

Strategic Placement of Low Voltage Connected Voltage Regulation Devices

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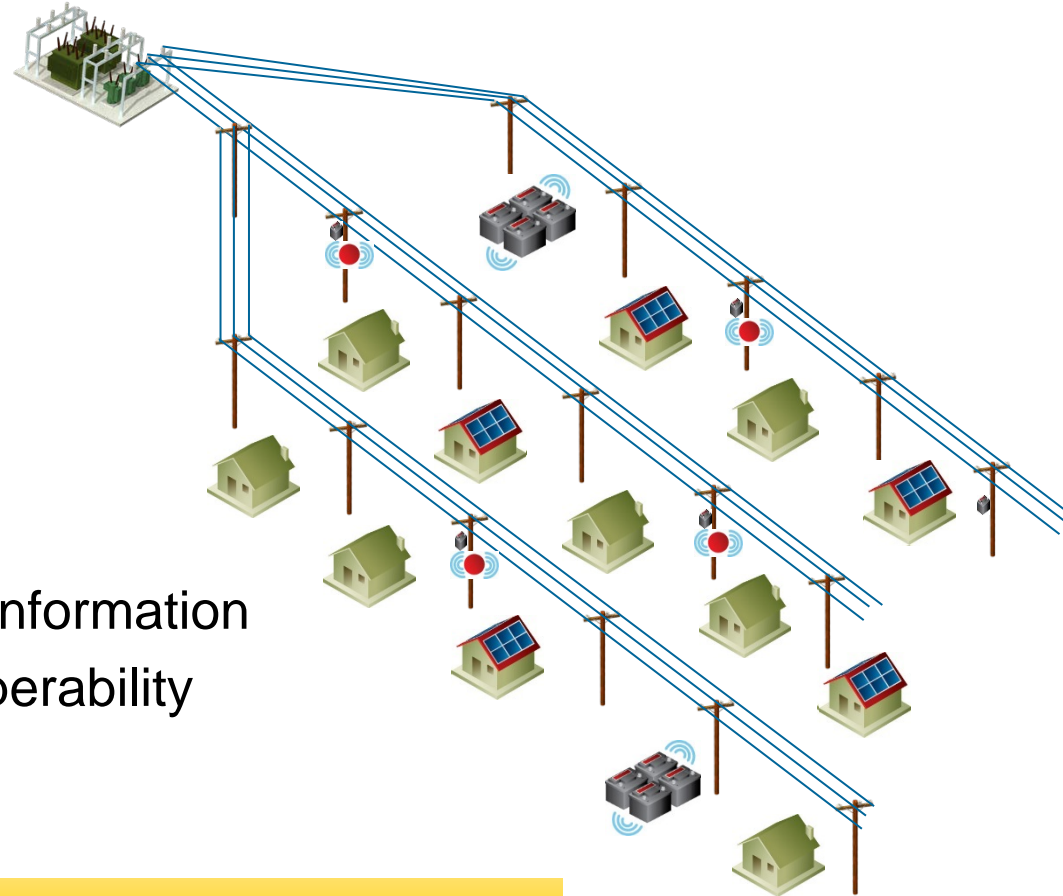
Change at the Distribution System “Edge”

Increasing levels of:

- DG
- RES
- Customer participation
- Advanced controls
- New assets

Result

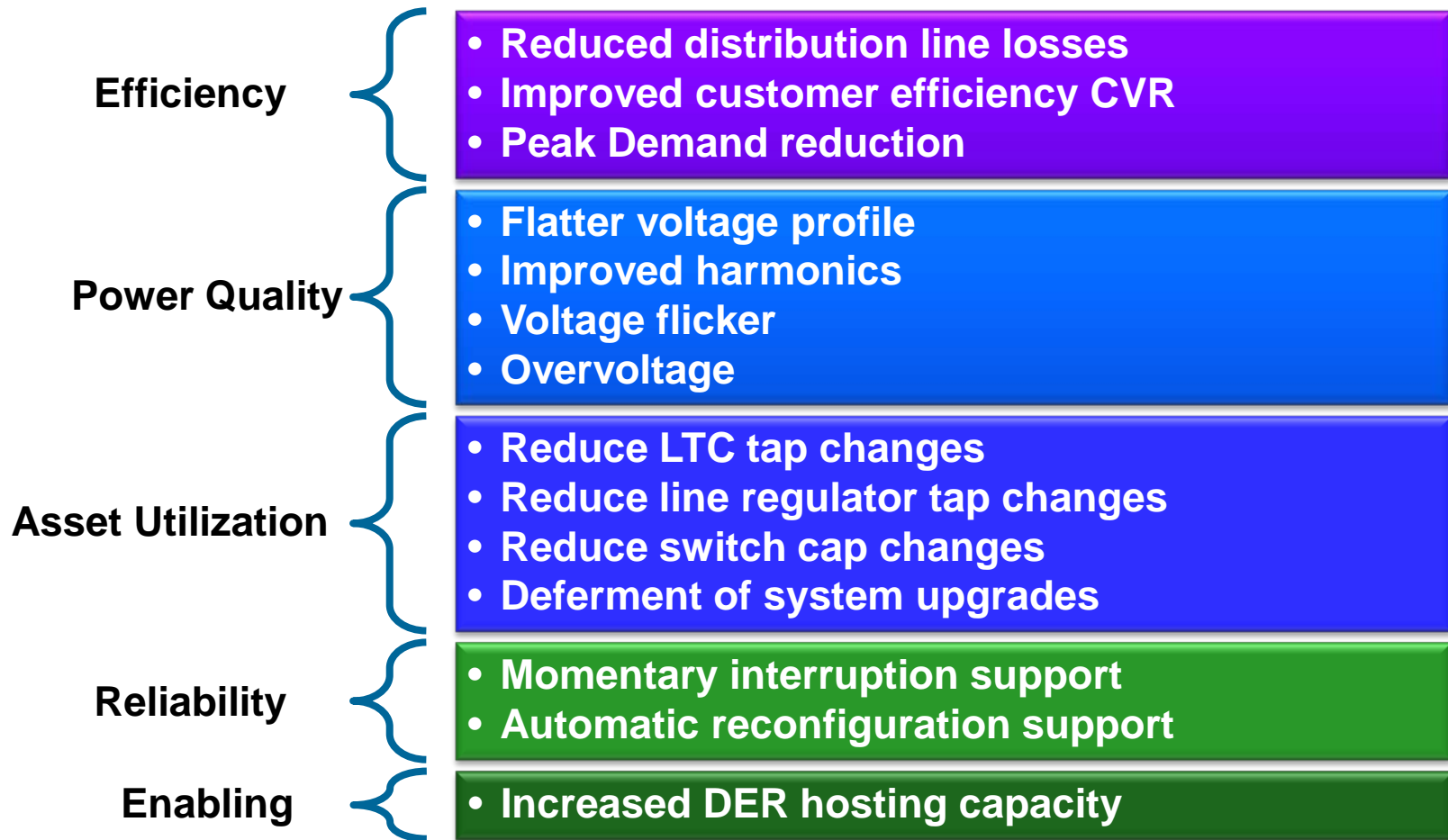
- Two way flows of power and information
- New forms of flexibility and operability



In many cases, a few well place SVC were able to mitigate multiple violations

mitigate multiple violations

Potential Benefits of Edge Connected Voltage Control



Network Edge Voltage Regulation Devices



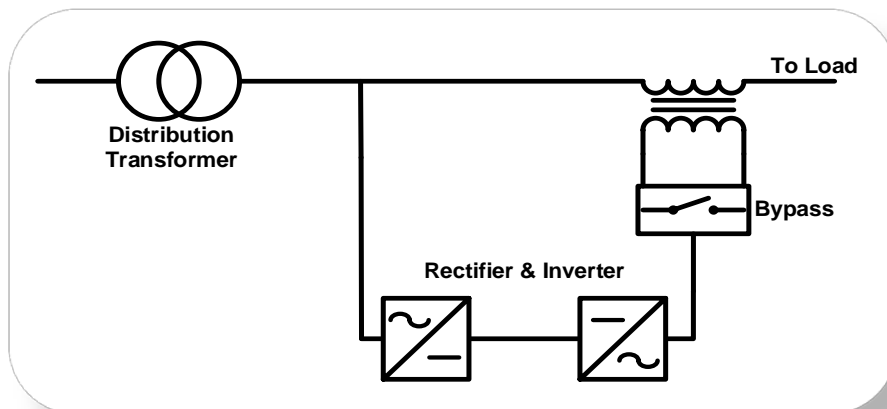
Study Devices

SVC

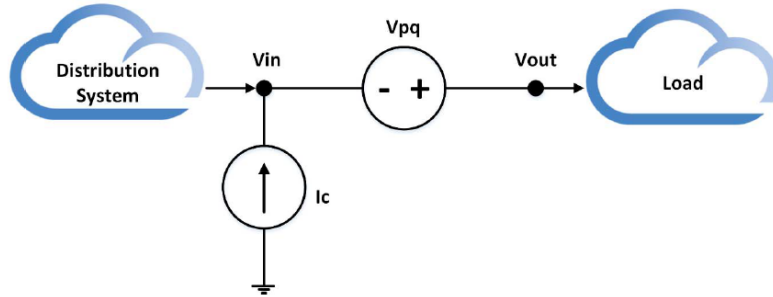
- 4 steps of 4.3 kvar
- 240V, 1-phase
- Voltage controlled

Gridco Services IPR-50

- In-line Power Regulator TM
- 240V, 1-phase
- 50 kVA
- Regulation $\pm 10\%$
- ± 5 kvar

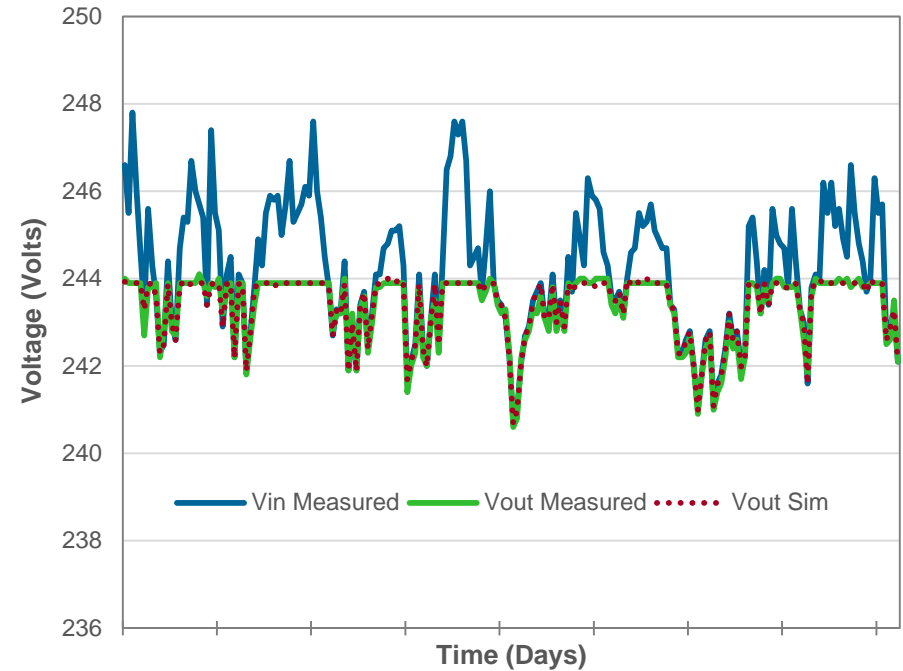


Unified Power Flow Controller Model

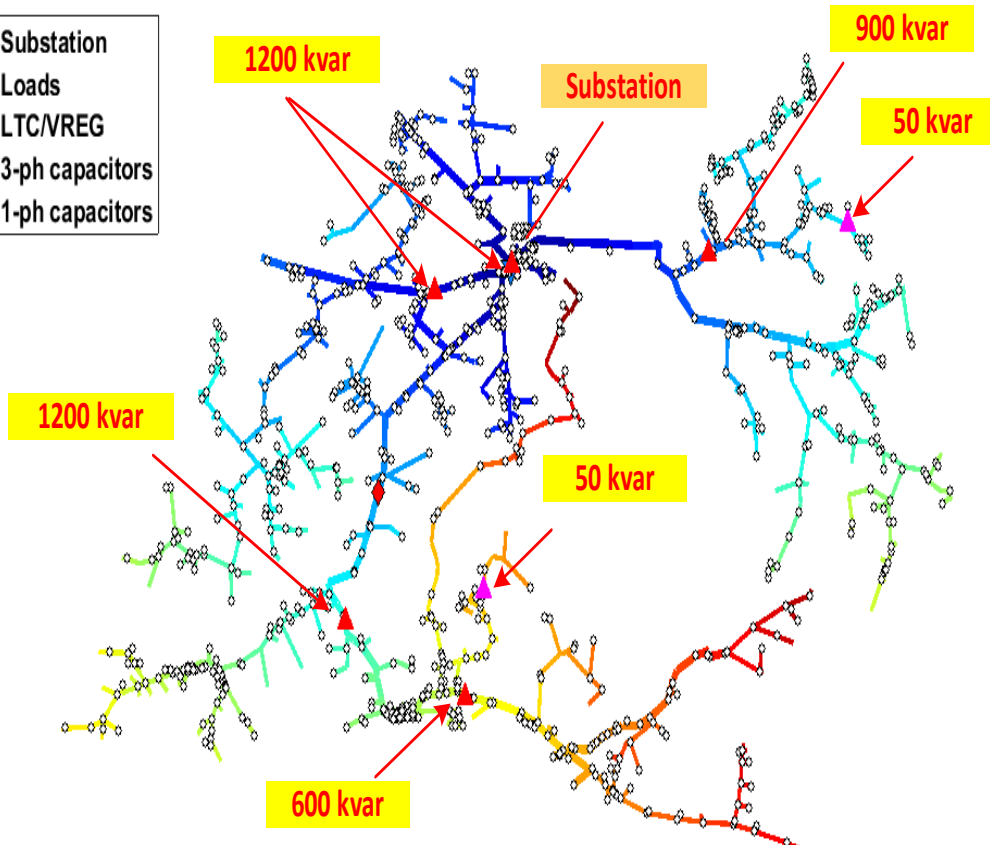
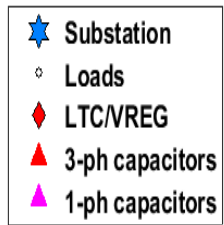


UPFC model in OpenDSS

- Generic device model
- Includes device losses
- Multiple modes of operation
 - Voltage regulation
 - PF Regulation
 - Hybrid



Device Placement



Field Demonstration

Objective:

Test ability of devices to mitigate existing voltage issues

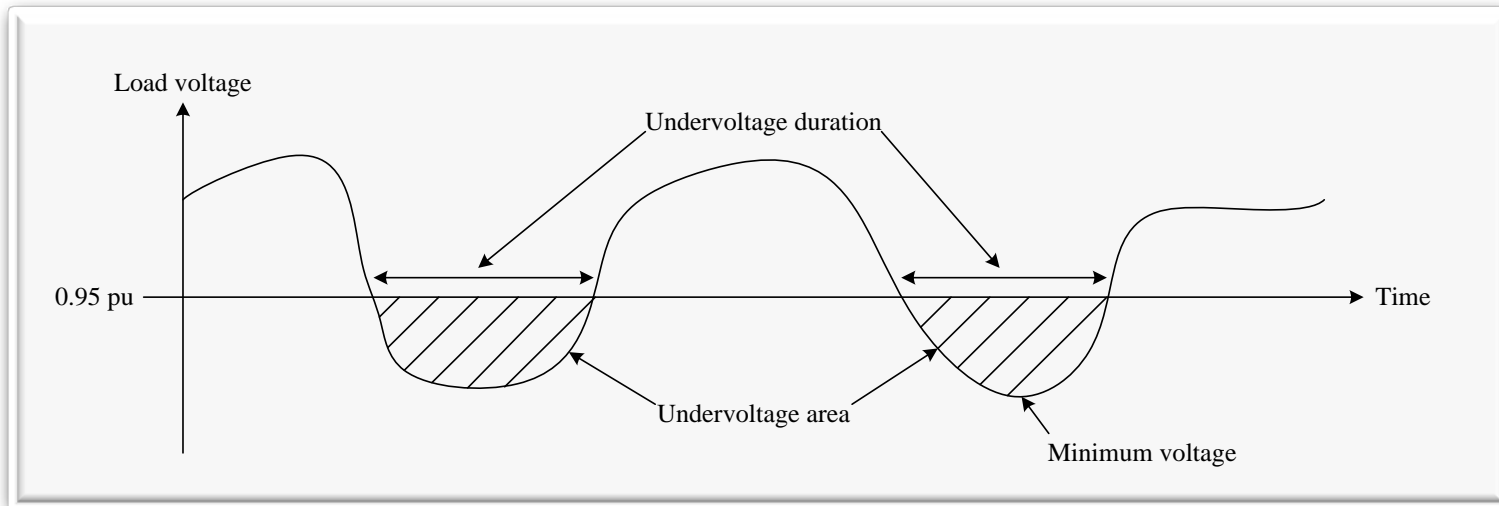
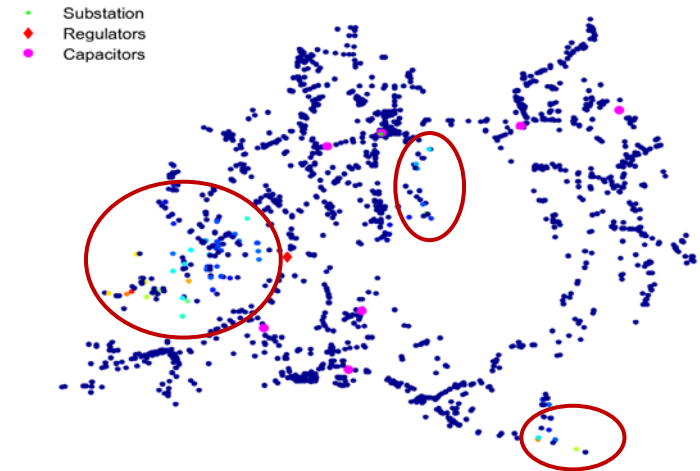
Locate:

- 19 SVC
- 1 UPFC

Voltage Violation Area Criteria

Problem and solution are not static in nature.

Optimal placement cannot be determined based on single load flow solution.

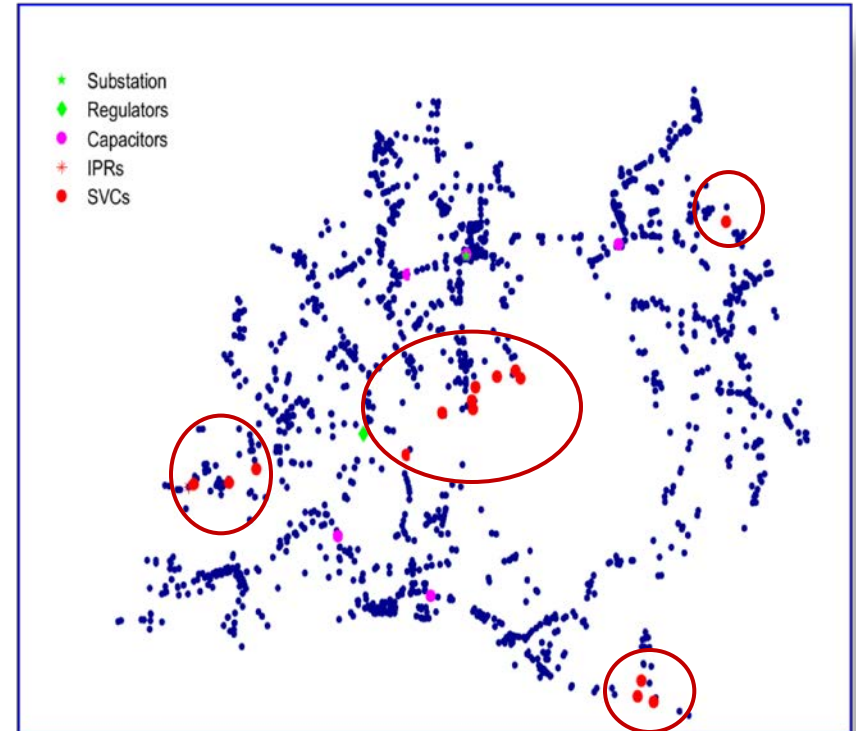


IPR and SVC Placement

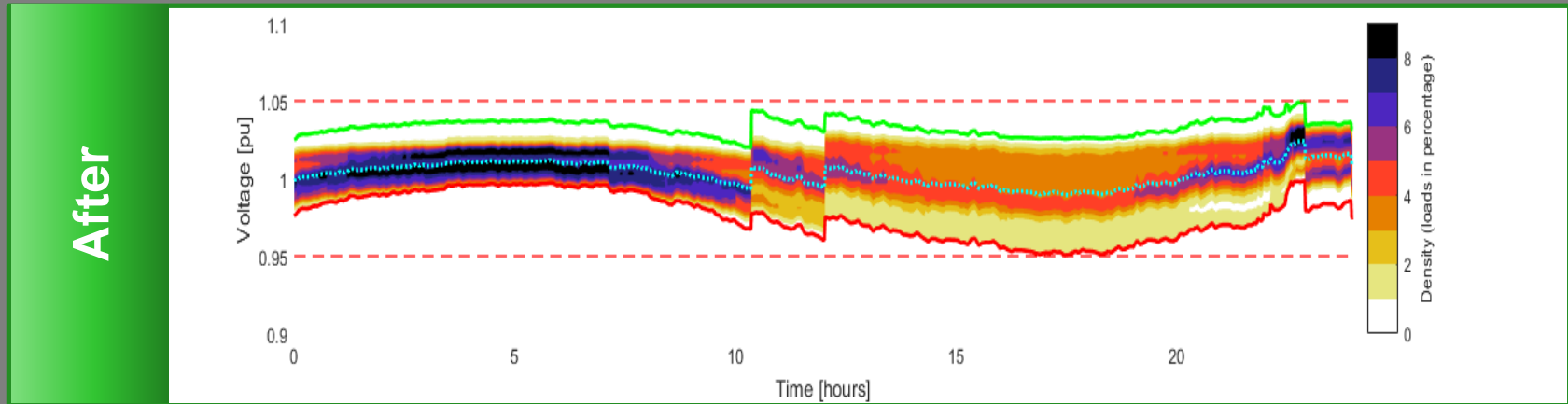
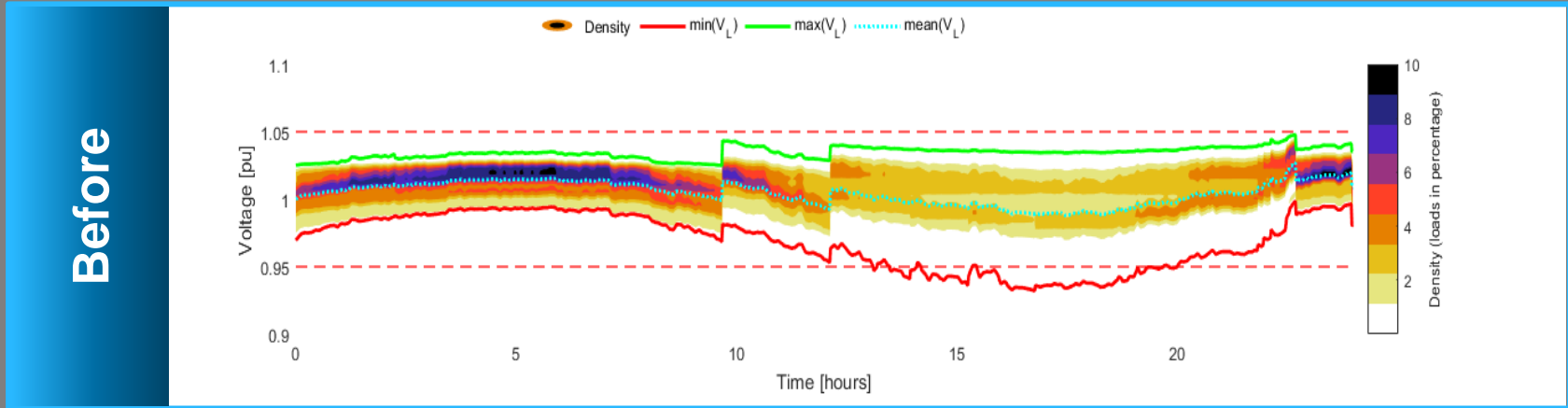
Siting Considerations

- Undervoltage violations
- Physical limitations
- Transformer rating
- Number and type of devices
- Iterative placement

In many cases, a few well place SVC were able to mitigate multiple violations

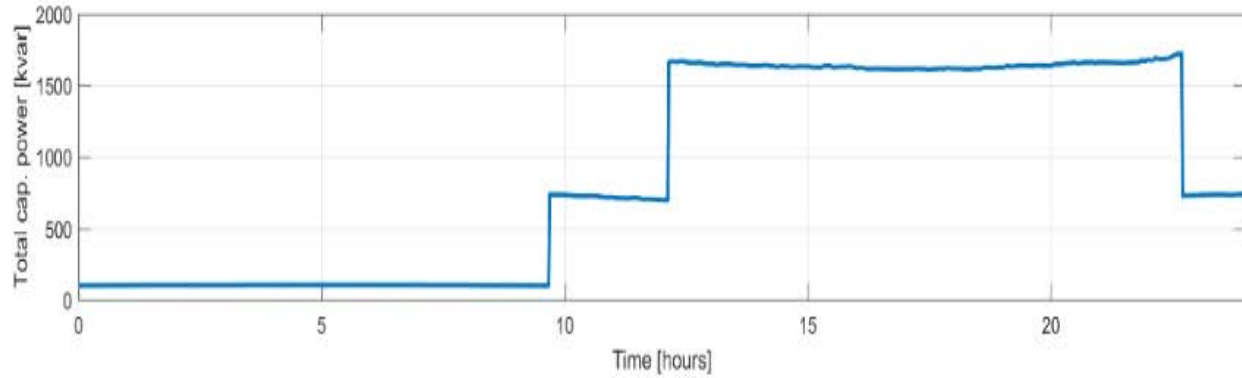


Voltage Impacts

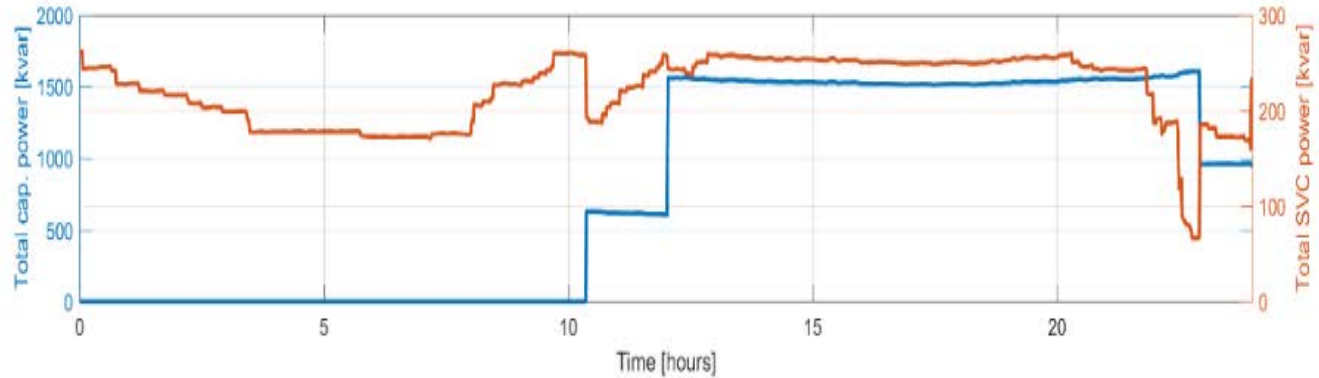


SVC & Capacitor Switching

Before



After



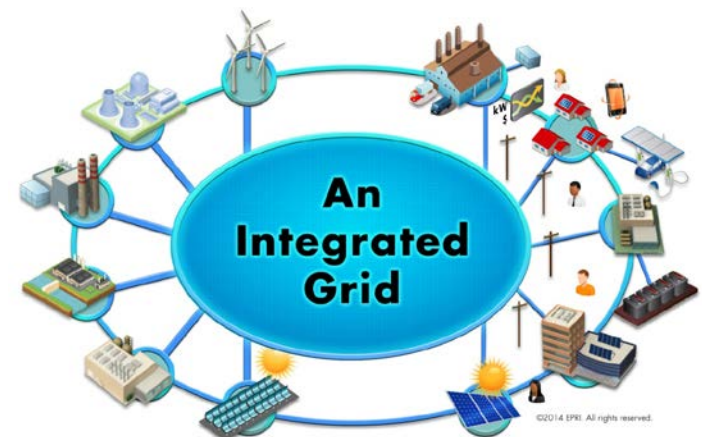
Continuing Efforts

Modeling and Simulation Advancements

- Creation and validation of emerging technologies
- Capability to holistically simulation network and advanced distribution automation

Planning & Design

- Coordination with traditional voltage regulation components
- Coordination/integration with DMS
- Determination of control settings practices
- Device location and sizing practices





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