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Session : BUILDING RESILIENT UTILITY ASSETS FOR CONGESTED CITIES AND CLIMATE RESILIENCE

Presented By

Gajanan S Kale, CEO, Tata Power Delhi Distribution Ltd.

Impact of Climate change on Distribution Sector

Major Climatic Changes	Types	Impact on Distribution Network
 **EXTREME WEATHER EVENTS**	**Storms / Cyclones, floods**	▪ Damage Distribution infrastructure, including poles, wires, substations, and distribution transformers ▪ Service disruptions and outages
 **TEMPERATURE EXTREMES**	**Higher ambient temperature during heatwaves**	▪ Strain power distribution equipment, increase electricity demand for cooling, and lead to thermal stress on assets ▪ Reduce the capacity and efficiency of power distribution equipment, such as transformers and switchgear ▪ Lead to de-rating, increased maintenance requirements, and decreased reliability of the power grid during periods of high demand

Addressing climate change threats through

- Risk Assessment
- Robust Engineering design
- Grid modernization
- Improved Emergency Response
- Adequate Investment in Resilient System

Risk to Distribution network in Odisha due to Cyclones

Cyclones impacting Odisha in the past			
Name of Cyclone	Occurrence	Severity Class	Peak Wind Speed (kmph)
Dana	Oct, 2024	Severe Cyclone	110
Remal	May, 2024	Severe Cyclone	110
Sitrang	Oct, 2022	Tropical Storm	88
Asani	May, 2022	Severe Cyclonic Storm	100
Jawad	Dec, 2021	Cyclonic Storm	100
Gulab	Sept, 2021	Severe Cyclone	95
Yaas	May, 2021	Very Severe Cyclonic Storm	140
Amphan	May, 2020	Super Cyclonic Storm	120
Bulbul	Nov, 2019	Very Severe Cyclonic Storm	110
Fani	May, 2019	Extremely Severe Cyclonic Storm	200 – 215
Titli	Oct, 2018	Very Severe Cyclonic Storm	60 - 80
Phailin	Oct, 2014	Extremely Severe Cyclonic Storm	214
Hudhud	Oct, 2013	Extremely Severe Cyclonic Storm	180 – 190
Super Cyclone	Oct, 1999	Extremely Severe Cyclonic Storm	260 – 270

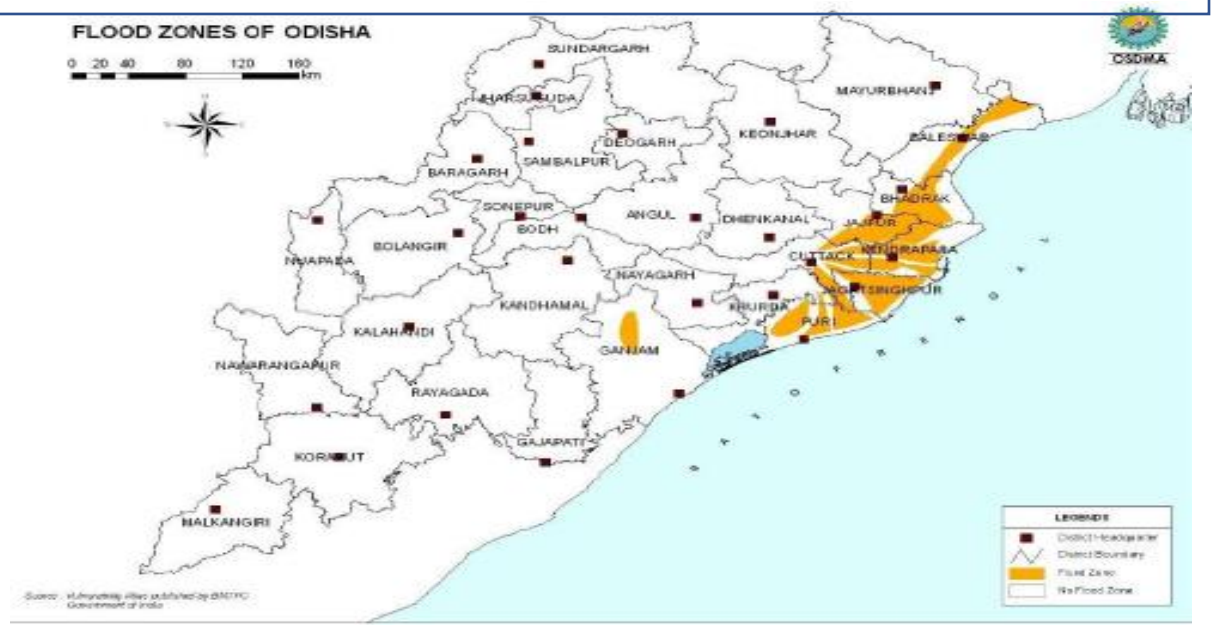
The impact of Cyclones & Floods brought into focus the need for disaster and climate resilient power infrastructure systems in Odisha

Infrastructure Redesign for Flood Protection

9 major river systems and their tributaries and distributaries

Heavy to very heavy rainfall in different parts of the Odisha State

- All districts received substantial rainfall due to Low pressure over Bay of Bengal and active Monsoon
- Heavy rainfall occurred in the upstream catchment area of river system
- Heavy rainfall also in downstream area of river caused flood in several districts in the state



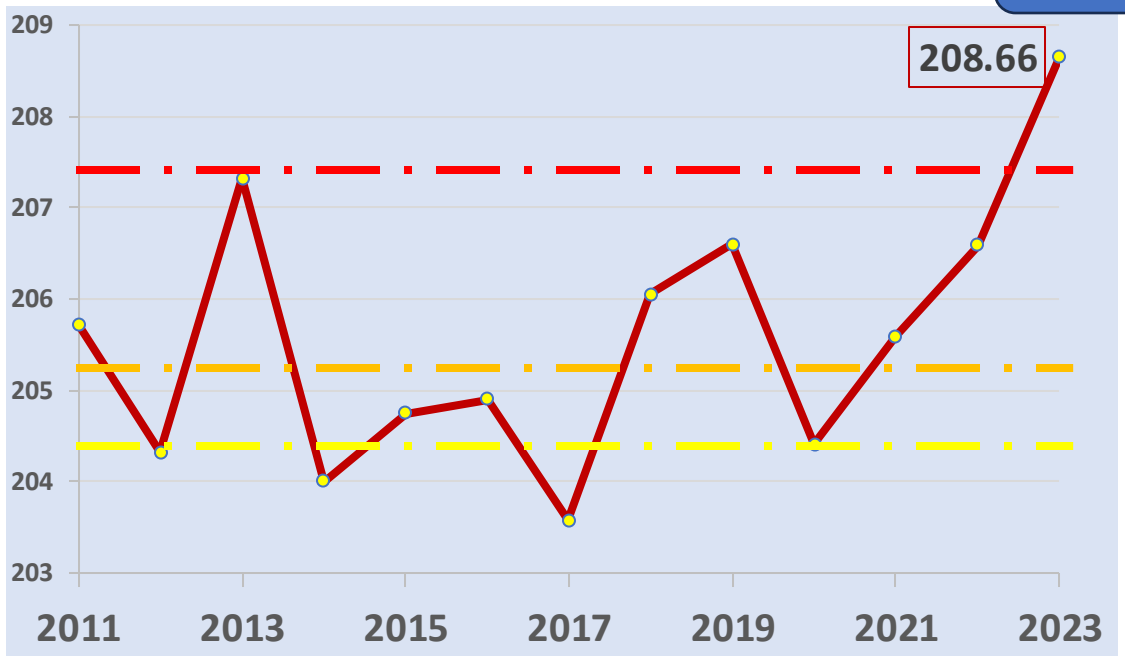
Design Approach

- **Installation of all electrical equipment higher than Higher Flood Level**
- **Distribution Transformers to be installed on elevated plinth**
- **Substation to be constructed above the road level and with proper drainage system**

Delhi on High Alert !

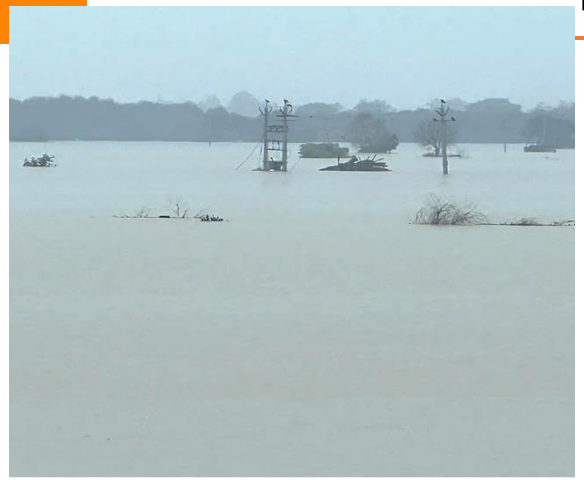
Yamuna Water Level (YoY trend – in meters)

Max level on 13th Jul'23

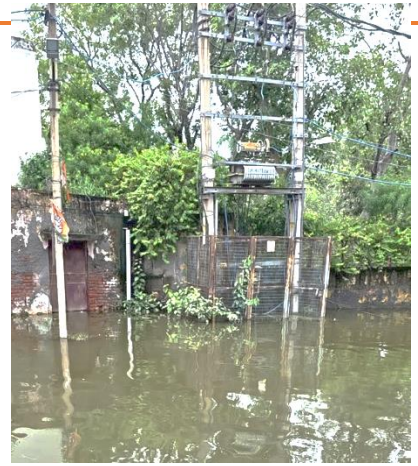


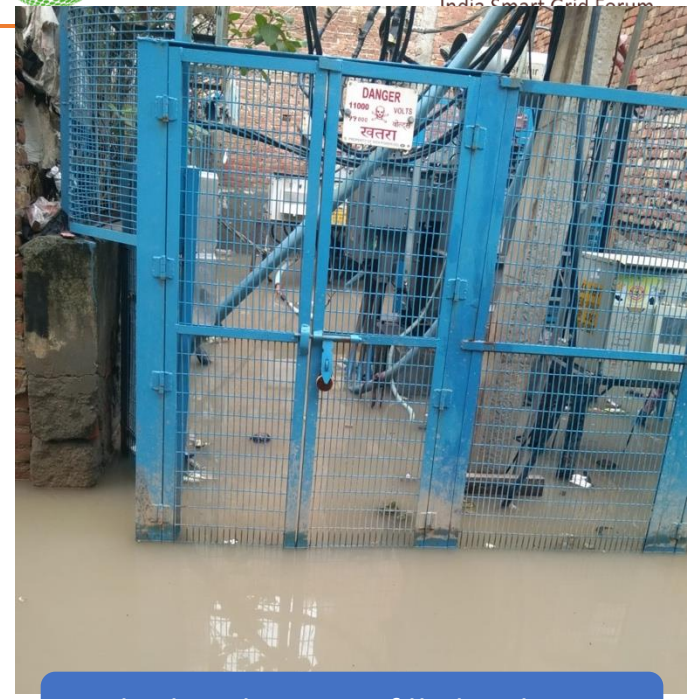
Highest Flood water level crossed in past 12 years

Substations/ equipment filled with flood water



Affected School Premises

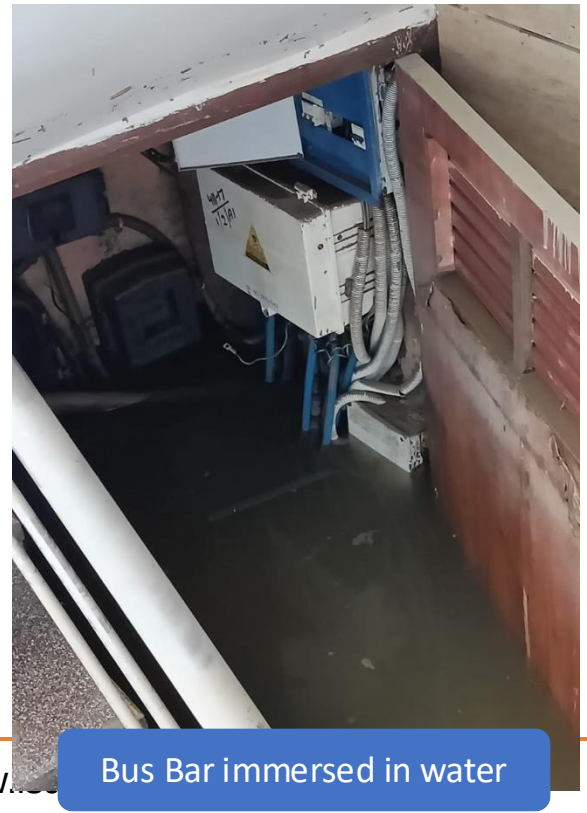




Multiple Substations filled with water

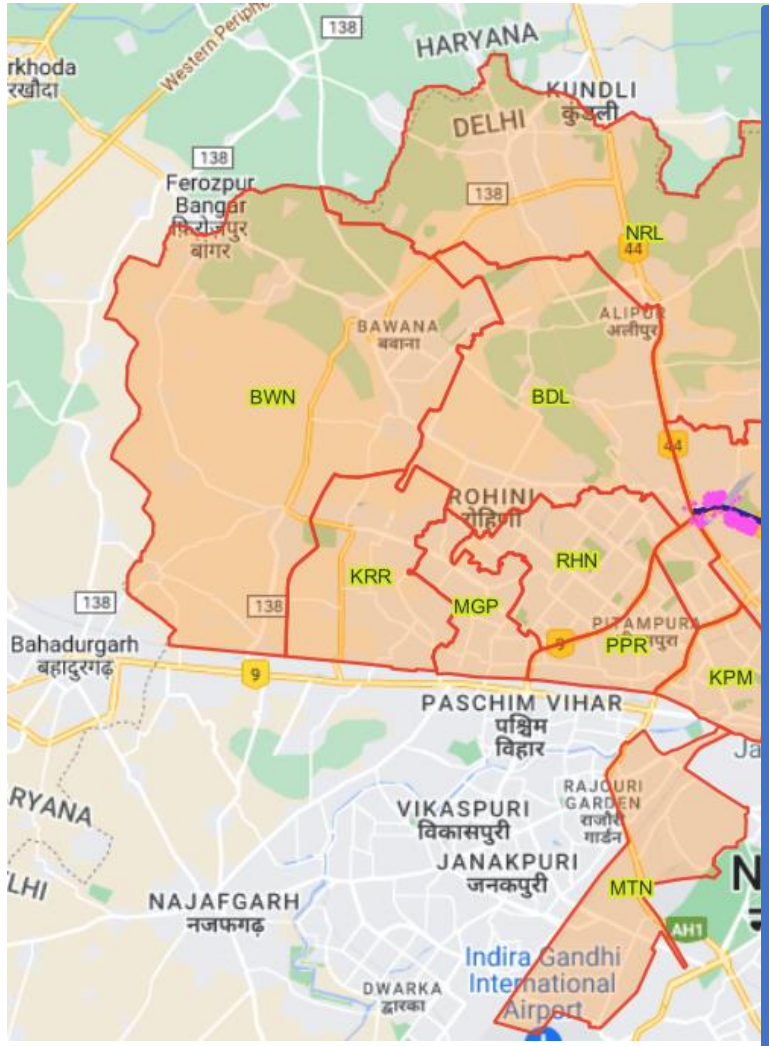
Transformer immersed in water

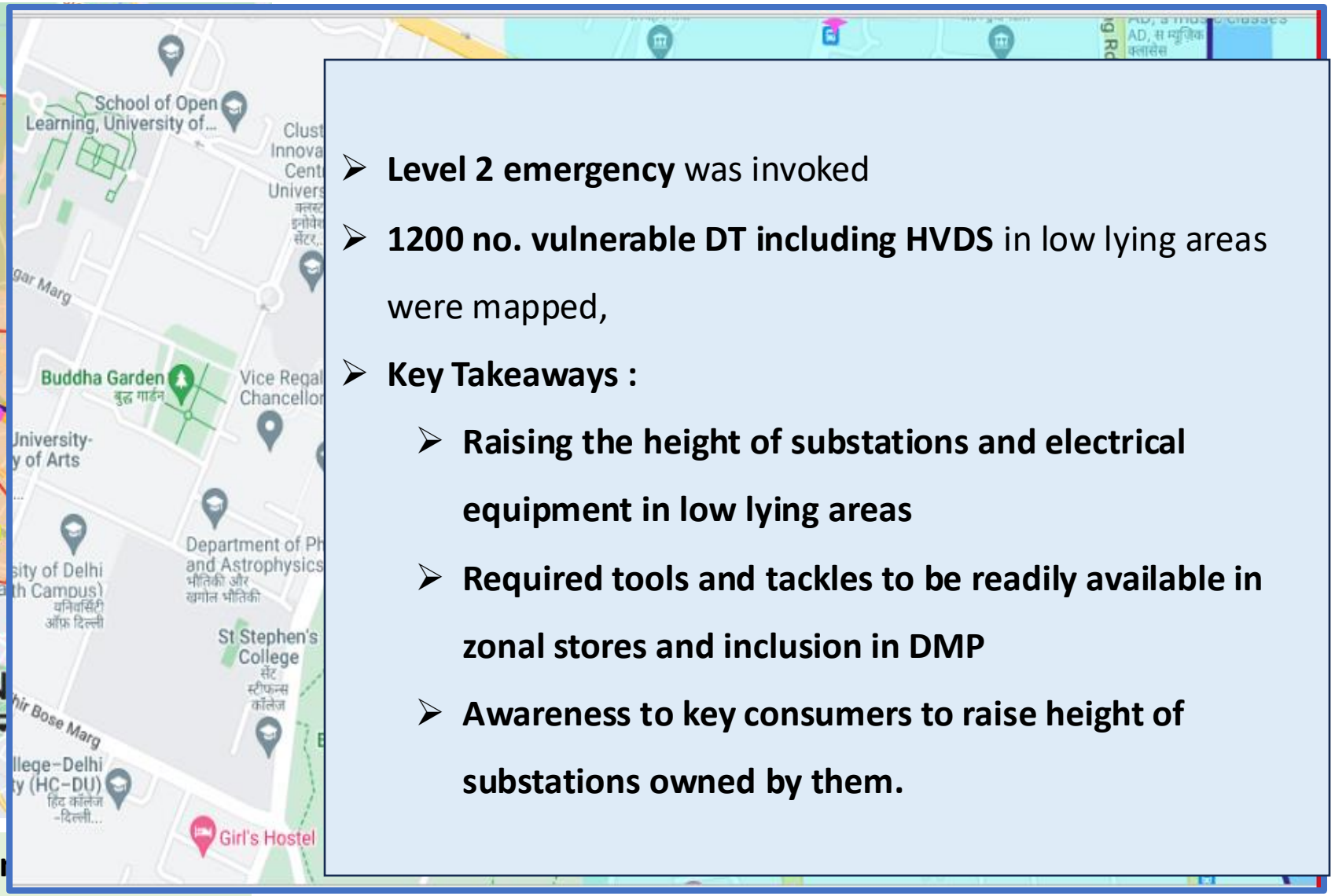
Substation trench filled with water



Bus Bar immersed in water

Proactive Identification of affected areas





- **Level 2 emergency** was invoked
- **1200 no. vulnerable DT including HVDS** in low lying areas were mapped,
- **Key Takeaways :**
  - **Raising the height of substations and electrical equipment in low lying areas**
  - **Required tools and tackles to be readily available in zonal stores and inclusion in DMP**
  - **Awareness to key consumers to raise height of substations owned by them.**

GIS Mapping of Affected Consu
in proximity to Yamuna in TPDDL area

Spun Concrete Pole

Approved by GoO as Cyclone Resilient Pole in FY22 (after Yaas Cyclone)

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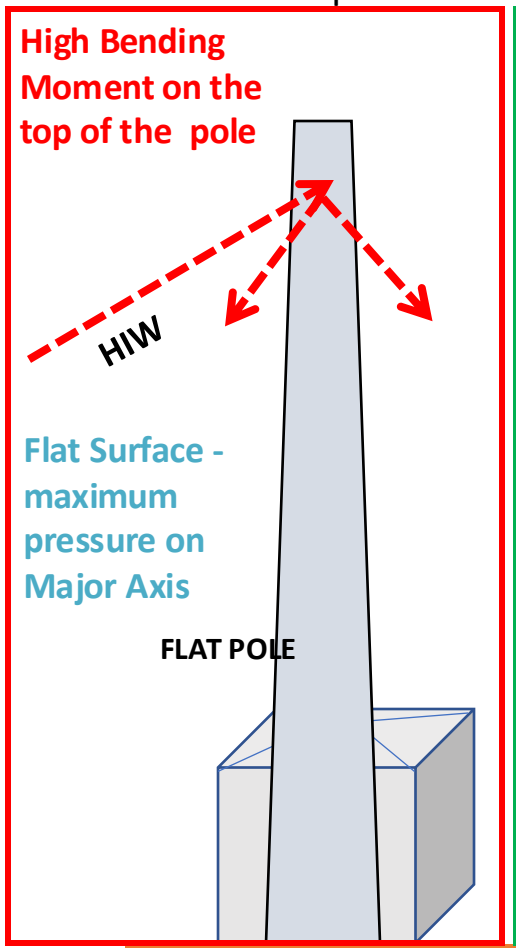
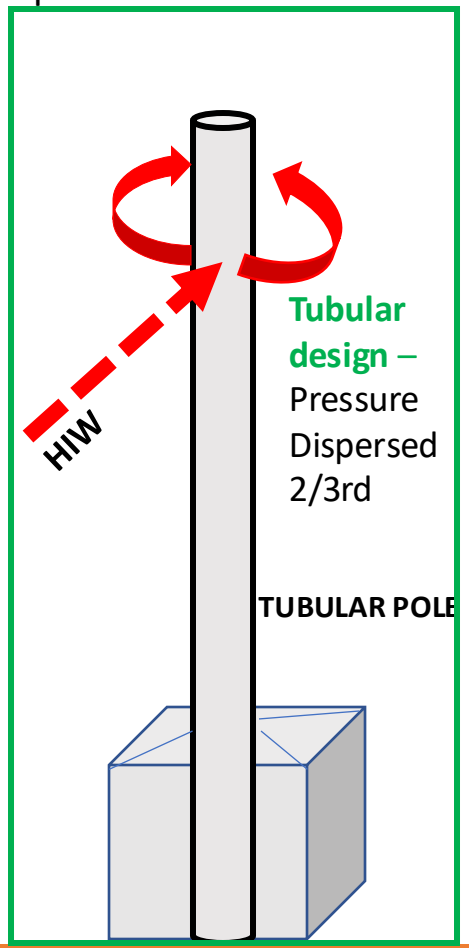
Type Tested in DANA cyclone (Oct 2024)– (wind withstand capacity upto 180 kmph)
Not a single pole was damaged at Cyclone Landfall Areas (Dhamara, Basudevpur)

Conventional RCC pole



Spun Pole



Uniqueness of Spun Pole

- Spinning causes large particles of concrete mix to move towards the outer surface
  - Uniform gradient of strength from inner to the outer surface.
  - **Outer surface resistant to damages/cracks**
- **Circular form - the magnitude of wind forces is 2/3rd Vs. rectangular pole.**

Most economical Cyclone Resilient Pole

1/3rd cost wrt Lattice Structure,
1/6th cost wrt FRP Pole

Spun Pole at Dhamara – Standing Tall in Dana

Rebar Lacing Pole: Cyclone Resilient & Cost Effective

- **Rebar Lacing Pole for 11 & 33 KV lines : A Low Cost** pole which can **withstand winds upto 300Kmph.**
-
- **Type tested at CPRI lab, Bangalore**

- **Design:** Simple design uses a box frame made of ISAs supported by MS rod welded connections from inside. It can be fabricated in one piece or two pieces. Uses suspension insulators.

- **Foundation:** Foundation design can be selected based on soil condition. A prefab STUB will be buried / embedded in foundation & the RLP has detachable bolted connection with the STUB.

- **Composite Insulated Cross Arm (CICA) :** TPCODL has developed low cost Composite Insulated Cross Arm (which will be used on RLP & will help in improving the overall reliability to very high level.

Installation at Puri Konark Marine Drive along coastline

Disaster Preparedness

Ensuring resilience and reliability of the electricity grid during and after natural disasters

Initiatives	Benefits of the initiatives
Backup Power Systems *DG sets at Critical Installations*	▪ Critical electricity supply during outages caused by disasters ▪ Maintain essential services ▪ Support emergency response efforts ▪ Minimize the impact on communities and critical infrastructure
Mobile Substations and Transformers	▪ Rapid restoration of electricity service in affected areas ▪ Quick deployment for replacement of damaged infrastructure ▪ Faster recovery and reducing downtime for customers
Prepositioned Equipment and Supplies	▪ Prepositioning at strategic locations for expedite response and restoration efforts following disasters

- ✓ Building resilience
- ✓ Reducing vulnerability
- ✓ Enhancing reliability
- ✓ Better prepared for response and recovery from disasters
- ✓ Safeguarding critical infrastructure against the impacts of extreme events

Underground Substation

1st time ever installed in India by Tata Power-DDL

- New design developed to install transformer inside a vault below the ground level
- DT manufactured by M/s Toshiba as per the requirement of Tata Power-DDL, having submersible duty (transformer can be in operation even after water ingress inside the vault)
- Suitable for congested areas, and the upper portion can be used for other purpose.

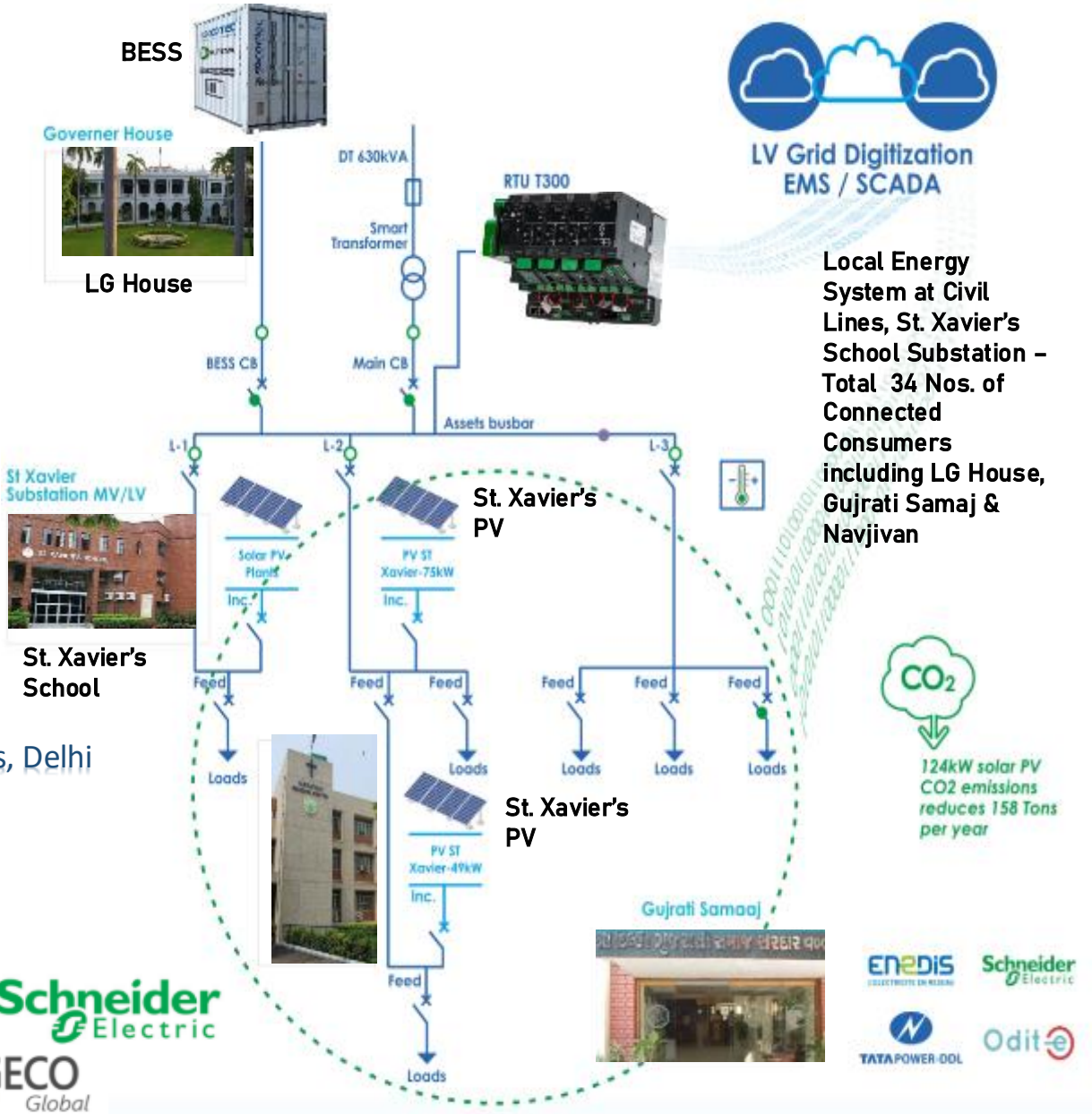
400kVA DT on Single Spun Pole

- Design was developed to install 400 kVA transformer on a spun pole, along with 4 way RMU and ACB
- Suitable for congested areas, the vertical space is utilized to enhance the capacity of the existing sub-station.
- Reduction of space requirement by 50%. Footprint reduction from 24 sq. meter to 12 sq. meter.

Drain Top Substation (up to 1000 kVA)

- Design was developed to install sub-station including RMU, DT and ACBs, to meet up load requirement in unauthorized areas with no space for a sub-station.
- Design has been standardized for similar space constraints areas.
- Virtually NO space is required

IElectrix SHAKTI - Energy Community Microgrid



St. Xavier's School – Civil Lines, Delhi

Objectives

ENERGY STORAGE

To increase renewable energy sources integration and enhance local use of local renewable energy

GRID AUTOMATION

To make power supply more efficient and reliable by digitizing the network and introducing automation

DEMAND RESPONSE

To enable flexibility of the customer's demand and enhance customers' involvement

ISLANDING

To increase the reliability and resilience of the electricity supply

Partners

IElectrix SHAKTI

Location: St. Xavier's School, Civil Lines, Delhi
Customer segments: Residential, Commercial, Schools, Government

Project details and update

- Key features of implemented project-
  - BESS 200 kW/274 kWh
  - MV/LV 630 kVA transformer with On Line Tap Changer
  - LV Energy Control Centre switchboard
  - 3 LV feeders supplying commercial & residential customers
  - Total consumer : 24,
  - Solar capacity of 224 kWp (3 prosumers)

- Used cases demonstrated-
  - Microgrid Operation
  - Congestion and Voltage Management
  - Islanding of Key consumer (School Campus)

- Project Timelines: Mar 2022 to Feb 2023
- Currently other use case of local energy market (Peer to Peer trading) is being pursued for demonstration project

Community Engagement in St. Xavier's School

IELECTRIX team

Undergrounding Distribution Lines

Major cause of damage to overhead distribution lines

Cyclonic wind speed exceed the wind speed for which towers/ poles are designed

Need for Underground Cables

Underground cables eliminates impact of high wind and direct lightning strikes

Overhead lines are preferred to Underground Cables

Ease of operation & maintenance

Ease of identification of faults

Less time for rectification of faults

Less initial cost as compared to underground cable system

UG : 3 to 5 times more estimated cost

Underground cable cost > 3 to 5 times of Overhead lines (for same voltage & distance)

Way Forward

For uninterrupted power supply during cyclone or natural disasters

- 33kV and 11kV lines should be planned for underground cable system within 20km from coast line
- Critical links like hospitals, water supply system may be considered with (N-1) contingency level

Future Roadmap for Resilient Utilities

Strengthen Infrastructure
Using state-of-the-art technology

Invest in Innovation
For next-generation energy solutions

Foster Partnerships
With public and private sectors

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THANK YOU

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Links/References (If any)