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India SMART UTILITY Week 2024

Session : Technical Paper Presentation

Modern Techniques for Managing the Voltage Profile at Customer Side

Presented By

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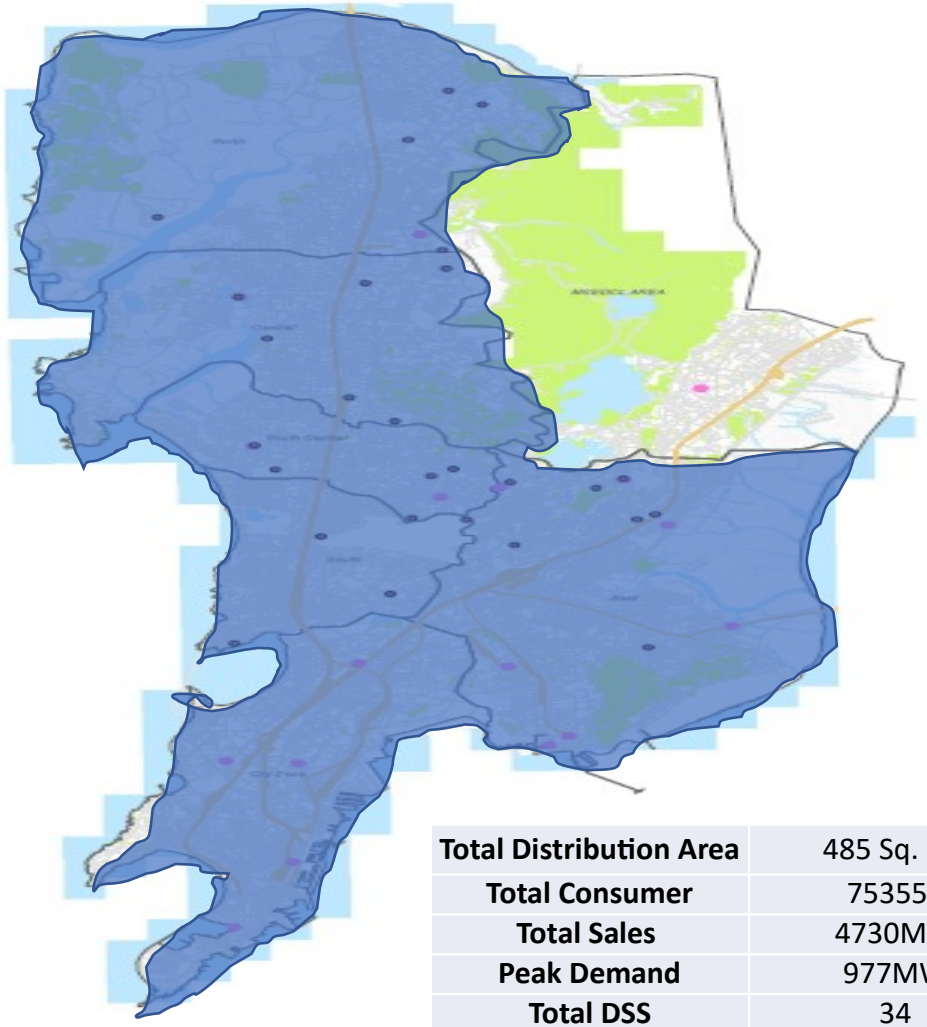
INTRODUCTION

- **Leading Provider:** Tata Power is a prominent electricity solutions provider committed to delivering reliable power.
- **Voltage Levels:** Power distribution includes High Tension (HT) at 11kV, 22kV, and 33kV, and Low Tension (LT), tailored to diverse needs.
- **Objective:** Identify root causes and propose cost-effective solutions to mitigate impact.
- **Goal:** Ensure stability and reliability in electricity supply across varied customer segments.



Total Distribution Area	485 Sq. Km
Total Consumer	753550
Total Sales	4730Mus
Peak Demand	977MW
Total DSS	34
Total CSS	1112
UG HT + EHV (in KM)	2728
UG LT (in KM)	2345

CONTEXT

One of our valued customer operating on 11kV network faced significant challenges during grid fluctuation.

- **Equipment Tripping**:- The dips and sags in the overhead lines have a direct impact on the quality of power supplied to customers.

- **Study on critical drives and PQM Analysis**:- A study revealed that transient voltage dips/sags led to the tripping of critical PLC drives (30kVA 16nos.) at the load end, resulting in operational disruptions.

AVAILABLE SOLUTIONS AND LIMITATIONS

SOLUTION	CHALLENGES
Control the faults at Transmission level	Uncontrollable faults.
Compensators to be installed on HT side (11kV)	Needs to be installed in TPC-D premises, Larger space required Costly
Compensators to be installed on LT side	Requires installation at customer end Additional Space & cost requirement

PROBABLE SOLUTIONS

DVR - Dynamic Voltage Regulator

Use of Active Voltage stabilizer for high-dynamic correction of symmetrical and unbalanced Voltage Dips faced by highly sensitive loads at customer, known as DVR – Dynamic voltage restorer, will be connected in series with the affected load.

Batteryless Online UPS

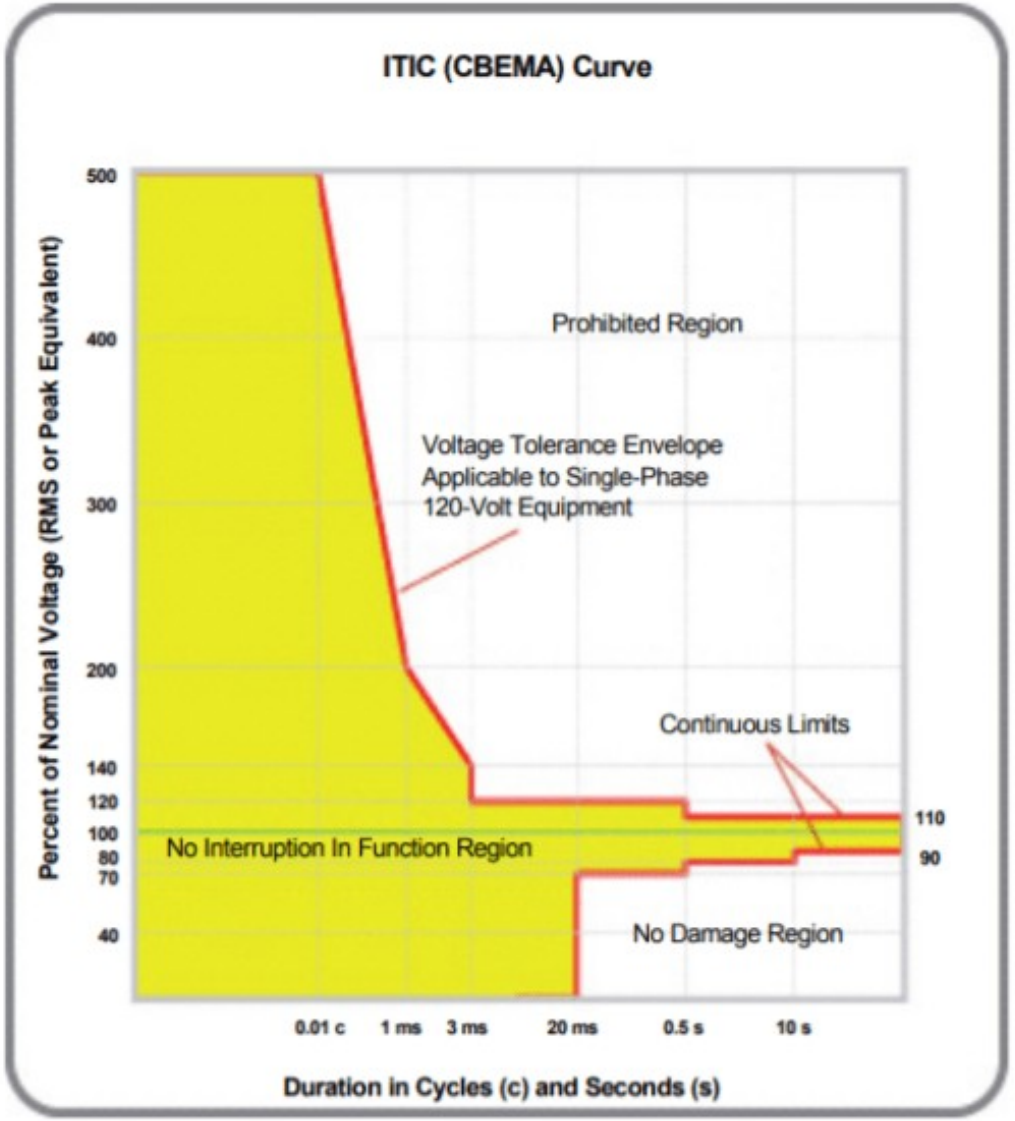
This option involves the use of an advanced UPS-based device, which will utilize a converter-inverter combination to provide disturbance-free voltage supply.

Static Voltage Restorer

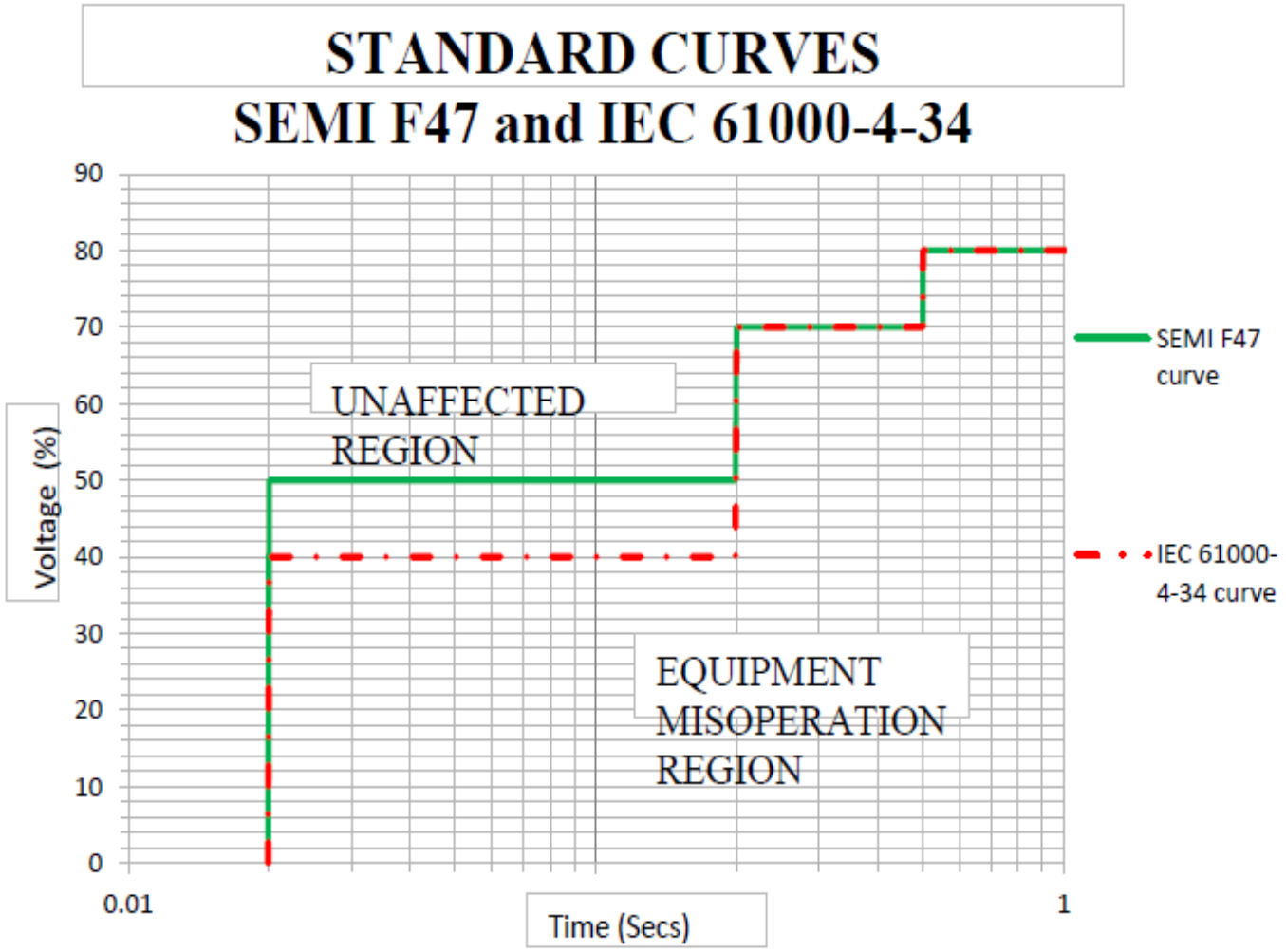
Static Voltage Stabilizer or Static voltage restorer is the same as a servo voltage stabilizer but without any moving part. It achieves regulation without distortion in the output waveform.

CASE STUDY

ITIC curve



SEMI F47 curve



CASE STUDY

Define

The overall problem defined
and capture to resolve.
ie. Fluctuation at Customer End

Measure

Measure the parameters on both HT & LT side via power quality meters.
i.e. Voltage of all HT & MV Side

Analyze

Analysis was done for data captured using
CYMEDist software

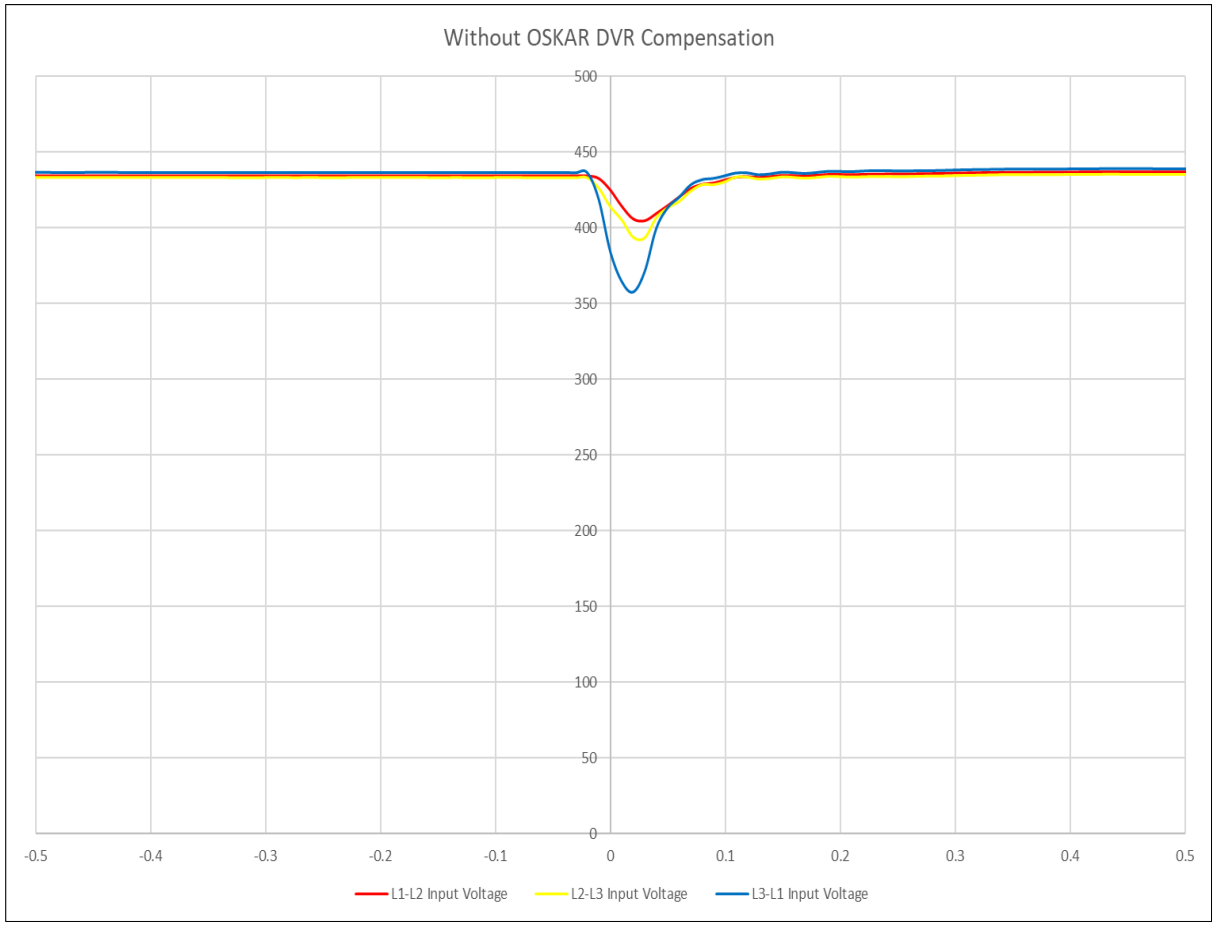
Improve

Detailed study using various options
Pilot installation at site

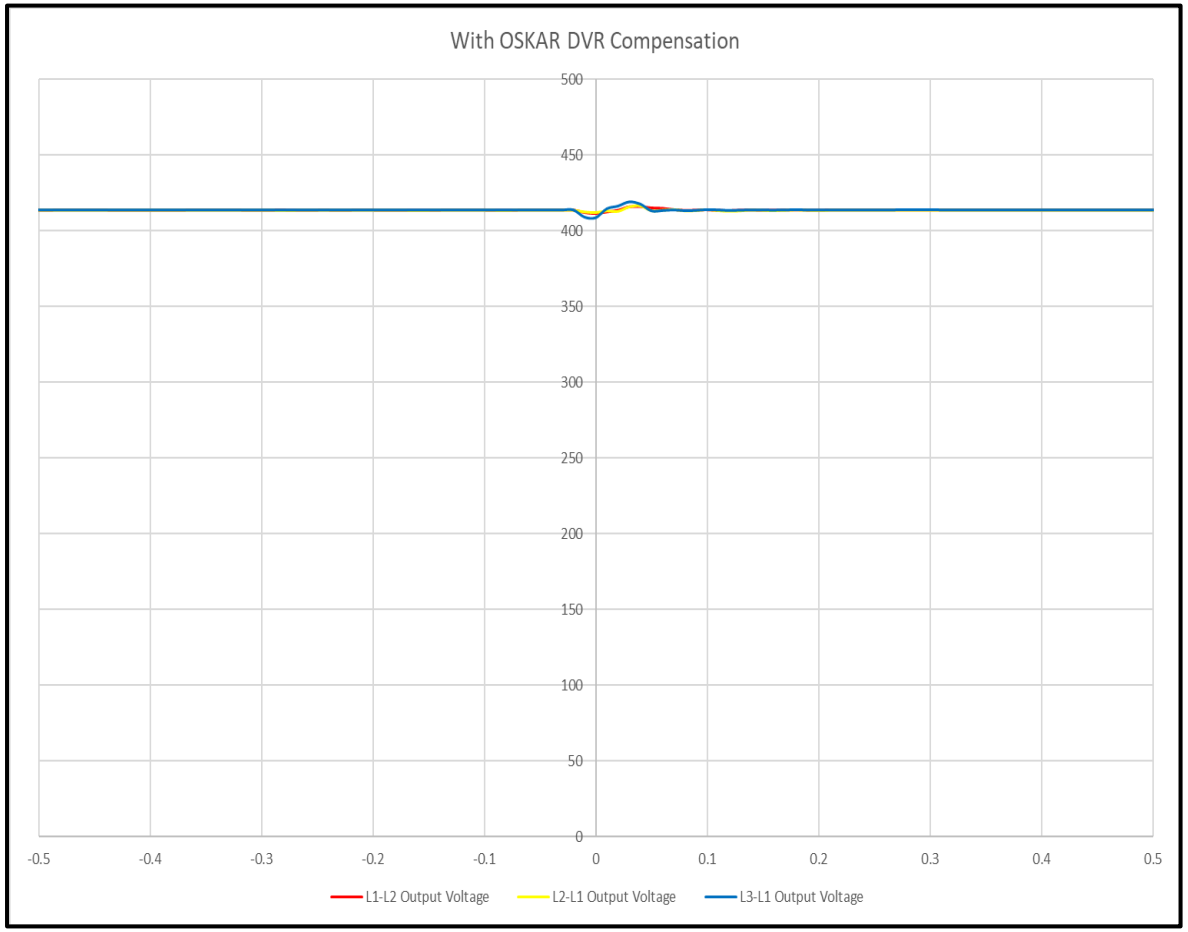
Control

Post analysis of data
Finalization of product

CASE STUDY



EVENT –Without DVR



EVENT – With DVR

SITE COMPARISON DATA

S.R.No	Date	Time	Malad DSS PQM reading		SVR PQM Data in ACG		Consumer Remark	
			Voltage	Duration	Voltage	Duration	Machine SVR Supply	Machine over Normal Supply
1	1/2/2023	3:46 AM	10.08 KV	50 mS	226.76 V	30 mS	Not affected	Not affected
2	1/4/2023	3:47 AM	9.34 KV	100 mS	217.63 V	80 mS	Not affected	Not affected
3	1/8/2023	4:41 PM	7.652 KV	60 mS	188.67 V	60 mS	Not affected	Not affected
4	1/10/2023	12:11 PM	6.393 KV	102 mS	163.212 V	100 mS	Not affected	Affected
5	1/11/2023	6:59 PM	7.83 KV	100 mS	202.519 V	100 mS	Not affected	Affected
6	1/12/2023	2:36 PM	6.32 KV	89 mS	173.52 V	80 mS	Not affected	Affected
7	1/13/2023	2:23 AM	4.18 KV	250 mS	122.34 V	140 mS	Not affected	Affected
8	1/13/2023	2:23 AM	3.55 KV	100 mS	94 V	100 mS	Not affected	Affected
9	1/13/2023	4:55 PM	3.76 KV	110 mS	118.22 V	80 mS	Not affected	Affected
10	1/15/2023	1:37 PM	7.196 KV	90 mS	184.22V	90 mS	Not affected	Affected

COMPARISON

Parameters	Dynamic Voltage Regulator	Online UPS	Static Voltage Restorer
Space required	Bigger footprint required and hence not installed in customer premises	Lesser footprint	Lesser foot print
Performance	Excellent	Good	Good
Cost	15 Lacs	7,00,000 per unit For 16 units 112 Lacs	1,70,000 per unit For 16 units 27 Lacs
Voltage compensator	Good	Good	Swift and no tripping was observed

KEY TAKEAWAYS / RECOMMENDATIONS

- Solutions like DVR, Battery less Online UPS, and Static Voltage Restorer mitigate fluctuations effectively.
- Site-specific assessments identify vulnerabilities and evaluate solution suitability.
- Prioritize installation of stabilization equipment for sensitive loads to minimize risks.

➢Way Ahead

❑Dynamic UPS using flywheel.

❑DVR using supercapacitor (In house study in collaboration with IIT)

THANK YOU

For discussions/suggestions/queries email:
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