2020-2021 Study Program Assessment Name

Assessment Introduction and Purpose:

FERC defines resiliency as the ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event. The need for resilience against extreme events, beyond resource adequacy, is growing. Questions of operational viability for grid events has received less attention, although, for example, the WECC work on the impact of California-Oregon Intertie (COI) outage (due to wildfires) was one reasonable investigation. That work shows that the system can work around this high-impact-low-frequency (HILF) outage. However, the dynamic behavior of the system while it is *in extremis* has been given little attention. This investigation will test some of the risks associated with HILF, under new conditions of the radically altered generation mix.

Key Reliability Questions:

Grid separation:

- Review existing HILF events already in the planning repertoire. Are any sufficiently severe to be known to cause separation?
- Are the characteristics of the system sufficiently different that breakup will: be more likely, behave differently and/or put equipment at risk?
- Examines existing production cost cases for high IBR conditions of high stress.
- Populates stability runs with those conditions (it is possible that this work could use or build on the cases envisioned for the stability investigation).
- Postulates system separation events and simulates operation. There is no need (and it is nearly impossible) to use detailed protection models to capture an exact breakup, preferably based on knowledge of the system and history, and credible illustrative breakup cases could be run.
- Examines the behavior of the system (and hopefully compare it to the present situation). How fast does the system come apart? Are there obvious transient risks, especially to equipment? Does the system cascade into conditions for which new limitations arise?

- Examines existing system restoration practices. Are critical resources likely to be available? Do they need to be augmented/replaced with new capabilities? What are the options for the new capability? How quickly can the system be restored?

Weather patterns:

- How do weather patterns drive loss of load events in a high wind/solar future?
- When do these occur? What creates them? Is extreme heat or extreme cold correlated with better than average wind/solar resources?

HILF events:

- How would BPS reliability be affected by risks associated with high impact-low frequency (HILF) events under new conditions of the radically altered generation mix?
- With increasing inverter-based resources (IBF), is the spectrum of HILFs considered now adequate? Sufficiently broad?

Conditions/resources:

- How would loss of load be affected by resource mixes, storage and demand response? (Need more info)

Results:

- How might transmission constraints emerge during the transformation of the system?
- Where is effort most urgently needed to relieve future congestion to maintain system reliability? (What case/situation to study)

Reliability Risk Priorities:

The Reliability Risk Priorities are:

- Changing resource mix, and
- Extreme natural events.

Assessment Requirements:

- **Tools** – GridView, PSLF
- **Models** - PCM, Power Flow
- **Data** – To be determined from scenario conditions and events
- **Potential Partners –** NREL/GE, ERCOT, AEMO, EirGrid
    - Will corners of WECC experience the kinds of problems that NREL/GE and others have simulated, or that have been observed by ERCOT, AEMO, and EirGrid? Their problems

are not fundamentally frequency control problems, rather they are a mix of all three "silos" of stability. (Need more info, seam study?)

Study outline:

- Research and gather resilience metric data – 4 weeks (January 29, 2021)
    - What is "resilience"?
    - Use August 2020 conditions for possible comparison
    - Examine probability of system conditions and event occurrences? (April 30, 2021)
    - Develop methodology for resilience? (April 30, 2021)
- Determine condition and/or event(s) created by different extreme weather patterns – 3 weeks (February 19, 2021)
    - Examples (Cold weather events, Hot Weather events (fire (smoke), prolonged heat wave, low hydro condition, low production of solar panels, lower wind production, higher demand), Earthquake?)
- Determine year(s) the event and/or conditions would impact – 2 weeks (March 5, 2021)
- Collect data and identify tools to build scenario – 4 weeks (April 2, 2021)
- Build scenarios starting with base condition and adding system conditions/events – 4 weeks (April 30, 2021)
- Determine resource mix – increase Inverter-based resources, battery storage? Integrate U-DER and R-DER scale storage as needed. – 4 weeks (can be done in parallel with other tasks) (April 30, 2021)
- Choose a starting case
    - Start with 2030 ADS PCM or choose "off-the-shelf" Powerflow case and update for conditions determined above - 2 weeks (May 14, 2021)
    - Add conditions for scenario development - 2 weeks (May 28, 2021)
    - Determine hour to export from PCM or use Powerflow case - 0-2 weeks (June 11, 2021)
    - Solve hour – 1 week (June 18, 2021)
- Steady-state
    - Analyze Powerflow against resilience metrics – 2 weeks (July 2, 2021)
    - Analyze PCM against metrics depending on scenario – 4 weeks (July 30, 2021)
- Dynamics
    - Create Master Dynamics file for case – 1 week (August 6, 2021)
    - Run the WECC standard Disturbances – 1 week (August 13, 2021)
    - Run the scenario determined above – 1 week (August 20, 2021)
- Analysis and Report
    - Analyze the study – 6 weeks (October 1, 2021)
    - Create study report – 4 weeks (October 29, 2021)

Timeframe of Study:

Timeline is a rough estimate and a year and starting case will be chosen depending upon the scenario chosen and the tools available. For example, the 2030 ADS PCM or an operating Powerflow case.

Reporting Metrics:

Reporting Metrics will be determined as part of the study timeline. Resilience metrics will be developed. Some examples of reliability metrics may include:

- Amount of load loss
- Duration of load loss
- Cascading outages
- Thermal Violations
- Voltage Violations
- Stability Issues
- Islanding of the system
- Unserved Energy
- Transmission Constraints