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Distributed generation the next frontier for utilities

By Kevin Whitehead

Utilities are facing a host of challenges today, including fluctuating energy costs, fewer resources, and ever-increasing end-user demand, among others. Even as we face these challenges, some incredible breakthroughs in technology are allowing us to fashion more innovative and cost-effective solutions to improve service, while reducing capital costs. One area where these breakthroughs are having a significant impact is distributed generation.

With deregulation in the utility market, energy (kWh) will become a commodity item that can be freely bought or sold. However, swings in supply and demand will leave end-users exposed to fluctuations in the cost of electricity.

Another consequence of deregulation is that utilities will be regulated on "Performance-Based Rates (PBR)", whereby regulators determine what a utility is allowed to sell power for, based on the assets of the utility. These rates are critical in determining the utility's staffing requirements and how well the utility can be maintained. They can ultimately compel utilities to cut costs, at the risk of less reliable power delivery to end-users.

Compounding this challenge is the impending threat of demand outstripping supply over the next few years. For some utilities, a 50 per cent increase in load growth over the next 10 years is not an unreasonable expectation. At the same time, the existing infrastructure, more often than not, cannot support that increased demand without the need to add more feeders and transformer stations. A new transformer station, depending on the location, can cost anywhere from $12 to $20 million to build – a significant capital cost that, as things stand today, is unlikely to be easily recouped.

Distributed generation the new alternative

The anticipated fluctuation in energy costs, reduced supply reliability and increasing demand have led end-users to consider maximizing efficiency through on-site generation, cogeneration, or "Central Heating and Power" (CHP). While co-generation is certainly not an unfamiliar term in the power generation lexicon, it has generally been restricted to specific industrial or commercial sites.

On-site generation, however, represents a potentially valuable resource for utilities by way of distributed generation. A utility can increase capacity by turning to "host" sites (e.g. industrial users) with an existing generator, allowing them to parallel with the grid, and thus use the on-site generator capacity to handle peak volumes.

While most existing sites use small gas turbines or reciprocating engines for generation, there are many alternatives that are being considered over the longer term. Technologies such as micro-turbines are currently available, but only used at a relatively small number of sites. These newer generators offer some inherent advantages, including built-in communications capabilities. It is also anticipated that fuel cells will be available in the next five years, providing some highly appealing and environmentally friendly options.

For utilities to truly benefit from a distributed generation scheme over the short term, they must look to the existing generator technology to provide a sustainable and affordable solution. As of now, small gas turbines and reciprocating engines account for most (approximately 90 per cent) of the existing on-site generator technology in place. Engines provide the best conversion efficiency (40 per cent), and can operate using non-pressurized gas. Micro-turbines, on the other hand, require compressed gas (60 psi) and their conversion efficiency is lower (approximately 30 per cent). These latter generators tend to be used in wastewater and landfill and other specialty sites, where a conventional prime mover is unable to stand up to the poor fuel quality.

Improved power, improved bottom line

From the utility's point of view, the key advantages to a distributed generation solution are twofold: improved system reliability and quality; and the ability to defer capital costs for a new transformer station. The elimination of line losses between the host and the power source allows for a better voltage profile at the site and on the feeder. At the same time, utilities can add to their supply capacity without incurring the construction costs of a new station.

By way of example, a 5-MW generating station at an industrial site would cost in the range of $6 million, which would be assumed by the host. The host then charges for the electricity sold, to achieve payback within a five-year time frame. The utility, in turn, can defer capital costs associated with a shortage in its system capacity, as the shortfall will be covered by the distributed generation.

The communications hurdle

Distributed generation, while being seriously considered by some utilities, has nevertheless not yet been resorted to in earnest. Leveraging existing generator resources has encountered some major hurdles – not the least of which is the cost and complexity of setting up communications with the host site for monitoring and control.

Automation is key to the success of distributed generation. Until recently, however, no "quick fix" automation system for managing peak generation has been available. In a scenario of this nature, notifying sites to run the host generators in a peak-sharing situation has required a telephone call to the site. This meant that if a utility had, for example, 40 host sites on the network, 40 phone calls would have to be made. Obviously, this is not a viable option.

Host sites could achieve the desired level of communication through the building of a customized SCADA (supervisory control and data acquisition) system at the site. This would incur considerable costs, which quickly negates any potential economic advantages.

One development with great impact on what we can do on the communications front is the Internet. As the demand for improved power quality at a reduced cost grows, it is inevitable that utilities will be looking at the Internet as a means to bridge that all-important gap, while maintaining reasonable profit margins. Distributed generation – as with many other functions within a utility – can become part and parcel of the new Internet-based utility enterprise.

The control and connectivity challenge

Tapping into the existing large pool of generators has not been without its challenges, which explains why distributed generation has not yet been readily accepted as a viable option for utilities. One key factor has been the matter of connectivity and control.

These connectivity issues have only recently been addressed with new relay technologies based on open systems – PC-based protection, monitoring and control equipment specifically designed for generator technology (such as the newest Universal Relay (UR) offering from GE Power Management). The latest intelligent electronic devices (IEDs) offer built-in communications capabilities that allow for easy interconnection with generators at the site, as well as on-line connectivity over the Internet.

This type of interface allows for very cost-effective, Web-based monitoring and control from a utility's central operations at a significantly reduced cost. Depending on the configuration and modem requirements, a utility could theoretically achieve a fully functional, bi-directional SCADA system for somewhere in the range of $10,000 to $15,000.

Whitby Hydro has been among the first in North America to work with GE Power Management on configuring its Universal Relay for SCADA control. The advantage of a PC-based device is that it

can function with virtually any technology and is completely independent of the make or model of turbine. Installation is easy (typical installation time is two to three days), and connectivity requires a simple plug-in.

Once the installation is complete, the relay serves as a communications interface for on-line access from head office. Monitoring and control functions can be provided using enerVista.com, a subscription-based Web service from GE Power Management that provides the SCADA functionality required to automate the system at a significantly reduced cost.

Distributed computing a growing trend

The proliferation of the Internet, when combined with the recent advent of PC-based protection, monitoring and control equipment specifically designed for generator technology, means that distributed generation scenarios can be easily implemented and effectively managed over the Internet, using existing technology at a reduced cost.

There is no question that we are seeing dramatic changes happening in the utility landscape. With the flexibility and versatility that is available through the Internet and PC-based relay technology, the utility industry now has access to a wide array of solutions – solutions not only to sustain greater capacity, enhanced power quality and reliable performance, but also support improved bottom-line results.

Distributed generation is just one way utilities can substantially improve operations over the longer term. What has brought it to the forefront is that the technology is now in place to make it a reality on an affordable scale. As the challenges of competing in a deregulated industry unfold, it's only a matter of time before distributed generation becomes an integral part of a utility's day-to-day operations.

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