

AEP Energy Primary Frequency Response Package

FERC Order 842 - "We conclude that applying the proposed requirements only to newly interconnected generating facilities will adequately address the Commission's concerns regarding primary frequency response."

3/21/18

Executive Summary

- Goal – Avoid unnecessary, costly expansion of requirements associated with FERC Order 842.
 - New generation and upgrades far outweigh generation retirements, thus requiring frequency control capability of new and updated resources is sufficient.
- New or existing resources undergoing the process of creating, or making a substantive modification to an (I)nterconnection (S)ervice (A)greement (e.g. ISA that increases nameplate capacity) become obligated to install, maintain, and operate a functioning governor or equivalent controls to provide Primary Frequency Response (PFR).
- Existing resources are those that have existing ISAs, are in the process of requesting ISAs, or have sought modifications via the PJM que prior to November 1, 2018. Existing resources should continue to provide PFR, as capable - i.e. status quo. Special conditions during system restoration.
- Cost-of-service revenues for providing PFR could optionally be sought via the FERC.
 - FERC will decide whether the resource compensation proposal is just and reasonable.
- Even though not explicitly required by FERC, this proposal includes an evolving PFR performance evaluation mechanism with potential non-performance referral after January 1, 2021.
- Recommendation that transmission owners and PJM study local, restoration-related issues.
 - Planning to ensure adequate localized primary frequency and instantaneous inertial response¹

¹<https://arxiv.org/pdf/1312.6435.pdf>

New and Existing Resources - ISAs

FERC's new PFR Order 842 is ONLY mandatory for those new resources entering into, or existing resources undergoing a material modification to their PJM Small or Large Generation Interconnection Service Agreement (aka SGIA, LGIA).

New resources entering the PJM que after October 31, 2018 would be obligated to the FERC requirement of having necessary hardware or controls to respond to frequency deviations.

Continue work to establish a published baseline requirement for electrical storage, as opposed to the FERC suggestion of private negotiations between electric storage resource and PJM during the interconnection process

Existing resources seeking an increase in electrical nameplate output via the PJM que after October 31, 2018, or that have sought and received compensation approval via FERC, would be obligated to the FERC requirement of having necessary hardware or controls to respond to frequency deviations.

Is this Sufficient?

- Frequency response is an eastern interconnection issue - not only internal to PJM. There is currently a sufficient quantity of PFR in PJM.
- Requiring all existing unit to provide primary frequency response is operationally unnecessary and a costly overreaction. FERC believes new generation in the eastern interconnection will address the issue.
- If existing PFR providers begin to limit their current capability and cause an aggregate system-wide PJM reduction of 10%, stakeholders will reconvene to rectify issue.
 - There are costs associated with an existing PFR provider choosing to no longer provide PFR - control modifications, software changes, unit response changes, etc.
 - Suggest PJM provide updates if this behavior begins happening at the Operating Committee.

Exempt Resources

Nuclear resources are exempt due to NRC operational requirements.

Existing Resources not choosing to modify their interconnection agreements after November 1, 2018 are not required to add or modify existing equipment, control logic, or change their operations to provide primary frequency response.

Compensation

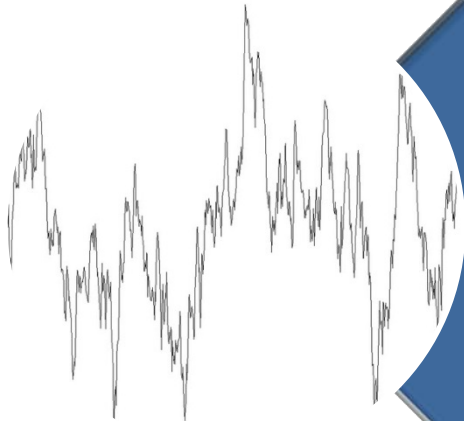
FERC's Order 842 does not prohibit compensation for primary frequency response.

A generator could seek a just-and-reasonable, cost-of-service rate filed with and approved by the FERC. This would typically be capital-related costs for new or replacement equipment.

Ongoing maintenance (VOM) within M-15. Could seek recovery from FERC if future M-15 modifications eliminate components necessary to maintain service.

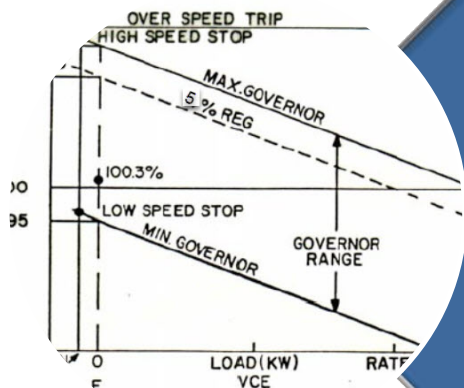
PJM would allocate any FERC approved cost-of-service rate consistent with Schedule 2 – Reactive Supply and Voltage Control

Performance Assessment Event and Equipment Settings



Performance assessments will take place during meaningful frequency deviation events. An event is:

- +/- 53 mHz and frequency remaining outside the +/- 36 mHz deadband for at least 60 seconds.



For all new and existing resources providing PFR, operating parameters should have a maximum droop setting of 5 percent, and a deadband setting of +/- 36 mHz. Critical load units should provide given 30 minutes notice.

Performance Assessment & Complications

Goal is to determine whether resources that are obligated to provide PFR responded to frequency events.

Performance Evaluations are informational for existing resources and new combined heat and power that have an ISA but do not export power to the grid.

Unit response to frequency differs by the operational characteristics of the asset type, hardware/software control systems, and even the 'following modes' on control valves . Performance assessment per asset type should evolve through a stakeholder process as experience is gained.

Operators of obligated electrical storage resources (batteries, flywheels, etc.) may specify an operational range for providing PFR during the interconnection process. PJM and stakeholders to develop and publish minimum requirements to ensure developers are aware of requirements.

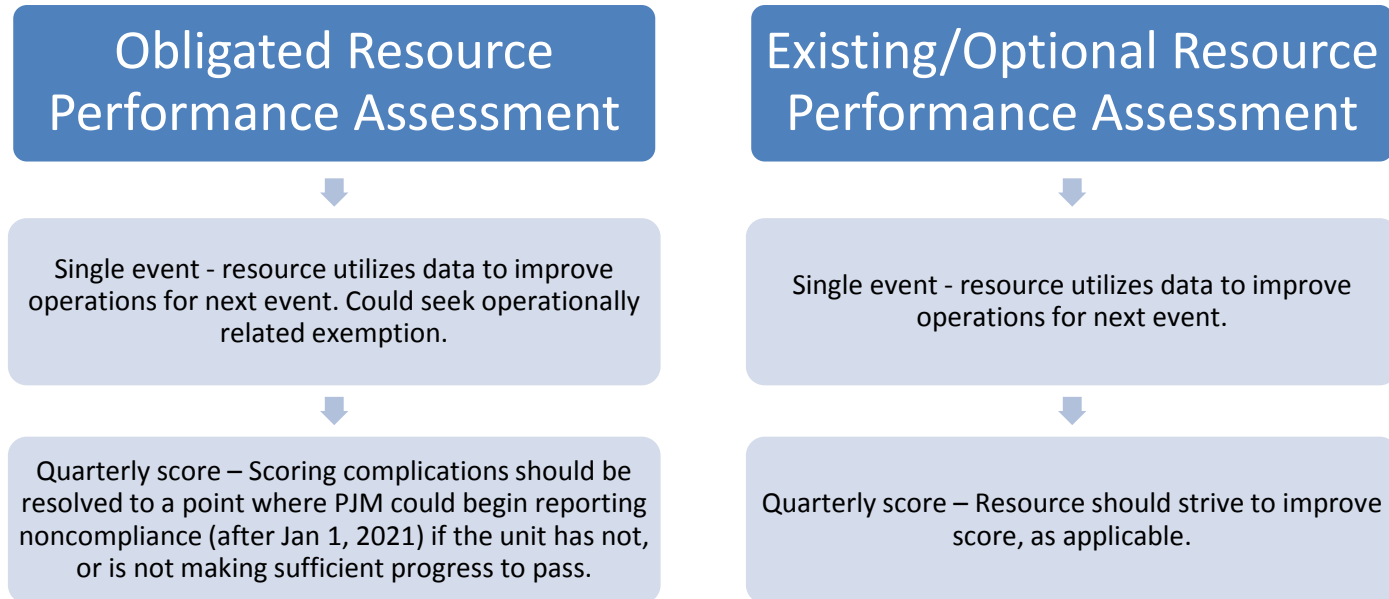
Scoring

For an individual event, did a non-regulation providing resource, that was not close to its Eco-Min/Eco-Max provide $\geq 50\%$ of its expected response during an event? Yes=pass.

On a quarterly basis, PJM will average the last 6 events over a rolling 12 month window to determine the resource's current overall score. Score $\geq 50\%$ to pass.

Units with governor or equipment outages impacting capability to provide frequency response are not subject to an event score failure if equipment outage ticket was submitted prior to the event.

Performance Assessment



It is anticipated that a failing resource will be discussing operational or performance assessment methodology issues with PJM prior to potential action at the FERC.

Closing Words

- The procurement of additional primary frequency response could be necessary, in the future, for system restoration. However, discussions should take place after engineering and restoration studies from transmission owners - the entities responsible for actual system restoration, NERC, or PJM identify a need.
 - Once a deficiency is identified, should there be a market mechanism, such as a RFP for services similar to black start?
 - Should we limit any expansion of existing units to those that became operational in the last 10 years and that can simultaneously provide synchronous inertial response?
 - Inverter based, artificial inertia (such as windfarms, solar, batteries) would be exempt.