

## Performance Assessments:

- Resources expected performance will be calculated with the primary frequency control calculation
  - Frequency below governor deadband

$$MW_{PrimaryControl} = \left[ \frac{(HZ_{actual} - 60 + DB)}{(60 * Droop - DB)} \right] * (FrequencyResponsiveCapacity) * (-1)$$

- Frequency above governor deadband

$$MW_{PrimaryControl} = \left[ \frac{(HZ_{actual} - 60 - DB)}{(60 * Droop - DB)} \right] * (FrequencyResponsiveCapacity) * (-1)$$

- Units will be measured on droop and deadband PJM has documented
  - Default parameters will be set to 5% droop and 36mHz dead band
  - Verification of droop and deadband settings should be performed by resource owner
- Ramp Rate will be calculated for a resource 10 minutes prior to the event start and the expected response will be adjusted for this ramp
  - Actual Response = (AvgMW<sub>20-52sec</sub> - AvgMW<sub>-16-0sec</sub>) - RampRate MW
- Events for which a resource is evaluated will be determined on the following exclusions if it is:
  - offline, or
  - operating as a synchronous condenser, or
  - assigned regulation, or
  - currently operating above 95% of its Eco Max when an under frequency event occurs, or
  - currently operating below Eco Min+(5% x Eco Max) when an over frequency event occurs.

## Event Selection:

- Event Criteria that needs to be met for performance selection to take place:
  - High or Low Frequency Event with a Minimum/Maximum frequency reach +/- 53mHz
  - Frequency must go outside +/- 40mHz deadband and remains outside this bandwidth for at least 60 continuous seconds
- Event selection criteria will be reviewed periodically by the Operating Committee for continued applicability, based on system conditions.

## Quarterly Performance Reviews

- Reviews to determine if resources are frequency response or frequency non-responsive
- Quarterly review will look at an average performance over 12 month window
  - PJM will require a minimum of 6 applicable events for a resource to perform the performance review (will go back further than 12 months if needed in this case)
- Each event will be evaluated separately and the performance will be averaged for responsive/non-responsive determination
  - 50% or greater average performance will be considered responsive
- Units without RT telemetry (per M-01) Performance Assessment will not be performed with RT data

- Required to submit data from a selected event or test results to demonstrate frequency response capability at least 1x per year
- Performance Review criteria will be reviewed periodically by the Operating Committee for continued applicability, based on system conditions.

#### Process for Non-Obligated Units

- PJM will provide unit performance data and rolling average scores for non-obligated resources.
- The resource owner may utilize this resultant data to improve unit performance.

#### Process for Obligated, Non-Responsive units

- If PJM determines a PFR obligated unit is not providing Primary Frequency Response based on the performance review, PJM staff may engage in conversation with the resources owner.
  - Telemetry, Operating scenarios, etc. will be discussed
- Root cause of non-responsive performance should be determined, solutions identified (if possible), and logged.
- A resources score during an event may be excluded from that event's rolling average calculation due to legitimate operating conditions hindering response.
  - Legitimate operating conditions hindering PFR could include, but are not limited to:
    - data/telemetry issues, unit mill/hold points, or
    - outside PFR operating range,
    - max turbine inlet temp limit,
    - max turbine outlet temp limit,
    - feed water makeup limit,
    - draft fans outages,
    - unit ramping prior to or in an opposite direction just prior to the occurrence of a frequency excursion,
    - turbine pressure or throttle valve limits,
    - lack of compressor make-up air, resource operating on secondary fuel,
    - etc.
  - A non-functioning governor or the equivalent frequency control system that allow a resource to provide PFR must be reported as being in outage (via eDART) prior to the event for a score to be excluded from the rolling average.

#### Initial Testing Period

- PJM will utilize the period up to January 1, 2021 to allow PFR Obligated resources to gain experience with the performance scoring. This period will also allow PJM and participants to make any slight modifications to calculations potentially necessary for resource class characteristics.