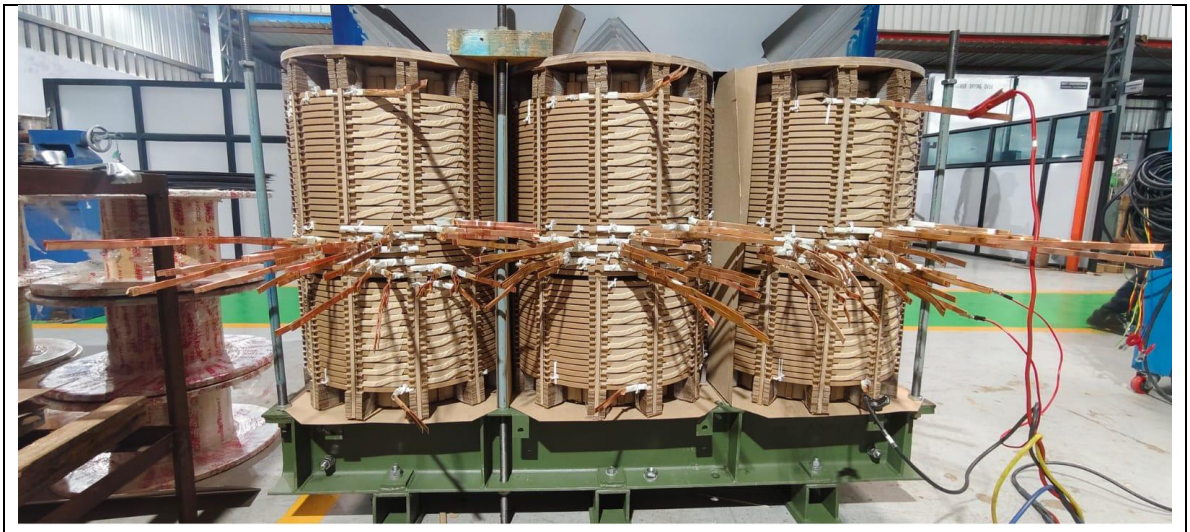
Group Photo

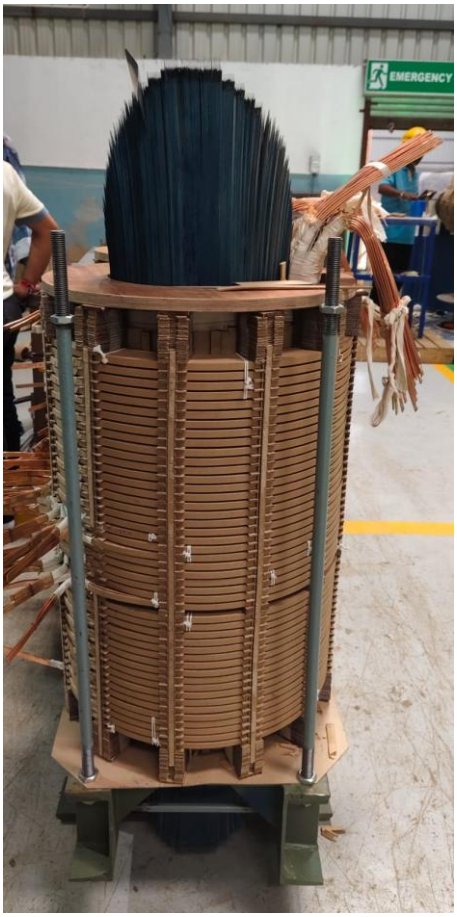
Switchyard Componets

7.2 Volta Transformers, POR Plant

Group Photo

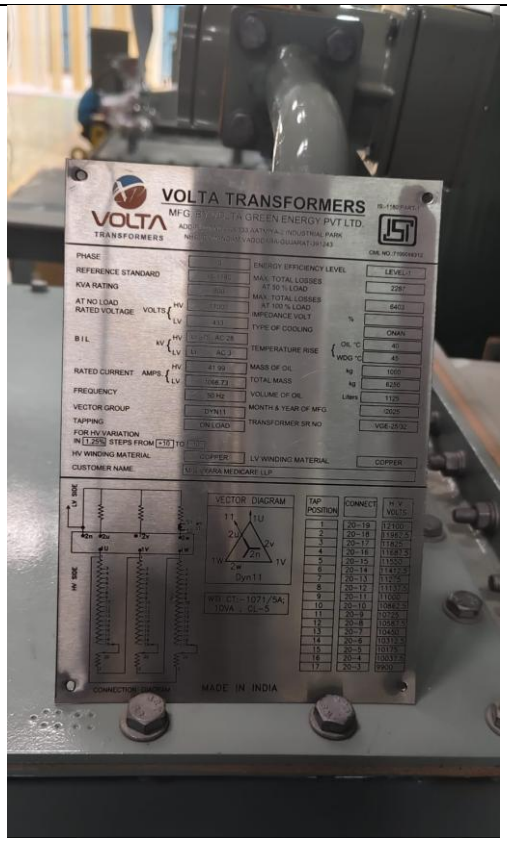
Transformer Testing Panels



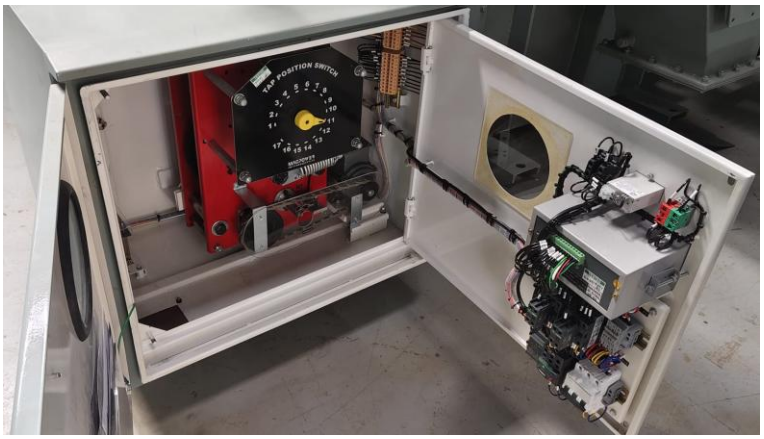


Final Transformer Assembly

Buchholz Relay



11 kV/433 V Transformer Nameplate



On-Load Tap Changer (OLTC) Mechanism