ORGANIZER

India Smart Grid Forum

KNOWLEDGE PARTNER

Power Foundation of India

DISTRIBUTION UTILITY MEET DUM 2025

SESSION PARTNERS

Power Foundation of India

AIDA Collaboration | Innovation | Excellence

SESSION

EMERGING CHALLENGES FOR DISCOMS

GW-scale AI DATA CENTERS, MW-scale EV CHARGING STATIONS, and GRID-level POWER QUALITY CHALLENGES Underground and High Rise Substations

Presented By

Chintamani Chitnis, Chief- Distribution Services, The Tata Power Co.Ltd

TATA POWER SUSTAINABLE IS ATTAINABLE

Distribution Utility Meet | 04 - 05 November 2025 | www.dumindia.in

CONTEXT

- Utility Challenges in urban cities: **Space Availability & High Density of Load**

Unorganized Constructions

Exponential Load growth with vertical expansions (as floors increase)

High land cost- builders try to reduce space for utilities

Solution –Underground Substations / Higher Level Substations

Global Study for going Underground

Installations Types

Dubai-Indoor Substations

Tokyo- **Basement** Substation, underground

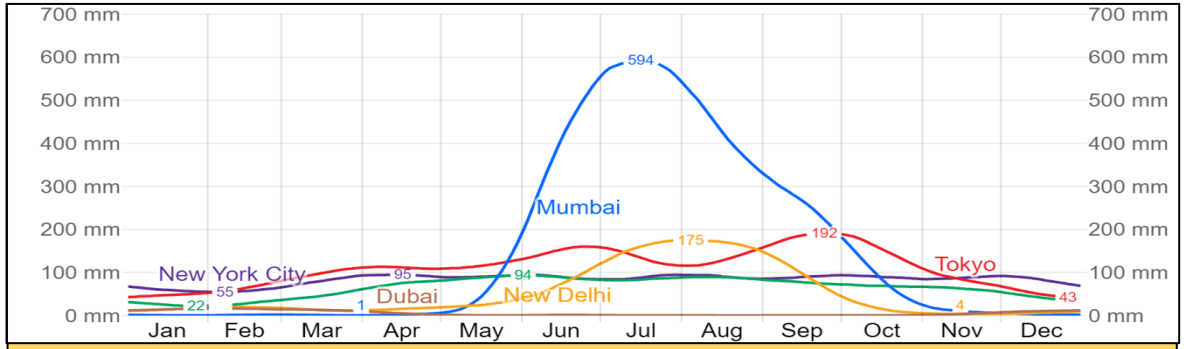
New York- Separate prefabricated Vault for Switchgear and transformers underground

India- Indoor and Outdoor mix

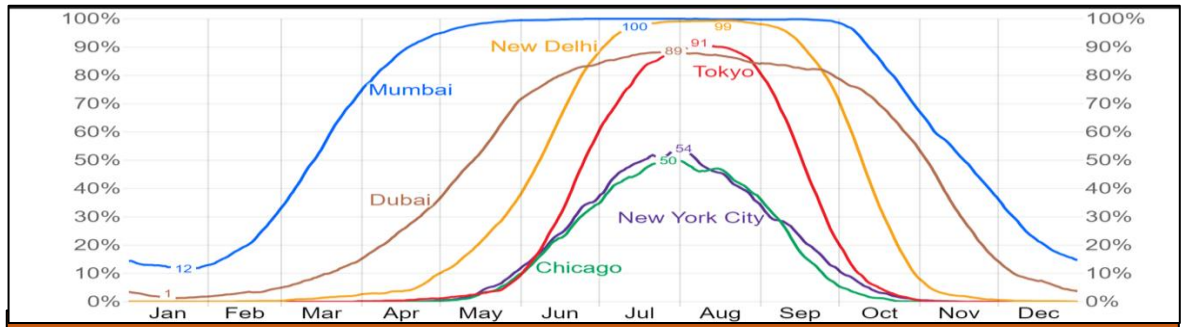
Globally only one standard talks about submersion duty transformer i.e. IEEE/ ANSI C57.12.24

The weather conditions, ambient temperature, design parameters differs for India

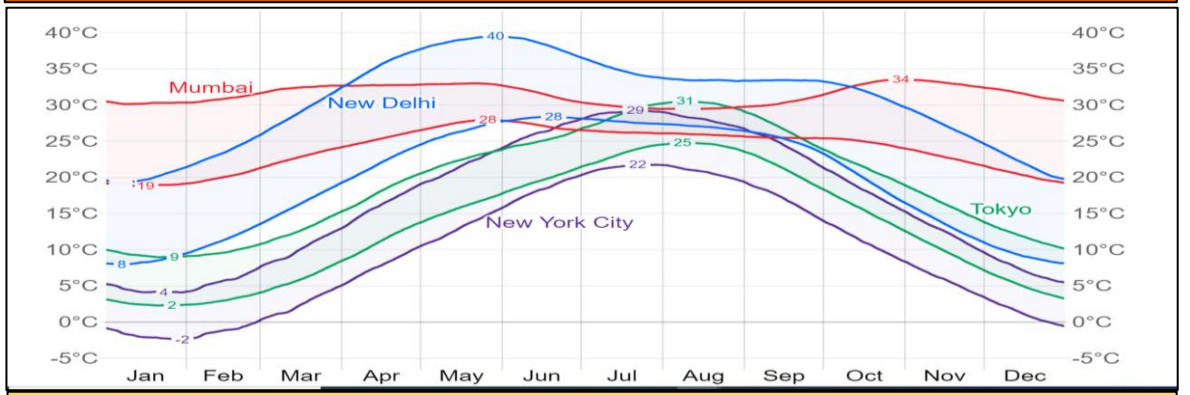
Could not adapt ANSI standards due change of network parameters, technical and operational challenges considered in standardization



Average Monthly Rainfall

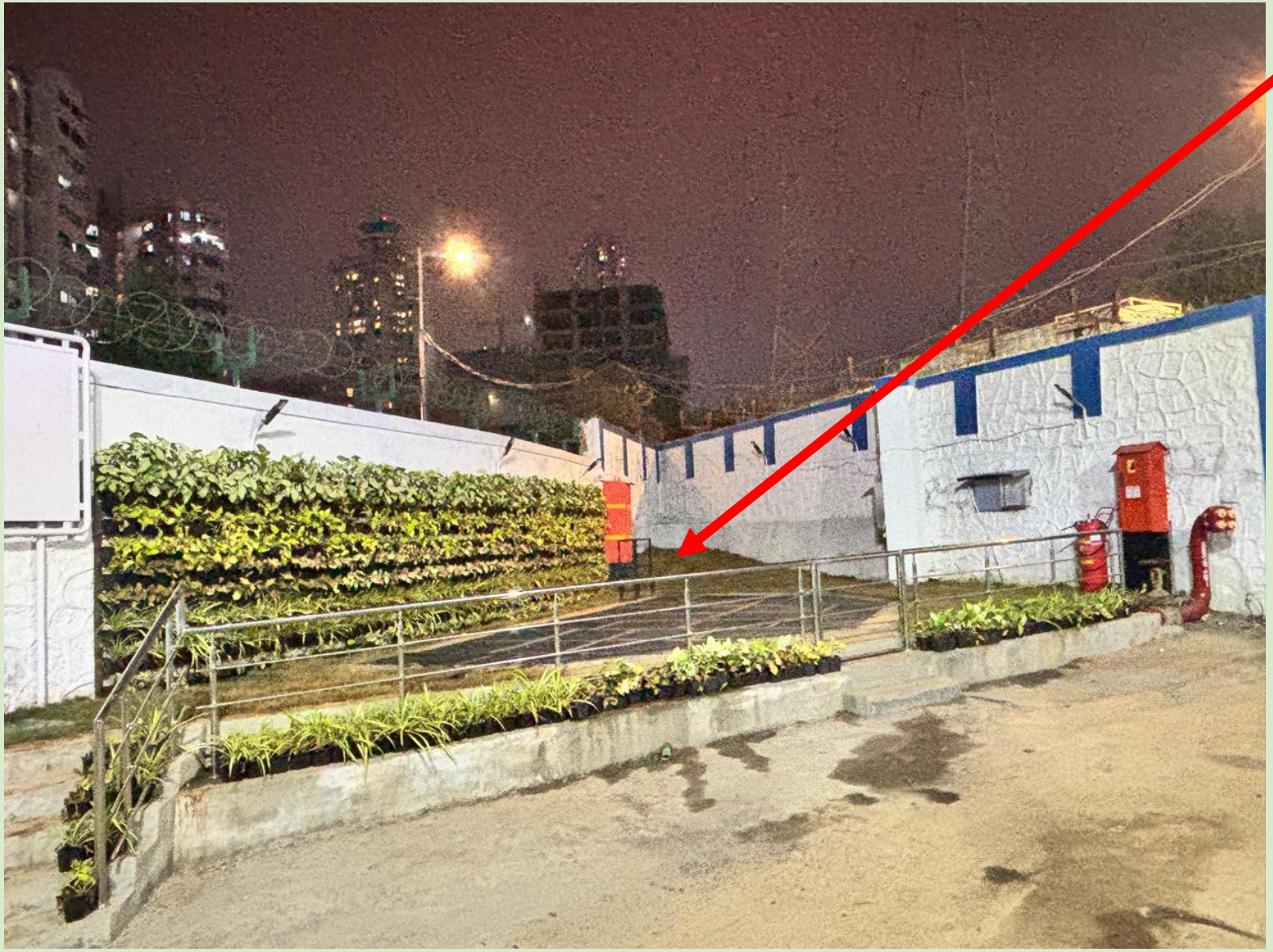


Chance of Humid Conditions



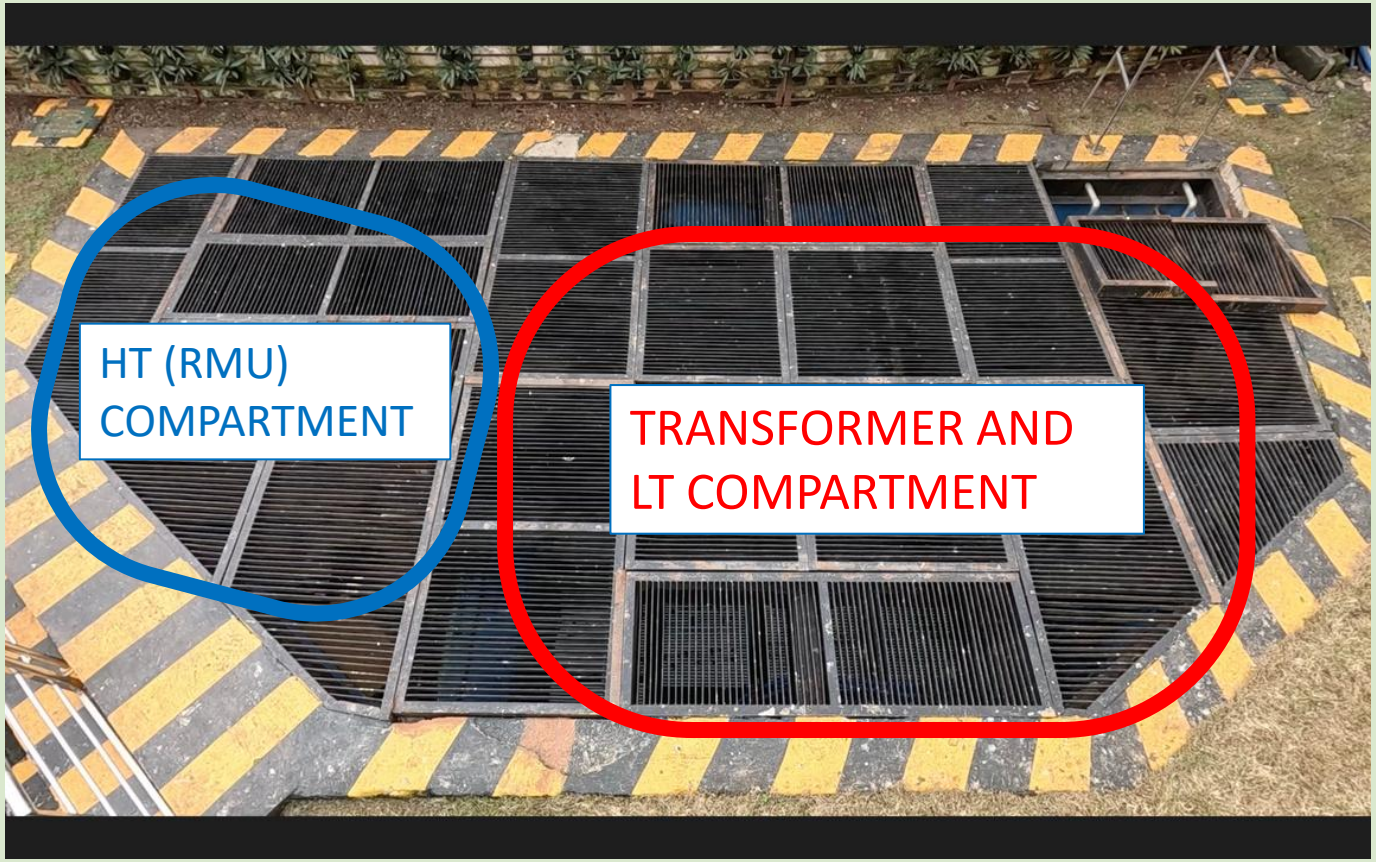
Average High and Low Temperature

IMPLEMENTED SOLUTION



UG SS SOLUTION DETAILS AND RATINGS

22 kV / 433 V, 400 kVA Submersible Substation



1. RoW Area Utilised for Sub station below ground: 38.5 Sq. meters (Virtually zero space installation)
2. Vault Capacity: 80000 Litres
3. Sump Pump Installed for Flushing Water Out of Sub Station Vault
4. CCTV, sensors installed for 24x7 Monitoring.
5. Fast acting protection.
6. Substation Designed as per CEA (Measures relating to Safety and Electric Supply)

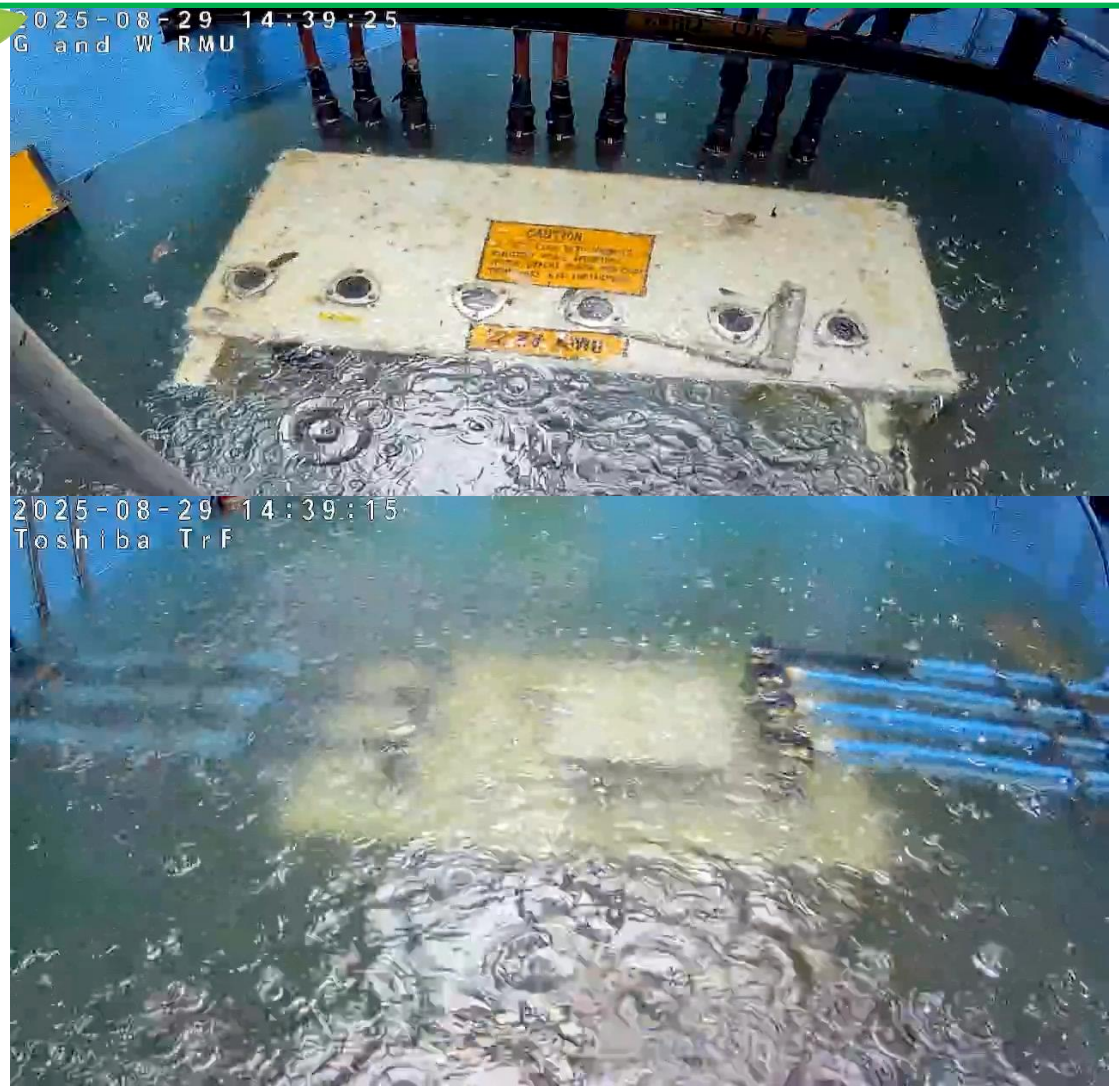
UNDERGROUND SWITCHGEAR (RMU) COMPARTMENT

1. Submersible RMU
2. Voltage Rating: 27 kV
3. Current Rating: 630 A
4. Short Circuit Rating: 25 kA for 1 Sec
5. Submersion Rating of RMU : IP 68.
6. Submersible VCB Relay is installed.
7. Touchproof and Submersible IP 68 rated HT Cable Connectors
8. Viewing window for ensuring disconnector operation.

UNDERGROUND SUBSTATION TRANSFORMER AND LT COMPARTMENT

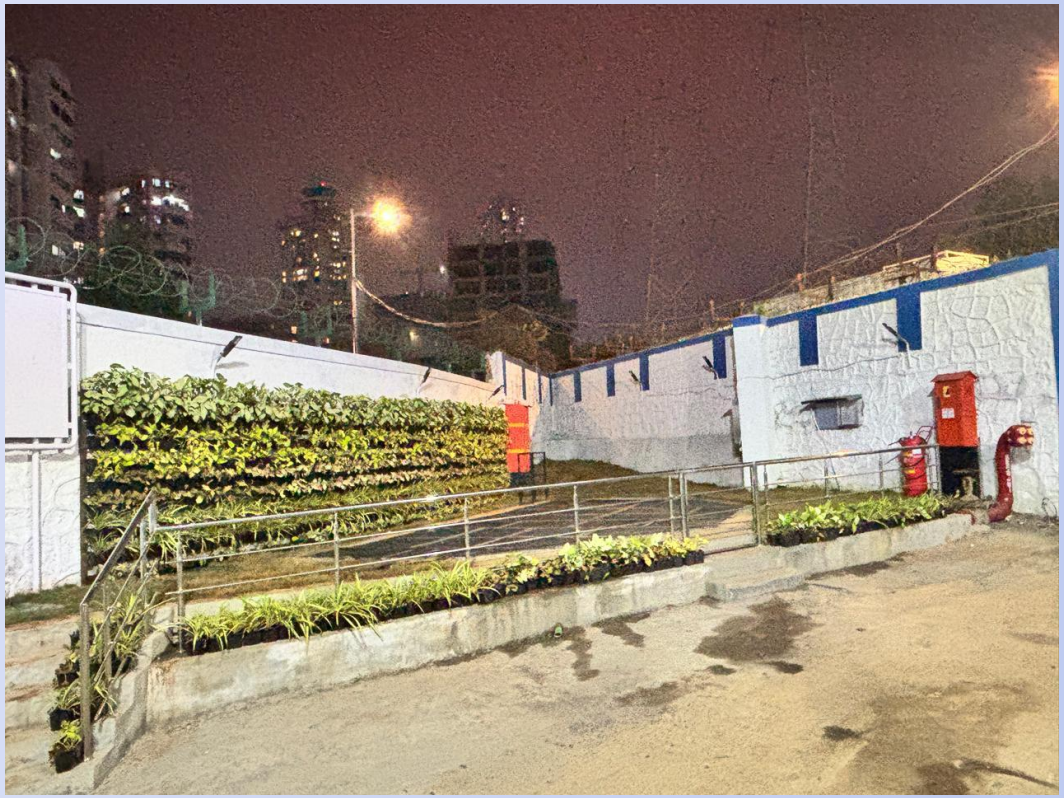
1. Hermetically Sealed Easter (FR3) Oil Filled Submersion Duty Transformer (Indigenous Design) Compliant with IEEE/ ANSI C57.12.24
2. Rating: 22 kV / 433 V, 400 kVA
3. Submersion Rating: IP 68
4. Losses as per IS 1180 and designed as per IS 2026.
5. Touchproof and Submersible LT Cable Connectors

Solution- Substation with submersible equipment



All Equipment's have been operating for the last 10 months at times fully submerged without any issues -Successful operation in heavy rainfall has been witnesses

BENEFITS OF UNDERGROUND SUBSTATIONS



Space Optimization

Can be installed below Park, Parking areas and RoW (Right of way in transmission lines).

Enhanced Safety and Reliability

Fully enclosed, touch proof IP 68 rated equipment,
Reduces risk of electrical hazards and fires.

Environment Sustainability

Ester oil provides eco-friendly insulation, reduces carbon footprint.

Operational Efficiency

Zero Maintenance – equipment sealed for life.

Lifecycle and Cost Benefits

Lower land acquisition costs.
Suitable for retrofit in high-value urban land areas.

Noise and Aesthetic Advantage

All equipment enclosed underground resulting in silent operation with no visual clutter.

Power Supply to High Rise Buildings

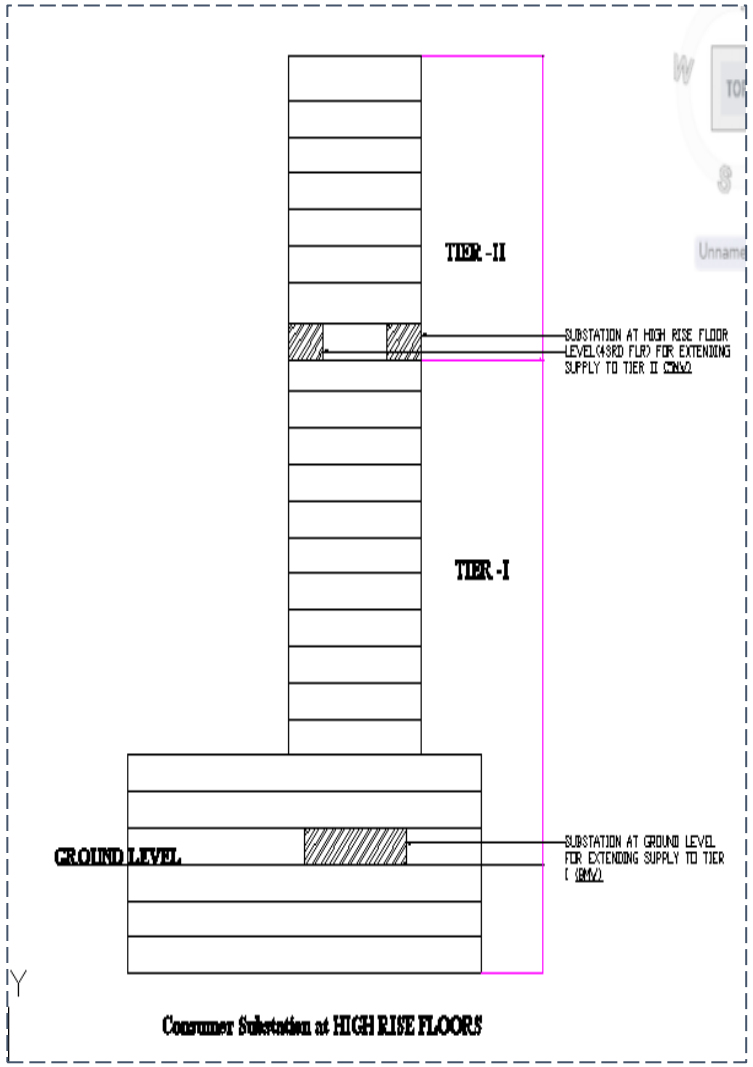
Design

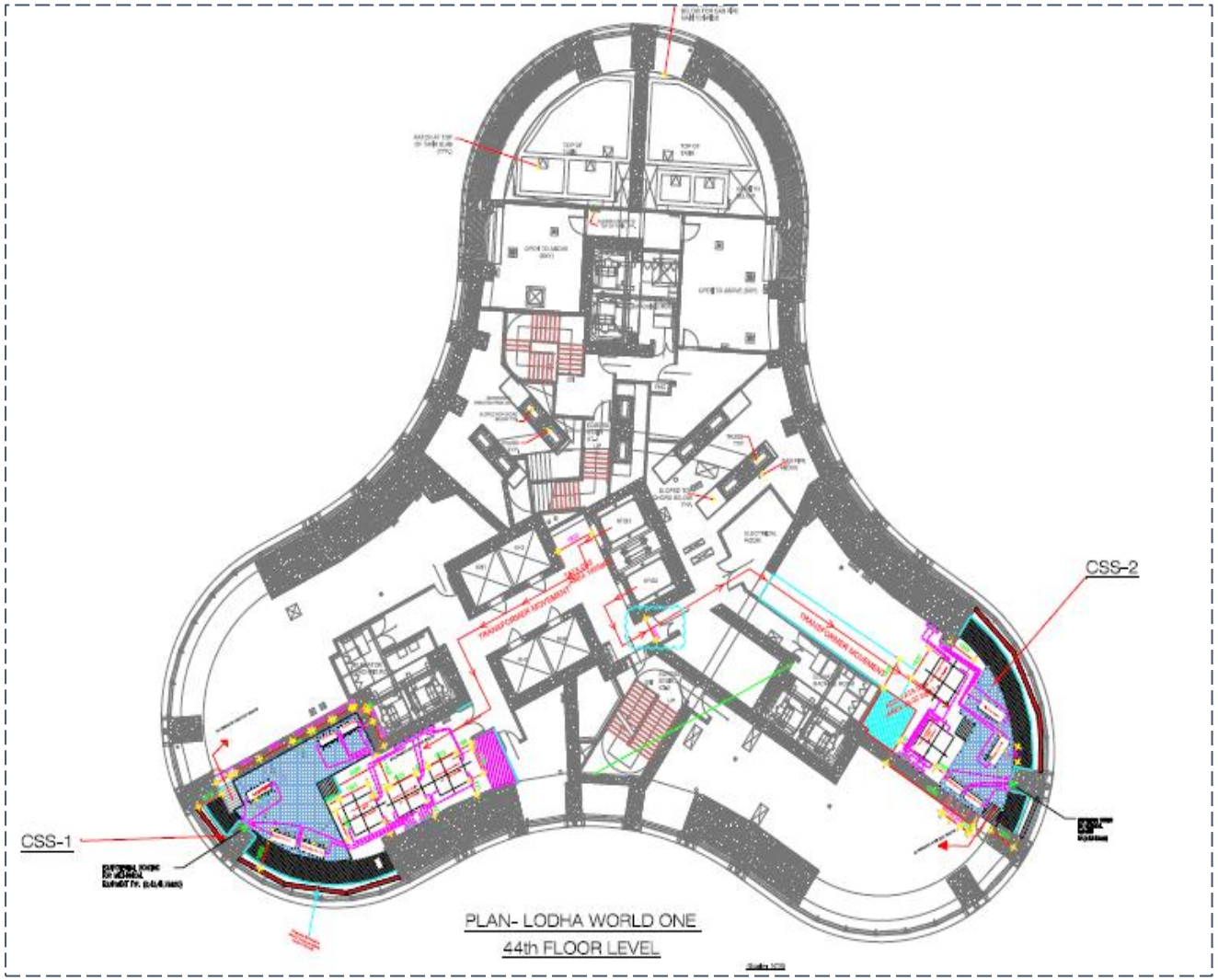
- **TIER wise** Multi Floor Substation near load center.
- HT, LT network extension **along vertical shaft.**
- **Structural & Civil design** of substation at Multi Floor level.
- **Earthing** for Multi Floor Substation.
- **Electrical Inspector** Approval.

Substation installed at 44th floor.

Distribution Levels: TIER - II : 44th to 79th Floor

Unique Design Aspects





India's First Multifloor substation in Mumbai @ 44th Floor

Unique Design Aspects

Customized size of transformer as per location constraint

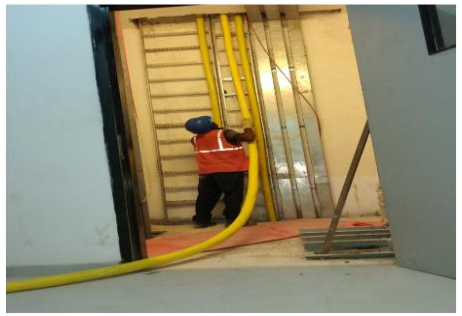
- **Unique design of transformer with delivery in two parts (Core & Enclosure)**
- **Assembling at 44th floor substation**

Non-availability of service lift

- **Usage of Tower Crane in Two Stages (Stage 1 : P0 to P6, Stage 2 : P6 – P44)**
- **Design & arrangement of structural landing platform**

Cable Laying & Safety Procedures

- **Brainstorming with safety experts**
- **HIRA / JSA**
- **Special Tools Training**



Implemented First time in India as protecting earthing for Multifloor substation in Mumbai @ 44th Floor

Pile Type Earthing

KEY TAKEAWAYS / RECOMMENDATIONS

Advocacy with BIS for formation of new Standards

Our proposal for formation of new standard for submersible distribution transformer has been considered by Bureau of Indian Standards (BIS) ETD 16 Committee. Primary Draft of new standard framed and circulated for comments

Document Number	Document Title	Doc Type	Document Stage
ETD 16 (27293)	Outdoorindoor Type Liquid Immersed Distribution Transformers Upto and Including 2500 Kva 33 Kv Specification Part 5 Submersible Duty Transformers with Naturalsynthetic Organic Ester Liquid Immersed	New Standard	P-Draft

Draft Indian Standard

OUTDOOR/INDOOR TYPE LIQUID IMMERSED DISTRIBUTION TRANSFORMERS UPTO AND INCLUDING 2500 kVA, 33 kV — SPECIFICATION
PART 5 Submersible Duty Transformers with NATURAL/SYNTHETIC ORGANIC ESTER LIQUID IMMERSED

1. **SCOPE**

This standard specifies the requirements and tests including standard loss levels of natural/synthetic organic ester liquid immersed, natural air-cooled, outdoor/indoor type, double-wound distribution transformers for use in power distribution systems with nominal system voltages up to and including 33 kV and of following types and ratings:

a) Three phase ratings higher than 200 kVA, up to and including 2 500 kVA sealed type; and

This standard permits use of natural esters as well as synthetic organic esters in sealed type of transformers.

There is need for changes in regulations and standards with lesser clearances for the new product innovations and relaxation in regulations for adopting new solutions.

ORGANIZER

India Smart Grid Forum

KNOWLEDGE PARTNER

Power Foundation of India

DISTRIBUTION UTILITY MEET DUM 2025

SESSION PARTNERS

Power Foundation of India

AIDA Collaboration | Innovation | Excellence

THANK YOU

TATA POWER SUSTAINABLE IS ATTAINABLE

For discussions/suggestions/queries email: ***dum@indiasmartgrid.org***

www.dumindia.in

Links/References (If any)