Performance Assessment for Primary Frequency Response Update

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When will assessment take place?

• PJM will reserve the right to perform performance assessment between 20-30 times a year
  – PJM will aim to find 2-3 frequency events per month for performance assessments, however system conditions may provide less opportunities
    • no set number of events will be prescribed
  – Events selected will be ‘clean’ frequency excursions where frequency went outside the deadband and engaged governors
    • Frequency outsides +/- 40mHz, and **Frequency minimum/maximum reaches +/- 53mHz**
    • Frequency stays outside of deadband for 60 seconds
    • Initial definition of an “event” and can be changed over time based on observed system conditions
  – PJM will aim to select events in both directions
Pass/Fail Assessment

- Scoring will be evaluated as average performance over 12 month window
  - Pass/Fail assessment will be down on a quarterly basis looks at a 12 month rolling window
    - Resources will need a minimum of 3 events for quarterly assessment
    - PJM will look back further than 12 months if needed
  - Each event will be evaluated separately and then performance will be average for pass/fail determination
    - 50% or greater average performance will be considered passing
  - Events for which a resource is evaluated will be determined on if the unit was expected to respond during the selected events
    - Headroom, Online, Regulation status, etc
Unit Ramping and PFR

Low Frequency Event, Units should be providing PFR in upward direction

High Frequency Event, Units should be providing PFR in downward direction

Actual Response = \((\text{AvgMW}_{20-52sec} - \text{AvgMW}_{-16-0sec}) - \text{RampRate MW}_{20-52sec}\)
• Units will be measured on the droop and dead band PJM has documented
  – Initial verification will be performed
  – Default parameters will be set to 5% droop and 36mHz dead band

• 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.
When will performance assessments start?

- The requirement to have Frequency Response capability would not be effective for 2 years after approval which is when “official” assessments will begin.
- As part of the transition, “field trial” performance assessments will begin shortly after approval and results will be shared with unit owners.
  - This will allow for time to work out any data discrepancies.
Appendix
Tool Overview - Setup & Initial Information

- Initial Data need to set up performance assessment
  - Additional data for awareness (ex. fuel type, unit zone, etc.)
- EcoMax/SpinMax data coming from Markets Gateway
  - Important this data is accurate
- Droop/Deadband will be set to PJM requirements (5%/36mHz) unless exception documented
• Data is collected from 1 minute before the event T0 to 5 minutes after the event
  – Frequency, Unit Output, Spin Max, and EcoBP are all collected data
  – FR Capacity is a headroom calculation (EcoMax – Unit Output) for low frequency and (Unit Output – EcoMin) for high frequency
  – Droop Coefficient and Expect Response is the calculated response
  – Regulation and Output Before Event used for situational awareness to make sure the performance assessment is done correctly

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Frequency</th>
<th>Unit Output</th>
<th>Spin Max</th>
<th>FR Capacity</th>
<th>Droop Coefficient</th>
<th>Expected Response</th>
<th>Ecost</th>
<th>Regulation</th>
<th>Output Before Event</th>
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Tool Overview- Point A and B Calculation

- Two points within the data are calculated to be used in the performance evaluation
  - Expected and Actual response at Point A, measured from -16 to 0 sec before the event
  - Expected and Actual response at Point B, measured from 20 to 52 sec after the event
• The full set of data is graphed
  – Event Data: Frequency Profile and Point A and Point B of the event
  – Unit Data: Unit output and Expected response
The addition data is also graphed:

- Unit Output 10min before the event shows the unit behavior before the event (ramping, etc.)
- Regulation graph shows if the unit was providing regulation during the event time period
Example Data
Low Frequency Event
No requested ramping, unit will be evaluated on droop characteristics

Evaluation done on average actual output at 20-52 sec AFTER frequency event compared to average expected output 20-52 sec AFTER frequency event

- Expected response = average MW of green dotted curve in purple band
• Resources expected performance will be calculated with the primary frequency control calculation
  – Frequency below governor deadband
    \[ MW_{primary Control} = \left[ \frac{(HZ_{actual} - 60 + DB)}{(60 \times Droop - DB)} \right] \times (FrequencyResponsiveCapacity) \times (-1) \]
  – Frequency above governor deadband
    \[ MW_{primary Control} = \left[ \frac{(HZ_{actual} - 60 - DB)}{(60 \times Droop - DB)} \right] \times (FrequencyResponsiveCapacity) \times (-1) \]
  – 36mHz deadband (or less), 5% droop (or less)
    • Calculation will be performed with 36mHz and 5% droop unless different settings are communicated to PJM