Advancing Reliability and Resilience of the Grid

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Reliability and Resiliency (General)

Reliability and resiliency of the Bulk Power System (BPS) are closely related characteristics, but with some important distinctions. Reliability is the ability to of the system and its components to withstand instability and failures during routine, or reasonably expected, events. Resiliency is the ability of the system and its components to recover following a non-routine, high-impact disruption.

In the context of the North American Transmission Forum (NATF), reliability expresses how seldom the (electric transmission) system "fails" or otherwise becomes undependable due to conventional impacts like equipment malfunctions, human error, and tree contact. Among other ways, these "traditional" impacts affect the system in the form of outages of varying frequency and duration that can result in disruption to end-users. In the most extreme cases, such as the August 2003 blackout, a compounding of "conventional" or "traditional" impacts or failures can result in cascading outages that affect a large geographic area for days or even weeks.

Mandatory and enforceable NERC Reliability Standards are one important tool to help ensure the reliability of the Bulk Electric System (BES) in the face of traditional impacts, which are better understood, more predictable, and generally geographically uniform. For instance, put simply, standards that help improve baseline protection system performance are typically independent of where that equipment resides. And depending on how they are crafted, standard requirements can provide a reliability benefit on par with or exceeding the burden to implement. Other important tools to improve BES reliability include NATF offerings and products, such as superior practices, peer reviews, and workshops, —especially with respect to clarifying compliance obligations, helping install "compliance margin" and strong internal controls, and promoting continuous improvement. To the extent practical, NATF also promotes adoption of relevant superior practices at the interface to and within the generation and distribution portions of our member organizations.

Resiliency, again in the NATF context, involves severe, infrequent, and often non-traditional impacts. These high impact, low frequency (HILF) impacts—also called "gray sky" and "black sky" days—include threats such as extreme weather or a coordinated cyber-physical attack, respectively. The NATF's resiliency approach considers that a severe impact to the BPS, however unlikely, could occur; therefore, it necessitates advanced planning, processes to "operate through" the impact, and strategies to restore the system based various considerations, including impact type (acts of nature differ from malicious ongoing attacks), geographic scope, expected duration, types of equipment involved/damaged, and cross-sector implications. In the most extreme cases, gray sky or black sky events are presumed to extend weeks or even months. As a result, robust communications, cross-sector collaboration and mutual aid, and alignment on restoration priorities are critical.

The risks associated with these extreme events do not generally lend themselves particularly well to prevention or mitigation via mandatory reliability standards for several reasons: development of a new standard typically spans a significant timeframe; the threats and risks are extremely dynamic, and not fully characterized or

geographically uniform; scope and jurisdictional issues; and, in many cases, implementation would require great expense to preclude an impact that may never occur.

Rather than using standards as a primary tool in this instance, BPS resiliency benefits could be achieved by FERC, NERC, the DOE, EPRI, and others better characterizing the threats and supporting application of more agile mitigations.

Great examples include NERC's long-term and seasonal assessments that are focusing increasing attention on the reliability and resiliency implications of the changing resource mix. Another is the NERC/FERC work to analyze issues associated with the Polar Vortex. Similarly, EPRI's work to characterize the risks and impacts associated with electromagnetic pulse is a key step to meaningful mitigations.

The NATF has focused extensively on resiliency over the last several years. Our initial efforts centered on socializing the importance of the topic and how it related to and was different from traditional reliability. We also helped clarify and reinforce the benefits of adopting an "all hazards" approach to resiliency. More recently, the NATF has focused on identifying and supporting implementation of tangible improvements—in particular, those that provide resiliency benefit across multiple hazards. To that end, we've promoted system hardening, emergency planning with cross-sector coordination, training and drills, and robustness in communications. Some examples of NATF resiliency activities and products include:

- Over 10 resiliency summits (jointly conducted with EPRI)
- "Supplemental operating strategies" detailing key system operation capabilities and how to manually cope with loss of energy management systems and/or SCADA across a large geographic footprint
- Creation of a repository for member superior resiliency practices
- Development (current and future) of specific superior practices for conservative operations, emergency operations, and further incorporation of resiliency considerations into planning (e.g., reconfiguring the system to reduce the number of critical stations and substations)
- Workshops and associated control center tours specific to new control center builds that incorporate resiliency hardening
- Template plans to implement DOE directives under a Grid Security Emergency
- Resiliency centric operating experience reports (experiences, lessons, and solutions)
- Support and lessons learned conveyed regarding member drills and exercises
- Highlighting of member resiliency innovations, such as mobile control houses and modular transformers, for adoption by other members
- Key spare parts (beyond transformers)
- Initial work on a Resiliency Maturity Model

A Path Forward

The NATF strives to be an effective industry partner. Continued improvements in the characterization and prioritization of resilience threats and risks by NERC and others promotes development of timely, agile solutions by the NATF and others. Examples of constructive efforts include the following:

- Continue work to define a common industry definition for resiliency, with special emphasis on clearly defined scope. Because high-impact black sky events, by definition, require significant cross-sector coordination, a common understanding of terminology, priorities, etc. will be essential.
- Focus on implementation of "no regrets" actions that will improve system resiliency across a range of hazards. For example, following the hurricanes of 2004 and 2005, Florida Power & Light (FPL) implemented significant system upgrades, including strengthening over 800 lines that supply critical infrastructure, moving underground or otherwise hardening about half of its main power lines, upgrading over 200 substations in flood prone areas with specific mitigations, installing over 80,000 intelligent devices (automatic feeders, etc.), implementing mobile command centers, and increasing drone use for damage assessment. As a result of these improvements, FPL performance during 2017 Hurricane Irma (a much more severe storm than those seen in 2004–2005) was demonstrably better, with average customer outage times essentially cut in half (2.3 days versus 5.4 days). What is particularly significant is that while these system upgrades improved performance for the targeted hazard (hurricanes), they also likely provide resiliency benefits across a number of other credible hazards.
- FERC, NERC, and the Regions should continue and increase work with regulated entities and state regulators to align on priorities for system hardening and to promote recovery for prudent investments.
- Rather than create new or revised reliability standards that focus on individual hazards or threats, conduct a comprehensive review of existing relevant standards (such as TPL-001) to determine baseline performance that would improve resiliency regardless of the hazard.
- The current grid control hierarchy (Reliability Coordinators, Balancing Authorities, etc.) is very effective and will be so in black sky events if communication capabilities are sufficient. Much of NATF resiliency work has underscored the importance of reliability communications as a key tool to prepare for, operate through, and restore from severe events. Added focus on strengthening communications—technology, redundancy, diversity, protocols—is essential.
- Lastly, resiliency performance improvements can be measured after implementation through traditional metrics (such as FPL's reduction in average customer outage times); however, added measures are likely needed to proactively understand system resiliency and any important gaps. These measures could take the form of a maturity model similar to the Department of Homeland Security C2M2 Model.

The NATF appreciates the opportunity to participate in the Reliability Technical Conference. I look forward to the dialogue and a productive collaboration going forward.