RELIABILITY AND RESILIENCE

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Mission Statement

The purpose of the Reliability and Resilience Tiger Team is to explore several key challenges in defining and evaluating the benefits of LDES investments on grid stability and to evaluate the methods and models used to quantify these impacts, assign value to them, and integrate reliability and resilience considerations into investment planning.

The purpose of the Reliability and Resilience Tiger Team is to address several key challenges:

1) How to define reliability and resilience and build a taxonomy of resilience and reliability services.
2) How to improve utility accounting of reliability/resilience objectives in the resource planning process.
3) How to refine and improve the measurement of reliability and resilience metrics.
4) How to monetize reliability/resilience contributions from grid investments and compensate resource owners accordingly.
5) How to build and improve tools/models used to evaluate the impact of grid investments on reliability and resilience; also, how to define and evaluate existing tools/methods while identifying current gaps.

Reliability and Resilience Tiger Team

Patrick Balducci (Argonne) – Reliability and Resilience Lab Lead

Torrey Lions (INL) – Reliability and Resilience Back-up Lead

Kimberly Johnson (NextGen Energy Partners) – Reliability and Resilience Industry Advisor

- **Team comprised of 56 members** that include representatives of technology developers, industry organizations, small and large utilities, several state and local agencies, national laboratories, utility commissions, and market operators.
- Team **met eight times (134 attendees, 17 per meeting)** between February and September 2024.
- We established **seven teams** that thus far have developed **15 recommendations** for addressing key challenges to LDES adoption.

Challenges/Recommendations Defined in LDES Liftoff Study

- **Challenge #4: A uniform approach toward developing resource adequacy compensation for LDES technologies does not exist, in either regulated markets or competitive markets.**
  - *Recommendation: Develop a suite of resource adequacy constructs based on duration that can serve a variety of use cases and support grid reliability. For example, in addition to the 4-hour duration requirement in several ISOs, develop a corresponding 8-hour, 12-hour, 24-hour, 100-hour, and 500-hour resource adequacy product and the corresponding amount in MW required for each. The actual number of products, the durations of each, and the amount of capacity required for each will vary by ISO. (Targets: FERC, ISOs, state regulatory authorities)*
- **Challenge #6: There is presently a lack of resources regarding how to evaluate grid upgrades or expansions that will be necessary to accommodate both new variable renewable generation sites and LDES systems.**
  - *Recommendation: DOE should fund efforts to identify and close key modeling gaps for LDES technologies and develop tools and datasets for closing these gaps. (Target: DOE)*
- **Challenge #8: LDES is not included in most utility grid firming plans.**
  - *Recommendation: Grid firming plans should include scenarios of greater penetration of renewables that produce protracted energy deficit and surplus periods. (Targets: Utilities, PUCs and other relevant state authorities.)*

"With higher levels of renewable energy penetration and long duration events, such as extreme weather, that lead to long term spikes in energy demand that coincide with reduced energy production, longer duration energy storage is necessary. The fact that grid firming plans neglect LDES could be a result of not planning for these realistic scenarios."

Challenges/ Prelim. Recommendations Defined by Reliability/Resilience Team

- **Challenge #1: Existing reliability and resilience analysis, and associated grid performance incentives, focus on high-cost, low-frequency events, such as earthquakes, hurricanes and other extreme events, while less attention is given to equally important multi-day (typical weather) events.**
  1. *Recommendation: Capture reliability impacts and the full array of investments that address energy deficits in resource planning by applying an all-inclusive cost and solutions framework. (Target: Utilities and RTO/ISOs)*
  2. *Recommendation: Expand the prudency investment test or standard set by public utility commissions (PUCs) to be all-inclusive of solutions that address energy deficits. (Target: State PUCs)*
  3. *Recommendation: Perform real-time grid threshold modeling with hour-by-hour simulation in regulated integrated and competitive markets to signal the deployment of prioritized mechanisms to address energy deficits. (Target: Utilities and RTO/ISOs)*
  4. *Recommendation: Revise and/or modify incentive mechanisms to capture value stacking in solving energy deficits for regulated utilities and competitive market players. (Target: Federal and state legislative bodies, FERC, State PUCs)*

- **Challenge #2: Utilities and power planning organizations do not judge system performance by providing reliable power to critical infrastructure, and there are few metrics used to measure reliability at these facilities.**
  - Recommendations still under development.

"LDES will be a necessary component of a deep decarbonization plan with a transition to vast deployments of intermittent renewables. However, there is currently an unlevel playing field for evaluating the benefits of LDES relative to traditional generators and other shorter-duration storage systems."

Challenges/Prelim. Recommendations Defined by Reliability/Resilience Team

- **Challenge #3: Traditional reliability metrics (e.g. LOLE, LOLP) and resilience metrics (e.g., SAIDI, SAIFI, CAIDI) are not sufficient alone for fully measuring reliability and resilience, or providing insight into the value that LDES can provide in these areas.**

  1. *Recommendation: Utilities planners and modelers should use metrics that capture the length, severity, distribution and probability of loss of load events to identify the appropriate storage technologies that are needed to address them. These metrics may include: EUE, LOLH, SAIDI, CAIDI and may include versions of those that look at the distribution of these events, e.g., 50th percentile to 95th percentiles. Planners and modelers should consider the following metrics when reporting on grid performance:*
     a. *Reliability: Expected Unserved Energy (EUE), and the 95th percentile of EUE (EUE95).*
     b. *Resilience: 95th percentile of SAIDI (Target: Utilities)*
  2. *Recommendation: State utility commissions should require utilities to report on these existing and additional metrics in their IRP planning processes and should require utilities to use these metrics to guide procurement decisions. Moreover, they should encourage utilities to use reliability metric that capture event severity (like EUE or LOLH) as the basis for establishing reliability targets and conducting capacity investment planning and accreditation. (Target: State PUCs)*
  3. *Recommendation: DOE should fund National Lab research to support the determination of appropriate target levels for these new metrics, similar to the 1-day-in-10-years target for LOLE. This research should build on ongoing research to capture the cost of experiencing high levels of EUE, LOLH, SAIDI, etc. that may persist if planners rely only on traditional metrics like LOLE. (Target: DOE)*

"Existing reliability metrics do not fully capture the contributions of LDES to provide reliability and resiliency, particularly during long-duration, challenging grid conditions."

Challenges/Prelim. Recommendations Defined by Reliability/Resilience Team

- **Challenge #4: Existing methods used to model reliability and resilience fail to capture the full range of outage costs. Impacts should extend beyond the value of lost load metric to include indirect and induced economic effects; injury, fatality, and morbidity costs; and others as needed to fully capture these effects.**
  1. *Recommendation: DOE should fund research efforts to support the definition and evaluation (e.g., taxonomy, models, comprehensive frameworks) of a broad range of outage costs to establish best practices and develop resources. (Target: DOE)*
  2. *Recommendation: IEEE, ESIG, EPRI, or other entities should establish establish working groups to develop working papers and standards/practices regarding the valuation of reliability/resilience. (Target: IEEE, ESIC, EPRI, and other research/industry groups.)*
  3. *Recommendation: DOE should provide regulatory support, engaging with PUCs across the US to address this challenge using outcomes from Recommendations 1 and 2. (Target: DOE)*
  4. *Recommendation: State PUCs should adopt standards/frameworks developed in Recommendation 2 and consider these value as part of resource allocation models and resource adequacy frameworks. Utilities should use models/frameworks/tools established through Recommendation 1. (Target: State PUCs and Utilities)*

"Deploying energy storage resources with a range of durations (possibly up to seasonal timescales) will enhance grid reliability in the face of weather-driven cycles and improve its ability to utilize variable low-carbon energy."