Microgrids Integrate Reliability and Renewables

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Safety and prosperity depend on the modern grid more than ever, but they are routinely rocked by natural disasters and volatile weather that may cause power outages of up to two weeks.

Outages cost millions of dollars and put lives at risk. The Department of Energy estimates that this country spends more than $26 billion annually on outages of more than five minutes. While the U.S. grid is good, its reliability does not compare well to other industrialized nations in Europe and Asia. Backup generation helps, but too often the emergency fuel is exhausted before the grid is restored.

One technology that increases energy security, improves efficiency, and often betters air quality is the microgrid, essentially a miniature version of the bigger macrogrid. Featuring localized generation and/or storage, it embodies the capability to "island," or separate from the grid, while running parallel to it. Offering reliability and stability as well as renewable integration, microgrids command a harder look.

The concept of the microgrid goes back to 1882 when Thomas Edison developed the first power plant—the Manhattan Pearl Street Station—as the first source of power before the electric grid as we know it was established. The technology has certainly evolved since then, but the fundamental concept remains the same. For example, in the aftermath of Superstorm Sandy, universities such as New York University and Princeton demonstrated how well-managed cogeneration systems kept campuses running for nearly two days.

A microgrid can be improved by fuel diversification. Florida experienced several hurricanes in 2004. Tampa General Hospital, which features a Level 1 trauma center and an 11MW campus, can be islanded intentionally to protect the facility's mission. In an emergency, Tampa General's microgrid may draw from grid power, diesel-fueled generators, and perhaps in the future clean, natural gas-fired cogeneration.

Localized and increasingly clean generation allows the microgrid to provide power to campuses and small communities independent of a macrogrid. These stability islands can keep whole communities of rate payers warm, fed, and safe. Of course, emergency services, communications, shelters, fuel movement, and supermarkets cannot tolerate weeks without the grid. Following a disaster, microgrids allow first responders to start their work sooner. They can be a super set of emergency power systems that use and ration distributed generation through pre-arranged plans and automated controls.

Cogeneration and emergency generation are increasingly used to anchor local renewable generation sources as well. Renewables that are always "on" are grid-tied, meaning they must go offline when the electrical grid is disrupted. When the microgrid islands, the anchor resource provides a stable source of voltage and frequency, which transitions grid-tied resources to microgrids. This happens regardless of macrogrid availability.

Other features of microgrids are sophisticated switching between diverse sources and black start capability. If power is disrupted, restoration of the ancillary systems providing lubrication, cooling, and starting current are necessary to restart generation or cogeneration.

Bringing Generation Closer to Loads

By bringing generation closer to the loads, we can achieve a higher penetration of renewables, mitigating costly grid modifications to manage the intermittent nature of renewable energy. Diverse energy sources or energy storage can fill supply gaps due to a lack of sun or wind. Further, the storage element and its high-speed power electronics can make the microgrid more fault-tolerant.

Recent projects seek to further monetize microgrids through participation in the ancillary services market. By providing local power for peak demand and regulation services, microgrid owners are capturing credits and reducing rates.

But there is more to do. Permitting, codes, and standards must continue to evolve to enable new generation technologies. Special rate structures for "certain power" must be approved by public utility commissions. The important work on IEEE 1547 *Interconnecting Distributed Resources with Electric Power Systems* must continue. It is important for more utilities to adapt to and embrace the microgrid momentum.

While upfront costs, pricing, and regulation are being managed, increased collaboration with utilities, public utility commissions, and public-private partnerships will help the technology reach its wide-scale potential. Pike Research predicts that more than 3.1GW of microgrid capacity will be available by 2015. ●

Mr. Barton leads Schneider Electric's U.S. activity to organize microgrid projects and solutions.