



Summary of LBNL Report: “Frequency Control Requirements for Reliable Interconnection Frequency Response”

Primary Frequency Response Sr. Task Force

4/26/18

Vince Stefanowicz

Sr. Lead Engineer - Generation

- Commissioned by FERC Office of Electric Reliability
- Performed by Lawrence Berkeley National Laboratory - Energy Analysis and Environmental Impacts Division
- Published February, 2018
- Stated purpose:
 - “to support ongoing FERC and industry efforts to ensure reliable interconnection frequency response...”
 - “to support policymaker and industry understanding of the physical requirements for reliable interconnection frequency response”

- NERC Reliability Standard BAL-003-1.1 (Frequency Response and Frequency Bias Setting) - mandates an interconnection-wide frequency response obligation
- Changing resource mix and the need for rapid and sustained Primary Frequency Response and how reductions in system inertia increase these requirements
- Support industry discussion of related issues for reliable interconnection frequency response, such as the importance of small deadbands

- Examined four key areas:
 - Interconnection Requirements for PFR
 - Headroom
 - Rate resources can provide PFR
 - Plant specific controls that limit response or withdraw response

- “Reserves held to provide primary frequency control must exceed the expected loss of generation.”
- “Primary frequency response must be delivered quickly, which requires many participating generators.”
 - “...it is prudent to ensure to the extent technically practical, that all generators [should] have the capability to provide primary frequency response.” [emphasis added]
- “For a given loss of generation, system inertia and the timing of primary frequency response determine how frequency is arrested.”
- “Primary frequency response must be sustained until secondary frequency response can replace it.”

- “Plant load controllers operated in pre-selected load mode without frequency bias will withdraw and not sustain primary frequency response.”
- “Plant load controllers operated in pre-selected load mode with frequency bias will sustain primary frequency response.”
- “Gas turbines may not be able to sustain primary frequency response following large loss-of-generation events.”
 - Acknowledges need for protective (outer loop) controls
- ““Synthetic inertia” controls on electronically coupled wind generation appear not to sustain primary frequency response.”
- “Fast demand response provides robust primary frequency response, but currently is inflexible.”

- “Smaller deadbands on turbine-governors increase how quickly delivery of primary frequency response will begin.”
- “Load sensitivity currently complements primary frequency response, but this sensitivity may be going away.”
 - Directly connected (motor) load draws less power as frequency declines, providing PFR
 - (Newer) electronically connected loads that utilize variable frequency drives do not draw less power as frequency declines, and do not provide PFR

- “Primary frequency control is a known issue in the Eastern Interconnection.”
- This study also clarifies how the large number of generators providing primary frequency response also contributes to measured frequency response of the interconnection.”
- “...it is important that industry monitor and, as appropriate, implement interconnection and region-specific operating policies and procedures that prevent excessive withdrawal of primary frequency response.
[emphasis added]

- “Focused attention should be directed to understanding the aggregate frequency control performance required of the fleet of resources that must be kept on-line at all times to respond to generation-loss events.”
- “All generators, to the extent feasible, should be capable of providing sustained primary frequency response.” [emphasis added]
 - “Reliable interconnection frequency response requires participation by many generators.”
 - “...reliability of the interconnections is enhanced by enabling this capability on all generators capable of providing sustained primary frequency response.”
 - “It is recognized that some generators will not contribute if they are already dispatched at maximum capacity and hence do not have headroom available.”

- “Barriers to adding a frequency bias to plant load controllers should be evaluated and addressed.”
 - “...early withdrawal of primary frequency response by plant load controllers can be prevented by introducing a frequency bias to the control logic of pre-selected load mode controls.”
 - “...some U.S. grid operators already require or have performance requirements that support the use of these controls.”
 - “...it is important to understand and address any financial disincentives that would reinforce current practices.”