Using Distribution Data to Optimize the Grid

Implementing a Distribution Volt Var Control Algorithm

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Introduction

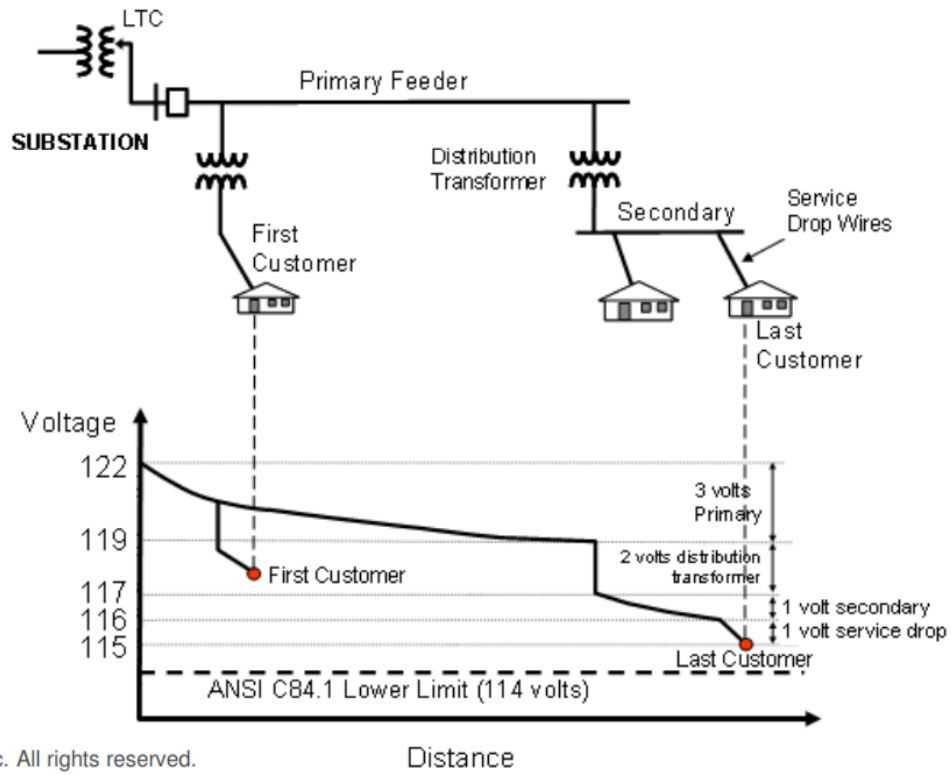
1. Definitions and Background – Volt/VAR
2. Utility Benefits of Distribution Volt/VAR Control
3. Implementation Challenges
4. Planning and Implementation Best Practices
   Next Generation VVC

Industry shift – bring value to the customer

Energy Reduction → Cost Savings for Customer

Volt Var Optimization

VVO is the practice of tightly controlling voltage and volt-ampere reactive (VAR) flow of an entire system to reduce energy losses and shave peak demand.



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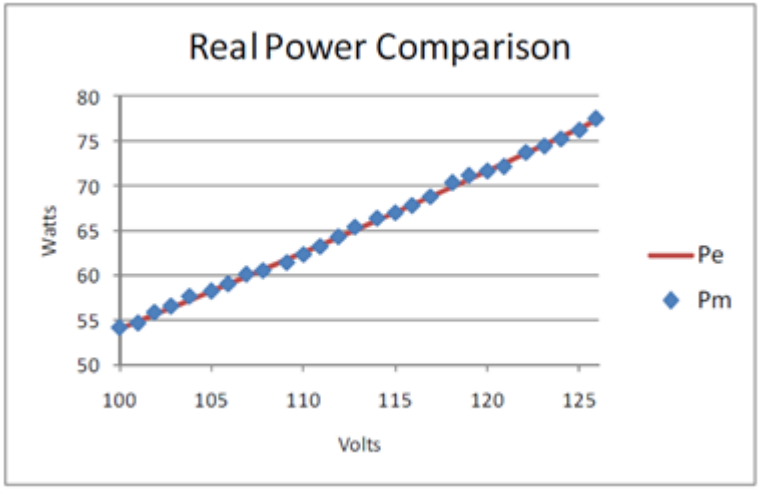
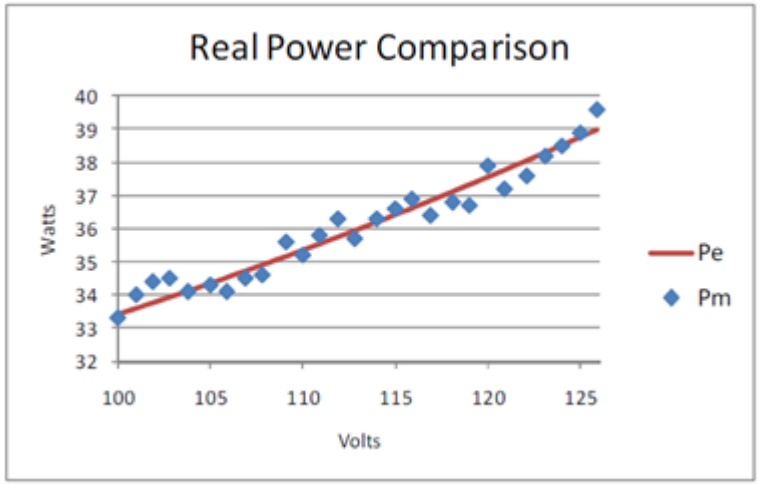
Conservation Voltage Reduction

CVR is reduction of the service voltage at the customer connection to reduce energy usage. Most electrical equipment loads consume less power at a lower voltage.

Incandescent Light Bulb



Fluorescent Light Bulb



CVR + VVO = DVVC
Distribution Volt VAR Control

- Increased power factor at the substation bus
- Lower losses in lines and transformers
- Lower losses in customer devices
- Optimized asset control for line and substation capacitors, LTCs and voltage regulators

DVVC Benefits

How do you quantify these benefits?

- Increased Real Power, reduced VARs
- 1% voltage reduction = ~0.8kW %

3% = **2.4%**

System **Voltage** reduction

Feeder **Energy** reduction

SCE's DVVC Process

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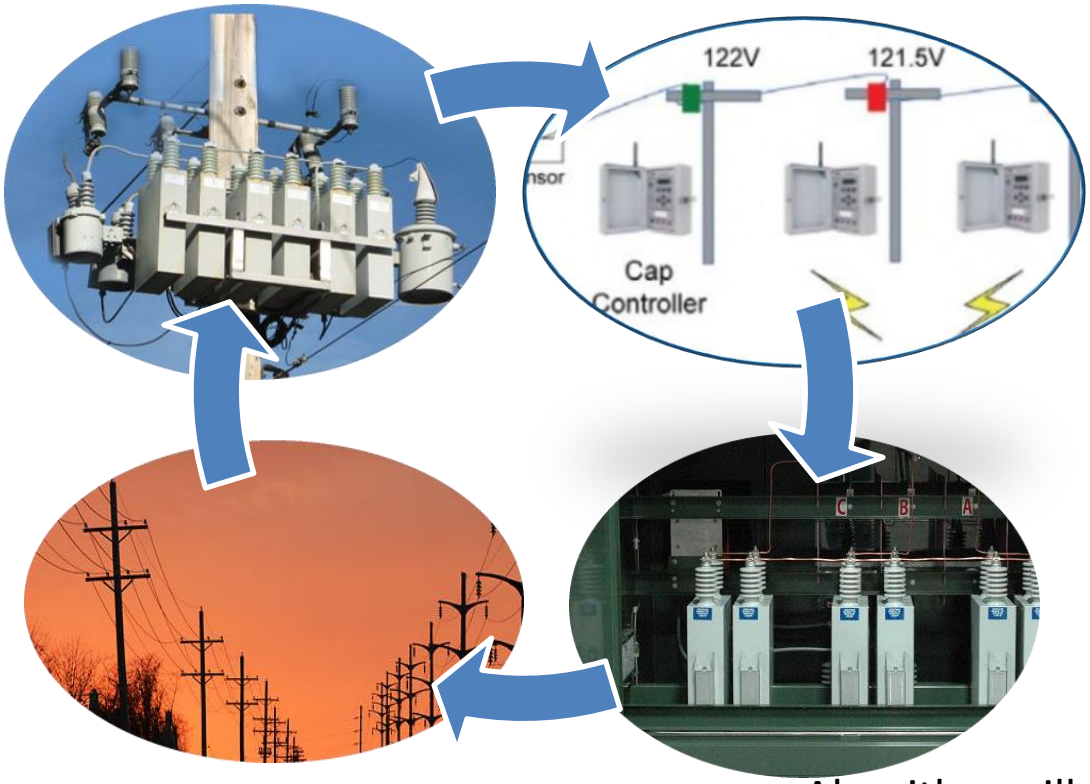
Calculate Voltage Rise effect of each capacitor on the system (modeling and system tests).

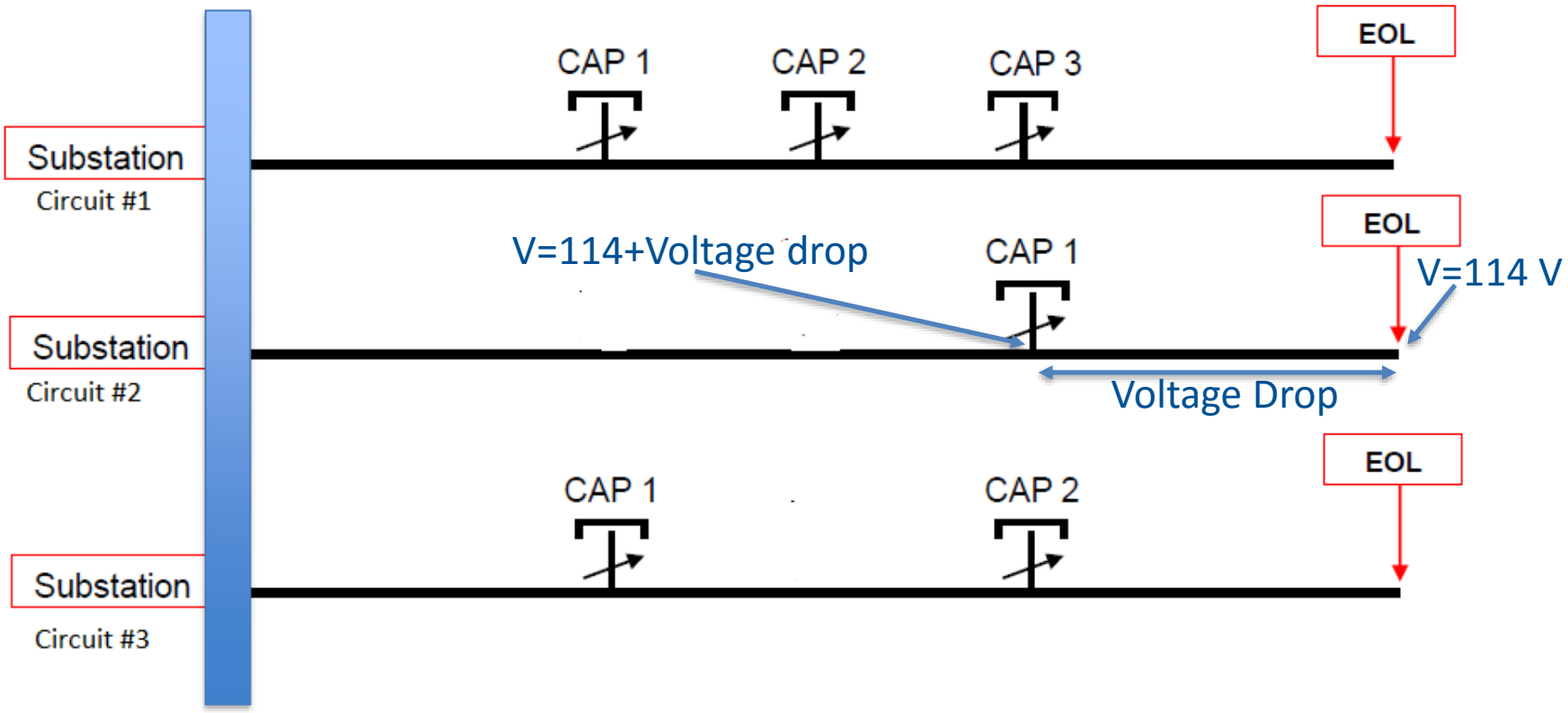
Determine voltage settings for each substation bus based on smartmeter data

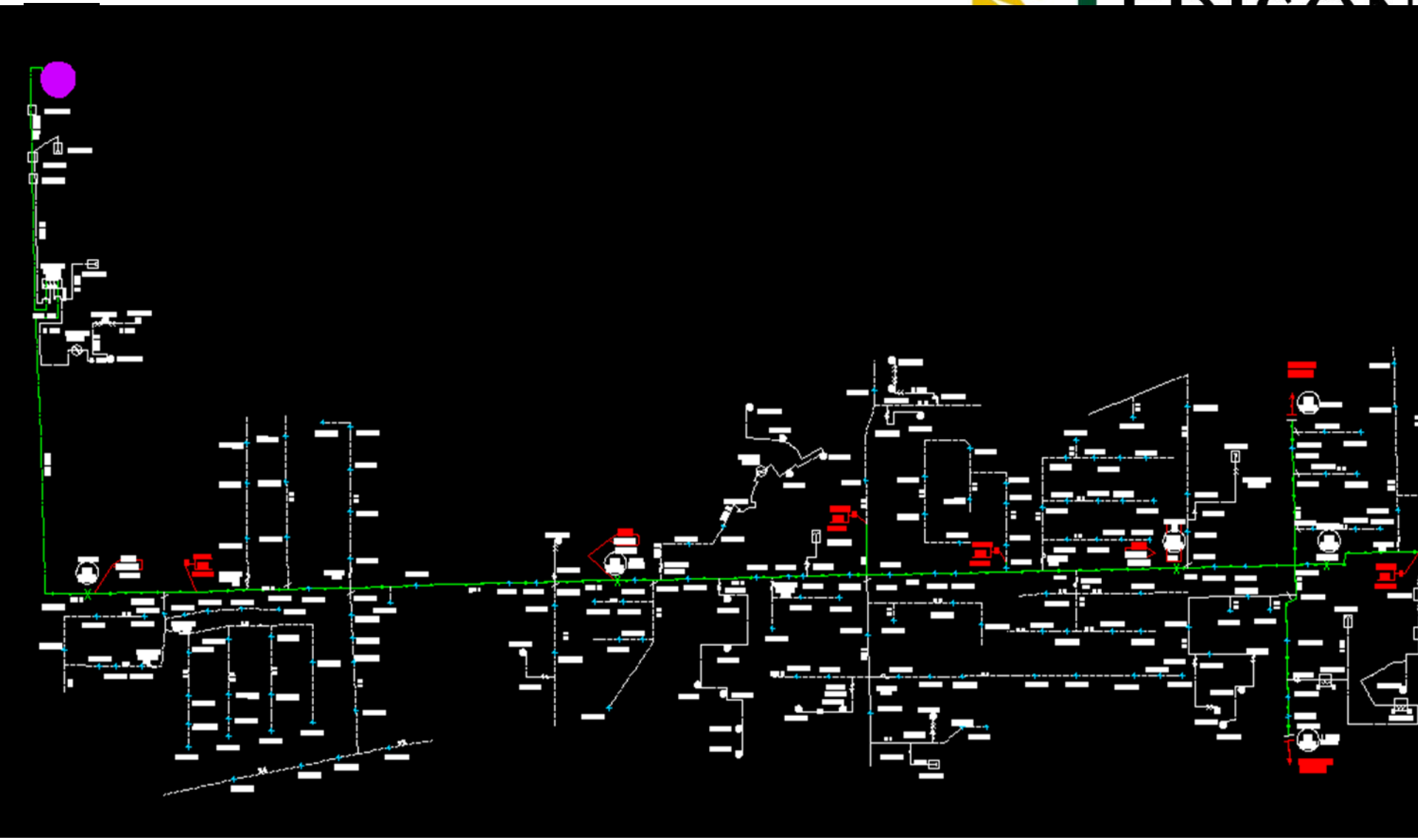


System load and/or voltage changes, and algorithm needs to adjust.

Algorithm will determine optimal combination of closed-in capacitors to achieve desired voltage.

Algorithm Setup





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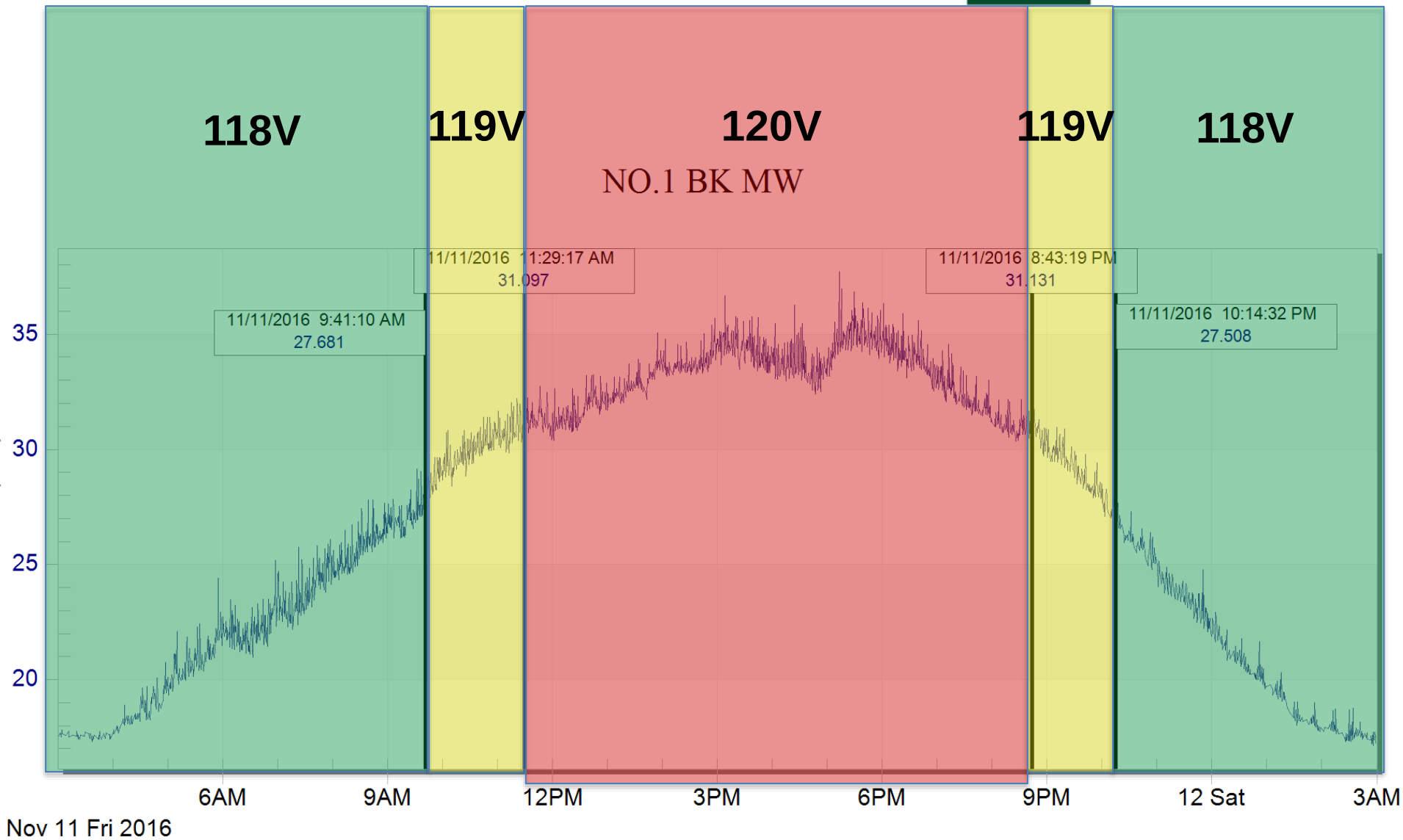


Challenges

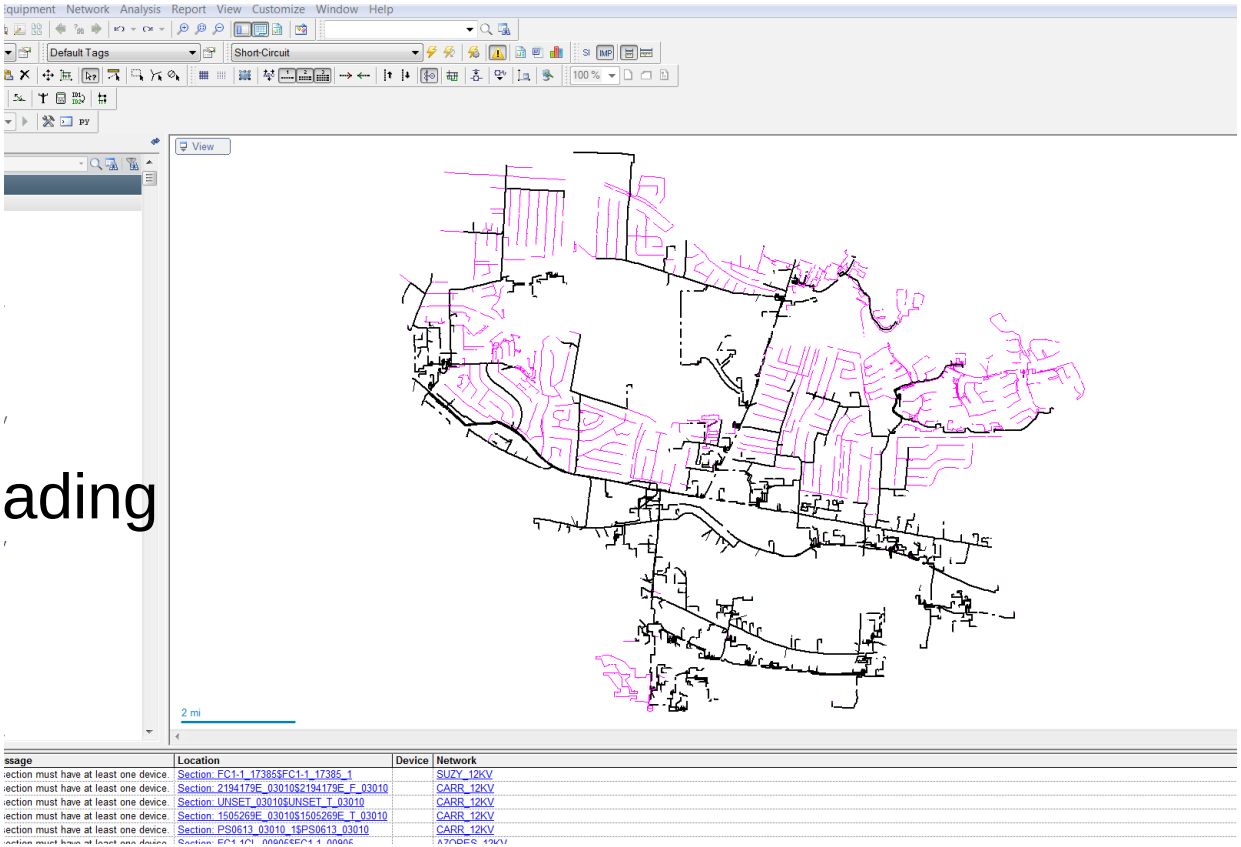
- How to determine worst case feeder quickly & efficiently
  - Determine which cap is closest to which end meter.
- Every circuit is its own perfect little snowflake
  - Mo’ data, mo’ problems
- No way to monitor low voltage issues other than calls
- Don’t have smart meter data everywhere
- Evaluating performance and making adjustments

Related Benefits of DVVC System

- Optimize the distribution system
- Prioritize distribution asset maintenance
- Goes hand in hand with Grid Modernization efforts

Benefits of Modeling

- Aggregating data into one centralized location
  - Mapping
  - Metering data
  - EMS
  - DMS
  - Outages
  - Transformer loading



Next Generation

- IVVC – Integrated Volt Var Control
  - Include OLTC at substation
  - Include voltage regulators
  - Real time feedback from Smart Meters
- Smart Inverter integration for power quality improvements
- GMS – Grid Management System (also known as DERMS)
- ADMS – Advanced Distribution Management

Conclusion

- Advanced communication networks now allow us to fine-tune the distribution grid.
- Need to change distribution design to handle increased distributed generation.
- The existing grid will not be sufficient as customer needs grow.