Smart Grid Voltage Optimization:
For EPA Clean Power Plan Compliance and Grid Resiliency

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Maria Seidler, Director Policy and Grants
Alternative Energy Solutions
Dominion Resources, Inc.
Dominion Resources, Inc. is a leading provider of energy and energy services in the U.S. with the following capabilities:

- 24,600 MW of electric generation
- 6,455 miles of electric transmission
- 12,200 miles of natural gas transmission, gathering, and storage pipeline
- 928 billion cubic feet of natural gas storage operated

- Cove Point LNG Facility
- 2.5 million electric customers in VA and NC
- 1.3 million natural gas customers in OH & WV
- 1.2 million non-regulated retail customers in 13 states (not shown)
- 252 MW of contracted solar generation in 6 states (not shown)
Overview

• Subsidiary of Dominion Resources
• Deliver grid-side efficiency solutions
• Patented approach using AMI data
• Proven customer successes
• Partnerships with world class companies

Built with Utility Expertise

• Utility-scale distribution system
• State goal for verifiable energy savings

More Than Just Software

• Efficient business processes
• Complete grid-optimization program and tools
• Integrate seamlessly into existing systems

Practical Approach

• Delivers immediate value
• Captures greater and more sustainable savings
• Provides continuous improvement process
• Deployable and measureable circuit by circuit
EPA Clean Power Plan
Validates CVR for Compliance

EPA Clean Power Plan Final Rule:

“[M]easures that improve the efficiency of the T&D system and/or reduce electricity use may be used… to reduce [line] losses … and T&D measures that reduce electricity use at the end-user, such as conservation voltage reduction (CVR)”.

What Can CVR Do for a State’s Implementation Plan?

DOE:

“When extrapolated to a national level, complete deployment of CVR … provides a 3.04% reduction in annual energy consumption.”

PNNL 19596, Evaluation of CVR on a National Level
ANSI Standard for electricity delivery to customers’ meters.

- Maximum allowed voltage: 126V
- Typical customer voltage for reliability margin: 122V
- United States Nominal voltage: 120V
- Minimum Allowed voltage: 114V

Consumer devices typically designed for 108V
1% voltage drop = .6 to 1.2% kWh savings. Excess voltage results in energy waste.

**CVR + Smart Grid = Voltage Optimization**

- **24x7 Optimization** multiplies kWh saved on customers’ bills.
- **AMI visibility and communication** assures ANSI compliance for all customers.
- **Automated Voltage Control** promotes grid resiliency and circuit stability.

**VO = 3% - 5% energy savings**
VO/CVR Technology
Primary Sensor Based
VO/CVR Technology

Smart Meter (AMI) Based
DVI VO Deployment

- Using VO for EPA CPP Compliance

- Central
- Lincoln
- Modesto
- PG&E
- NV Energy
- Palo Alto
- Pedernales
- Naperville
- CLECO
- HECO
- Hydro Ottawa
- TREFOR (Denmark)
- DVP
- DVI
- Current Customer
- 2015 Customers
Glendale Smart Grid VO Project

- The initial VVO/CVR project was to control one circuit with 3,800 meters.
- Project generated 2.95% energy savings
- Glendale plans on deploying VVO/CVR on remaining circuits over the next few years
- Expected savings to be 14,500 MWh per year
- Avoided costs (savings) at $65/MWh expected to be $3.8M
Central Lincoln PUD - Oregon
DOE Smart Grid Investment Grant

• The VO project included one substation, two feeders and 1,400 meters.
• Project began in May for 6 months, during which voltage was reduced from 123.5 to 119.5V.
• Project resulted in 2.15% energy savings or 325 MWh/yr -- from 1 substation.
• Glendale plans on deploying VVO/CVR on remaining circuits over the next few years

“All socioeconomic groups benefit as the 2% customer savings occurred without regard to homeowner or renter status ... results of the pilot project were so impressive, that Central Lincoln is undergoing plans for a full system wide implement.”

From Central Lincoln DOE Report
Volt-VAR Optimization (VVO) and CPP Renewable Energy Goals

VVO helps manage load swings caused by:
- Distributed solar generation
- Storage
- Electric Vehicles

VVO stabilizes circuits for more distributed solar

VVO can increase a circuit’s hosting capacity by 2x or more.

From EPRI’s Volt/VAR Research
CPP’s Evaluation, Measurement and Verification (EM&V) Opened for Comments

- CPP requires energy efficiency energy savings be quantifiable, verifiable, enforceable, non-duplicative, and permanent.

- An EM&V plan must define a project’s baseline and identify independent factors affecting savings.

- States looking to VO savings should file comments that:
  - EPA distinguish distribution efficiency from behind-the-meter efficiency methods;
  - EPA recognize rigorous statistical algorithms are available to measure VO within reasonable confidence total energy savings realized by the utility and customers.
  - EPA should allow SIPs to adopt certified EM&V software as alternative to EPA’s Independent Verifier process.
Questions & Discussions

Thank You!