Performance-based Energy Resource Feedback, Optimization, and Risk Management: Tentative PERFORM Program Overview

1. What are you trying to do? Articulate your objectives using absolutely no jargon.

At the asset level (assets include: bulk renewables, bulk storage, distributed energy resources (DER), and conventional generation technologies):

- Track asset performance
- Quantify asset delivery risk (i.e., the likelihood and impact whether the asset delivers on its operational obligations), at standard look-ahead time stages (e.g., day-ahead, hour-ahead)
- Introduce asset risk metrics and asset performance metrics

At the systems level:

- Understand and quantify the true operational risk (i.e., inability to serve load) for an evolving system heavy with and reliant on intermittent assets
- Design modern grid management systems around emerging technologies and asset mix
- Achieve a performance-driven and risk-driven operational paradigm that is capable of utilizing all technologies and assets towards all energy and reliability services to break the reliance on conventional generation assets
- Introduce system-level risk metrics and performance metrics into grid management

2. How is it done today? What are the limits of current practice?

Antiquated grid operational protocols and grid management systems:

- Are designed around conventional generation assets (e.g., natural gas power plants)
- Ignore the full capabilities of emerging technologies and emerging assets (e.g., bulk intermittent renewables, bulk storage, distributed energy resources including distributed storage)

Existing grid risk management practices:

- Are primarily limited to N-1 (rare events where any single large asset fails)
- Model intermittent assets (bulk intermittent renewables and distributed energy resources) as deterministic, fixed inputs that have limited or no flexibility
- Treat intermittent assets as uncontrollable, negative load while relying on conventional generation assets to balance net load and to maintain reliable operations
- Model storage either as a generator or a load, not as a risk-mitigating asset
- Rely only on conventional generation assets for required reliability services

3. What is new in your approach and why do you think it will be successful?

Modern grid operational protocols and grid management systems will:

- Account for and include asset flexibility and dependability
- Provide a quantifiable, transparent, and verifiable asset delivery risk assessment
- Incorporate a system-wide risk-driven approach acknowledging asset performance risk, asset interdependencies (i.e., correlation), and the collective system risk
- Analyze and update asset risk assessments and system position both spatially and temporally

This program will be successful because it will:

- Open new revenue streams for emerging assets
- Acknowledge and utilize storage as the ultimate risk-mitigating asset to extract its true value
- Provide an enhanced, risk-aware strategy for integrating and valuing (monetizing) new assets
- Balance complexity relative to the decision making stage (i.e., application)
- Replace the existing reliance on operator intuition and rule-of-thumb approaches with holistic approaches that quantify and optimally manage risk while reducing overall costs

4. Who cares? If you are successful, what difference will it make?

Who cares?

- Bulk renewables, bulk storage, DERs, conventional generators, consumers, RTOs, utilities, software vendors
- New parties: investment sector, finance sector, insurance groups, actuarial scientists
- Venture capitalists interested in exploiting an emerging industry

What difference will it make?

- **75%** of all grid required products and services from bulk renewables, distributed energy resources, and flexible load (renewable portfolio standards only consider energy)
- **100%** of grid products and services from clean resources (nuclear energy resources, bulk renewables, bulk storage, DERs, flexible load, and CCS-based fossil fuel energy resources)
- Reduction in operator discretionary changes (i.e., out-of-market corrections, OMC) by **at least 75%** (standby flexibility to compensate for intermittent assets)
- Cost reduction of **10%** for a $400B industry per year (for the same asset mix)

5. What are the risks?

- Obtaining real, high quality, sufficient data to support PERFORM validation efforts
- Representative organizations willing to conduct pilot studies to verify technology (Phase 2)
- Difficult to integrate within existing management systems, which may not be plug-and-play
- Requires major overhaul of management practices that have existed for decades
- Requires industry acceptance and transition to a new operational paradigm
- Complexity: the greatest achievement of the 20th century, as identified by the NAE, is the electric power grid and the management systems are a major part of that achievement
- Regulatory and market structure (for some regions)

6. How much will it cost?

- Product cost for end user subject to how disruptive the change is (e.g., insertion of a standalone module or full-on replacement of EMS/MMS)

7. How long will it take?

- PERFORM Program: years 1-3; data collection: years 1-5; pilot sites, R&D teams, data: years 4-5 with industry engagement years 1-3
- 5-10 years after the pilots for industry to achieve stakeholder and regulatory approval

8. What are the midterm and final “exams” to check for success?

- ***Midterm Validation 1:*** Use of synthetic data provides insight as to what real data (data type, quality, quantity) is required for PERFORM implementation and success
- ***Midterm Validation 2:*** Counterfactual analysis based on publicly available data, which confirms feasible path to achieve the stated goals in Question 4 above
- ***Midterm Validation 3:*** Initiate negotiations with industry groups targeting pilot studies
- ***Final Validation 1:*** Counterfactual analysis based on public and proprietary data, which confirms feasible path to achieve the stated goals in Question 4 above (Pre-Phase 2)
- ***Final Validation 2:*** Pilot study kickoff with representative industrial groups (Phase 2)