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SMOOTH DELIVERY

Voltage Management Complements Distributed Generation

By Mark Petersen

THE ELECTRICAL grid, which delivers the resource that powers day-to-day existence, has been called "the largest machine in the world". Like all machines, it will get old, wear out and occasionally be pushed to do things it wasn't designed to handle.

Today's electrical grid is volatile, and it is becoming more so every day. Inflows of distributed generation, such as wind and solar, and fluctuating demand contribute to the situation. Meanwhile, utilities are tasked with delivering the correct amount of power, at the right time of day, to meet demand that fluctuates wildly across a 24-hour period: low overnight, up through the day, and peaking through the dinner hour and into early evening.

Imagine working to meet those fluctuating demands in real time, and ensuring that as little of this precious resource as possible is wasted. That's a day in the life of those who manage the grid.

Producing, then transporting power over vast distances across aging infrastructure is an ongoing challenge. Utilities typically send out more power than is required — albeit still within a prescribed allowable range — to ensure that all of their customers receive the power they need. This is referred to as overvoltage.

Electronic and electrical devices are designed to operate at a certain maximum supply voltage, and considerable damage can be caused if the voltage is higher than that for which the devices are rated. In Canada, allowable voltage levels are set out in the standard, CAN-3-C235-83 (R2015) Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

The standard allows for a wide range of voltages at the service entrance of a facility or building. Anything from -8% to +4% for 600V service is acceptable, meaning that voltage can range from a low of 550V to a high of 625V.

For their part, building owners and operators have the ability to monitor and control the voltage levels at a facility. If they can ensure that the variation is managed, reducing the range of voltage seen at the building and passed on to the various loads (electrically powered equipment and resources) presents an opportunity for energy savings.

Utilities likewise have an interest in voltage management. BC Hydro, Hydro Quebec, and the United States Department of Energy (US DOE) have conducted research into energy usage, and they all came to the same conclusion: reducing voltage saves energy. For example, the 2010 US DOE study estimated that electrical consumption could be reduced by 2.4% to 3% through implementation of a conservation voltage reduction (CVR) program. The question is: where in the system can energy be reduced?

Implementing voltage management at the utility sub-station level is imprecise and expensive because every circuit provides energy to numerous facilities. Interventions at this point are unable to tailor the voltage needed to balance equipment performance, reliability and energy use to each recipient. Voltage control at the facility level — which utilities term "on-site" — can meet that need.

A commercial office tower with a typical voltage profile can usually attain a 4% to 6% average voltage reduction. Over a one-year period, implementation of an up-to-date, active voltage management solution could provide a 100,000 kilowatt-hour (kWh) reduction in energy use for a facility with a 3 million kWh energy baseline.

There would also be a related drop in GHG emissions. Given that systems typically have 20-year or longer useable lifecycles, the ongoing savings and overall long-term value can be substantial.

This delivers best results when voltage levels are managed holistically in the electrical room. On-site voltage management platforms effectively become an extension of the grid, bridging the meter and the switchgear.

They read inbound voltage from the grid and fine-tune it to the optimum levels for the building, and for every piece of electrical hardware in it. In this way, everything from lighting to highly sophisticated machinery will get the voltage it was designed for, and avoid issues that come from overvoltage.

The technology may also qualify for incentives that various North American jurisdictions and/or power utilities offer for energy efficiency. Typically, these range from $0.10/kWh to $0.30/kWh and can cover up to 50% of the total capital cost of a voltage management implementation. ■

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