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.
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

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

\[ V = 114 + \text{Voltage drop} \]
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.