

Transmission Resilience Overview

Definition and Scope

The NATF/EPRI definition of electricity sub-sector resilience* is:

The ability of the system and its components (both equipment and human) to 1) **prepare** for, 2) **anticipate**, 3) **absorb**, 4) **adapt** to, and 5) **recover** from non-routine disruptions, including high impact-low frequency (HILF) events, in a reasonable amount of time

Where:

- 1) **Prepare** involves both longer-term mitigation strategies (e.g., system hardening, sparing strategies/acquisition) and shorter-term preparations (e.g., reconfigurations, staging)
- 2) **Anticipate** provides situational awareness before and during an event
- 3) **Absorb** requires inherent robustness of the system and supporting processes during an event
- 4) **Adapt** entails flexibility and scalability of the system and supporting processes during an event
- 5) **Recover** relates to response and recovery activities during an event

*See "[Understanding the Definition of Resilience \(Companion Document\)](#)" for additional detail and explanation.

Background

The electric grid serves as a vital societal function and an essential aspect of national security. Every sector of the national economy, including food production, banking, manufacturing, and retail distribution, depends on it. Electricity users have come to expect a high degree of electric reliability and availability, and meeting those customer expectations is a fundamental delivery requirement for all electric utilities.

Beyond the economy, extended power outages can also have severe consequences on society at large, specifically for things such as national defense, communications, water and wastewater, healthcare, emergency management, transportation, and law enforcement. Considerations during outages also include interdependencies among critical infrastructures (e.g., the gas and electric industries); needs for workforce support; and local, state, and federal collaboration and assistance.

While delivery of electric service has been very consistent and highly reliable for much of the past 100 years of the development, expansion, and continuous operation of the power grid across North America, the industry realized that the focus solely on reliability can be insufficient in improving system integrity and availability of electric power going forward. As the threat landscape changes or becomes better known, it is apparent that the electric grid also needs to be capable of timely recovery from more severe, non-routine, larger impact and duration events in order to minimize the impacts on society overall.

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NATF Resilience Activities

The North American Transmission Forum (NATF) has been actively working to support and improve transmission system resilience. In 2013, the NATF, in conjunction with the Electric Power Research Institute (EPRI), began holding resilience workshops on geomagnetic disturbances (GMD), which ultimately evolved into our annual resilience summits. The summits have transformed to cover resilience holistically, including topics on electromagnetic pulse, cyber resilience, resilient communications, system hardening, spare strategies, incident command system, and more. The NATF has also initiated several other efforts to enhance resilience.

Transmission Resilience Steering Group

- Forum and resource to set course for resilience activities
- Includes EPRI and RESTORE liaisons

Transmission Resilience Maturity Model (TRMM)

- Free, easy-to-use tool (publicly available)
- Jointly developed (U.S. Department of Energy, Pacific Northwest National Laboratory, and EPRI)
- Designed for transmission utilities to evaluate/trend resilience program maturity
- NATF-facilitated TRMM assessment offering for members

Grid Security Emergency (GSE)** Support

- Coordination with the Electricity Subsector Coordinating Council and U.S. Department of Energy

Summits and Webinars

- Annual summits in conjunction with NERC and EPRI
- Special webinars (e.g., resilience program management/roadmap, TRMM)

RESTORE Spare Sharing Program

- Optional, self-funding program is available to NATF members at minimal additional costs
- Voluntary agreement to share available spare equipment (transformers) following major event
- Complementary to other industry programs (STEP; Grid Assurance)

**Per the FAST Act (2015), the Secretary of Energy may issue an emergency order following a presidential declaration of a GSE. [Fixing America's Surface Transportation \(FAST\) Act](#) Public Law 114-94 (2015), U.S. Statutes at Large 129 (2015): 1774.

Status and Approach

As evidenced by the broad-ranging topics for the summits over the years, progress has been made on many fronts related to resilience activities and research. Improving resilience requires a systematic, strategic approach and cost-effective solutions that may be unique for individual utilities. Investment strategies for hardening the system, upgrading assets, and acquiring and maintaining spare equipment need to be cost-effective, flexible, and agile, while accommodating the adoption of new technologies. A comprehensive plan to address resilience requires an “all hazards” approach.

Efforts to improve reliability and resilience involve risk-based, strategic decisions that may be different for individual utilities. Available resources, level of risk tolerance, geographical locations, and regulatory policies will influence the type of investments, planning, designs, construction, upgrades, and operations for each system. New threats, hazards, and vulnerabilities continue to emerge even as utilities work to protect against today's challenges, so utilities must remain vigilant.

Resources

The NATF produces resources for members and the industry at large. Resilience documents available for the industry are posted on the NATF public site at <https://www.natf.net/documents>