Viewpoint—From Texas Torrents to Generator Island: Insights from a Destructive Hurricane Season

Mike Howard, President and Chief Executive Officer, EPRI

In thinking about the resilience of our power systems, it occurs to me that *resilience* can be considered as *reliability* in response to attack, stresses, or rapid change. For the United States, three distinctive power systems suffered attack from hurricanes in the U.S. Virgin Islands, the Commonwealth of Puerto Rico, and several states in the Southeast.

Hurricane Harvey poured down more than four feet of water on coastal Texas. Hurricane Irma's outage totals were staggering—six in ten Florida customers, a quarter of Georgia's, one in five for Puerto Rico, and about one of ten in South Carolina.

Hurricane Maria destroyed grids on St. Croix, St. Thomas, St. John, and Puerto Rico. One month later, on October 19, only 21% of Puerto Rico's normal grid load had been restored. About 78% of customers were still without power. For the Virgin Islands, the range was stark—with 98% of St. Croix's customers restored and none on St. John, which depended on restoration through an undersea cable.

Mainland restoration proceeded more swiftly, owing to several factors. For example, flood damage differs from damage caused by very high winds. Mutual assistance programs deployed crews and materials relatively swiftly. Florida and Texas utilities had invested in grid hardening and smart grid technologies to help withstand storms and to speed restoration.

We're continuing to learn how a hardened, smarter infrastructure can withstand nature's attacks. We're gaining insights technically, operationally, and financially in repairing such systems. Some of the improvisation now under way in the Caribbean may inspire new approaches for grid hardening, grid resilience, and disaster recovery.

The New York Times reported that Puerto Rico, with its grid destroyed, had become "Generator Island," with generators ranging in size from lawn mower to moving truck. Google received a federal license for its Project Loon to deploy balloons equipped to provide Internet service. Elon Musk's installations of solar power coupled with batteries have drawn significant public attention.

Several key insights emerged from EPRI's Research Advisory Council in October:

- Experience with 2017 hurricanes demonstrated the value of grid sensors, automation, and advanced communication networks.
- What must follow is to rethink grid resilience *and* community resilience. EPRI is leading efforts on zero net energy and other advanced energy communities equipped with technologies to support reliability during severe weather.
- Utilities demonstrated the effective use of social media along with call centers to engage customers and provide outage information.
- Opportunities exist to expand mutual assistance programs to call center operations and inspection drones.

For EPRI, the grid's resilience and vulnerabilities link to many different areas of research. The November/December edition of *EPRI Journal* reports on research and development that demonstrates just how diverse these can be.

EPRI's advanced metering infrastructure (AMI) Industry Status Database includes 75 utilities operating 80 million meters. We're working to make it a comprehensive guide for optimizing AMI. The global market for smart meters will reach $19.8 billion in 2018, and they will continue to grow in importance in storm recovery and system restoration—to name just one important application.

We're working with utilities to investigate augmented reality with grid equipment. Two obviously important areas in the wake of Harvey, Irma, and Maria are worker safety and storm response.

Inside fossil-fueled power plants, our researchers and collaborators in EPRI's I4GEN program are examining the application and benefits of sensors, advanced diagnostics, digital dashboards, and digital worker technologies such as tablets, smartphones, and augmented reality. Ultimately we expect plant operators to process massive streams of real-time equipment data to operate plants more flexibly and reliably in concert with a more dynamic grid.

The *EPRI Journal* interview with IKEA's Joseph Roth provides an important customer perspective as the company seeks to produce as much energy as it consumes in its global operations. He emphasizes the commitment to staying connected to the grid and supporting investment in utility infrastructure. Assuming other large companies pursue IKEA's goal, the technical and financial ramifications are significant for grid resilience and reliability.

Resilient microgrids may require a fuel-based "anchor" generator for baseload power. Fuel cells offer reliable, 24/7, quiet operation along with the highest efficiency and lowest emissions of all fuel-based generation technologies. Many customers may be willing to pay a premium for these attributes.

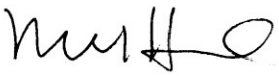
We also highlight EPRI's Integrated Grid pilot projects, including:

- Entergy's tests of utility-scale solar and lithium ion battery storage systems for smoothing solar's variable output, shifting peak production, and enhancing power quality
- Southern California Edison's evaluation of distributed battery energy storage impacts on its distribution planning, considering grid services, dispatch, and reliability

- New York Power Authority's (NYPA) and Central Hudson Gas & Electric's evaluation of solar and energy storage coupled with smart inverters to minimize the impact of variable power flow in the distribution grid

In the months following these hurricanes, society has focused on rebuilding the grid and the significant work that remains for building more resilient grids and communities. We see opportunity to do this, drawing on what we are learning from the hurricanes of 2017.

Mike Howard



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