Conservation Voltage Reduction

Midwest Energy Efficiency Association

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ActOnEnergy.com

What is Conservation Voltage Reduction?

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Conservation Voltage Reduction (CVR)

- is an existing technology concept that can increase grid efficiency.

- is the general term for the changes to distribution equipment and operations that can reduce line losses, peak loads and reactive power needs, and save (or defer) consumption by some types of consumer equipment.

What is CVR?

- CVR is the intentional and routine reduction of system voltage, typically on distribution circuits, to reduce line losses and energy use by some types of end-use equipment while maintaining customer service voltage within applicable national standards (e.g., ±5 percent of nominal).

- Conservation voltage reduction or “voltage optimization” – a term sometimes used to refer to advanced forms of CVR that include VAR control – is designed to reduce capacity needs overall, to reduce energy use, or both.

CVR Operations

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- According to studies, operating a utility distribution system in the lower half of the acceptable voltage range (120-114 volts) saves energy, reduces demand, and reduces reactive power requirements without negatively impacting the customer.
- The distribution lines that deliver energy to homes and businesses typically lose 3 percent to 7 percent of the electricity they carry.

CVR Operations

- Reducing electric service voltage also reduces energy consumption of some consumer equipment. In fact, much of the savings potential may be on the customer side.
- A study found that when voltage reduction is coupled with major system improvements, 10 percent to 40 percent of the savings accrue on the utility distribution system; the remaining savings are the result of reduced consumption by equipment in homes and businesses operating at lower voltage

(R.W. Beck 2007)

CVR Savings

- 1-3% reduction in energy use
- 1-4% peak load reduction
- Most energy savings: *end-use* equipment at lower voltage
- Cost is low
- *Incremental* impact of smart grid for CVR estimated at 2%; studies needed to confirm

Estimates from Electric Power Research Institute, Northwest Energy Efficiency Alliance, Northwest Power and Conservation Council

Existing Technology

- In the past, voltage improvements to the distribution grid have been initiated in the form of installing fixed capacitors (in all three phases) connected along the distribution lines.

- One feeder line of certain length might have one or two capacitor banks installed at 40% and 80% of the line length. These capacitors act as the VAr generators to boost the voltage of the feeder line around them as well as lowering the current that the line would have to carry to support the same loads.

- In addition, both voltage regulators and load tap changers (LTC) are often used at the feeder and substation level respectively to help maintain a consistent voltage profile.

Challenges for Existing Technology

- Loads and the resulting line currents are extremely dynamic. Changes and fluctuations occur daily (day versus night loads) as well as weekly (workdays versus weekends) and seasonally (winter versus summer).

- With the integration of distributed energy sources such as wind and solar along with the increase in use of electric vehicles, distribution grid complexity continues to increase substantially.

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Challenges for Existing Technology

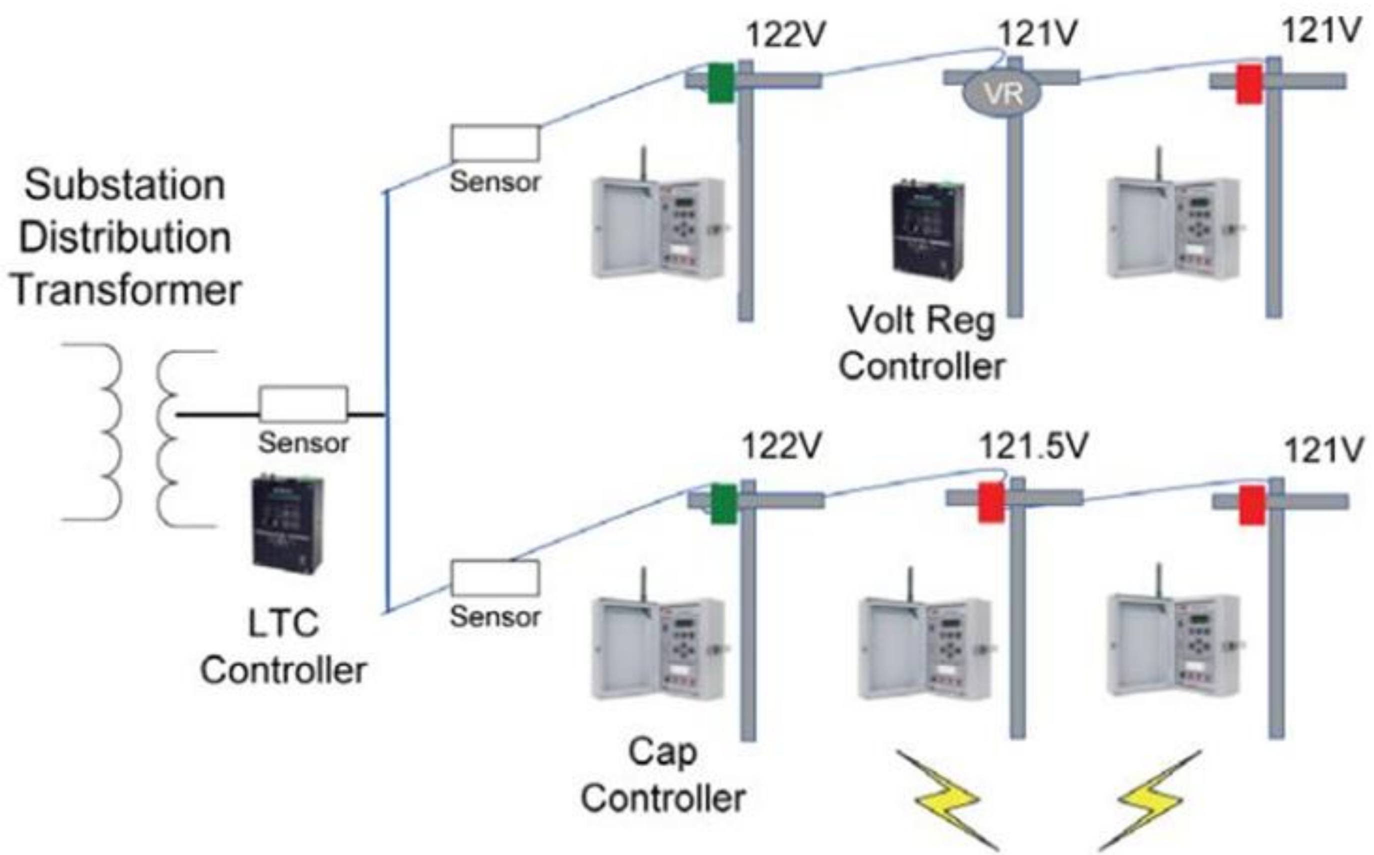
While system operators may be used to considerable slack above minimum voltage standards, more precise controls and communications allow for margins to be smaller without compromising service quality or damaging consumer equipment.

Communications Technologies

- Today, with the advancement of sensor, controller, communications technology, utilities can have the distribution grid between the substation and consumer at their fingertips.

- Sensor technology such as transformer controllers and line post sensors integrate accurate, reliable measurement of the primary current and voltage to allow precise switching from the controller at voltage, current, and/or VAR flow magnitudes.

- Coupled with communications back to the operations center, CVR is equipped to take advantage real-time visibility and control to address the increasing complexity of the grid and allow utilities and consumers to experience the benefits of efficiency improvement.


Substation
Distribution
Transformer
Sensor
LTC
Controller
Sensor
Sensor
122V
121V
121V
VR
Volt Reg
Controller
122V
121.5V
121V
Cap
Controller

Is SmartGrid Necessary To Implement CVR?

- No – while voltage must be measured at one or more points on the feeder and communicated back to the utility to go beyond the line drop compensation approach, SCADA and strategic placement of a small number of voltage transducers on each circuit are sufficient.

Ameren Illinois Pilot

- ICC order to pilot a Voltage Optimization project in 2010
- Include testing of demand response and energy efficiency capabilities
- Design a number of tests using industry best practices

Ameren Illinois Pilot Expectations

- Demonstrate ability to control and levelize voltage
- Test and verify amount of demand reduction
- Test and verify amount of energy efficiency (24/7)
- Determine applicability to remainder of system & develop implementation plan

Pilot Status

- Equipment installed at two substations on four selected feeders in 1Q 2012
- On-going monitoring of urban and rural feeders for 1 year period
- EPRI assisting with pilot design and analysis including methodology, circuit modeling, testing criteria, test data analysis

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Questions?