Modeling Generation Senior Task Force Update & Recommendation

Glen Boyle

Manager, Operations Analysis and Compliance

Markets & Reliability Committee Meeting

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- Focus of the Modeling Generation Senior Task Force (MGSTF)
    - Charter developed and approved by the PJM MRC in March 2017
    - Consider expanding the model that is used in PJM's systems to improve the ability to represent the various components of all generation
- Key Work Activities
    - Review the work of prior groups addressing the model of combined cycle units to better understand the reasons the model was not implemented or used.
    - Promote understanding of generating plants and their need for a more flexible model.
    - Identify and assess the feasibility of market rules/mechanisms to integrate generation resources into PJM's markets such that their operating characteristics are understood, are properly modeled and adequately compensated.
    - Identify necessary changes to OA, Tariff, and manuals needed to implement any new model.

- The Modeling Generation Senior Task Force has developed solutions to improve resource modeling for complex resources such as combined cycle units, coal units with multiple mills, and pumped hydro in PJM's market clearing engines

- Many of the proposed solutions are dependent upon the completion of PJM's next generation energy market (nGEM) systems development efforts which will require several years to complete and implement

  - Current nGEM implementation forecast to support advanced resource modeling is 2023

- As a result of the long-term solution timeframe, PJM's market participants requested that PJM staff develop modeling options which can be implemented in the near-term prior to the nGEM implementation

- Add additional segments to the Energy Offer Curve beyond the 10 currently available to increase resource configuration modeling capabilities
  - ***Approved by MRC for implementation (12/19/19)***
- Provide market participants with the ability to submit Hourly Differentiated Segmented Ramp Rates for resources in both the Day Ahead and Real Time Markets
  - ***Approved by MRC for implementation (12/19/19)***
- Implement Soak Time modeling of resources to allow Market Sellers to specify in Markets Gateway the Hot/Intermediate/Cold Soak Time(s) for resources and the expected hourly energy output produced prior to the resource becoming dispatchable by PJM
  - ***Vote deferred by MRC to 1/23/20***

- Add additional segments to the Energy Offer Curve
  - Low complex solution with implementation possible in early 2020
  - No Tariff or manual language changes required for implementation
- Provide market participants with the ability to submit Hourly Differentiated Segmented Ramp Rates
  - Medium complex solution with implementation possible in 2020
  - Tariff and manual language will need to be approved
  - A FERC filing and FERC approval will be required prior to implementation
- Implement Soak Time
  - Highly complex solution with implementation possible in 2022
  - PJM has identified additional Tariff, Operating Agreement, and manual(s) changes as a result of other market system enhancements such as hourly offers and fast start pricing impacts to soak time and soak cost
  - A FERC filing and FERC approval will be required prior to implementation

Question:	Yes	No	% in favor
Do you support Option 1: Increasing the number of segments available to the Energy Offer Curve from 10 to 20?	57	45	56%
Do you support Option 2: Implementing Hourly Differentiated Segmented Ramp Rates?	111	7	94%
Do you support Option 3: Implementing the Soak Time Parameter?	78	10	89%
Do you support continuing discussions regarding Option 3: Implementation of Soak Time?	76	28	73%

- ## Soak Cost added to Offer Verification for Soak Costs > $1000
  - OA Schedule 1, Section 6.4.3

- ## Update to Operating Reserve during soak time for units selecting price-based option for Soak Costs
  - OA Schedule 1, Section 3.2.3, Manual 28, Section 5.3
  - Units that choose the cost-based option for Soak Costs per section 1.7.4 will be considered following dispatch during their submitted Soak Time. Units that choose the price-based option for Soak Costs per section 1.7.4 will be considered to be not following dispatch when both(i) their price-based soak MW profile is not equal to the cost-based soak MW profile and (ii) their total Real Time soak MWh are greater than 110% of the submitted total soak MWH or less than 90% of the submitted total soak MWh and will be subject to balancing Operating Reserve Deviation charges. Deviations will be charged on a five minute interval basis based on Real Time settlement interval MW minus Day Ahead MW profile.

Additional Implementation Details

- Vote opened: December 9, 2019
- Vote closed: December 11, 2019

- Total Unique Responses: 13
- Total Member Companies Represented: 118

- Memorialize the Modeling Generation Senior Task Force Stakeholder Requirements Document for implementation with PJM's next generation energy market systems
  - Review and provide updates to the MGSTF Stakeholder Requirements Document on a bi-annual basis going forward through implementation
  - Provide periodic updates to the MRC and MC via MC Informational Webinars
- Implement Near-Term Solutions:
  - Additional segments to the Energy Offer Curve
  - Hourly Differentiated Segmented Ramp Rates
  - Soak Time Parameter

- Following PJM MRC and MC endorsement PJM staff will:
  - Memorialize the Modeling Generation Senior Task Force Stakeholder Requirements Document for implementation with PJM's next generation energy market systems
    - Review and provide updates to the MGSTF Stakeholder Requirements Document on a bi-annual basis by the MGSTF going forward through implementation
    - Provide periodic updates to the MRC and MC via MC Informational Webinars
  - Submit required FERC filings as required
  - Begin implementation efforts to:
    - Add additional segments to the Energy Offer Curve in 2020
    - Implement Hourly Differentiated Segmented Ramp Rates in late 2020, and
    - Implement the Soak Time parameter in 2022

- Increase the number of segments on the energy offer curve from 10 to 20
- Market Sellers can better represent break points in the offer curves for CC configurations, duct burner operation, coal unit mills, and pump storage pump operation.
  - Startup and No-load costs would have to be updated hourly to reflect planned resource configuration
  - The ability to update startup and no-load costs is only available for units that Opted-In to Intraday Offers and only for cost-based startups and no-loads
  - Updates to resource min-run times will not be reflected in dispatch for already committed units. PJM Dispatch systems will maintain the original min-run time from the time of resource commitment. In addition, min-run times cannot be updated for committed hours.

- Markets Gateway User Guide

- Allow hourly differentiated segmented ramp rates in both the Day Ahead and Real Time Markets

- Provide the ability to change segmented ramp rate Intraday

- Follow existing Intraday logic rules

  – Updates permitted after the Reliability Assurance Commitment (RAC) run up to 65 minutes prior to operating hour

  – Intraday updates can be submitted for multiple hours

- Hourly differentiated segmented ramp rates provides PJM the capability to perform more accurate reserve calculations

- Manuals
  - M11 Energy & Ancillary Services Market Operation
    - Sections 2.3.7 & 9.1
- Open Access Transmission Tariff
  - Attachment K – Appendix
- Operating Agreement
  - Schedule 1
- Markets Gateway User Guide

- Soak Time Manual and Tariff changes were approved at the January 26, 2017 MRC and the February 23, 2017 MC.

- PJM has recently identified additional Tariff, Operating Agreement, and manual(s) changes which need to be made as a result of other market system enhancements such as hourly offers and fast start pricing impacts to soak time and soak cost
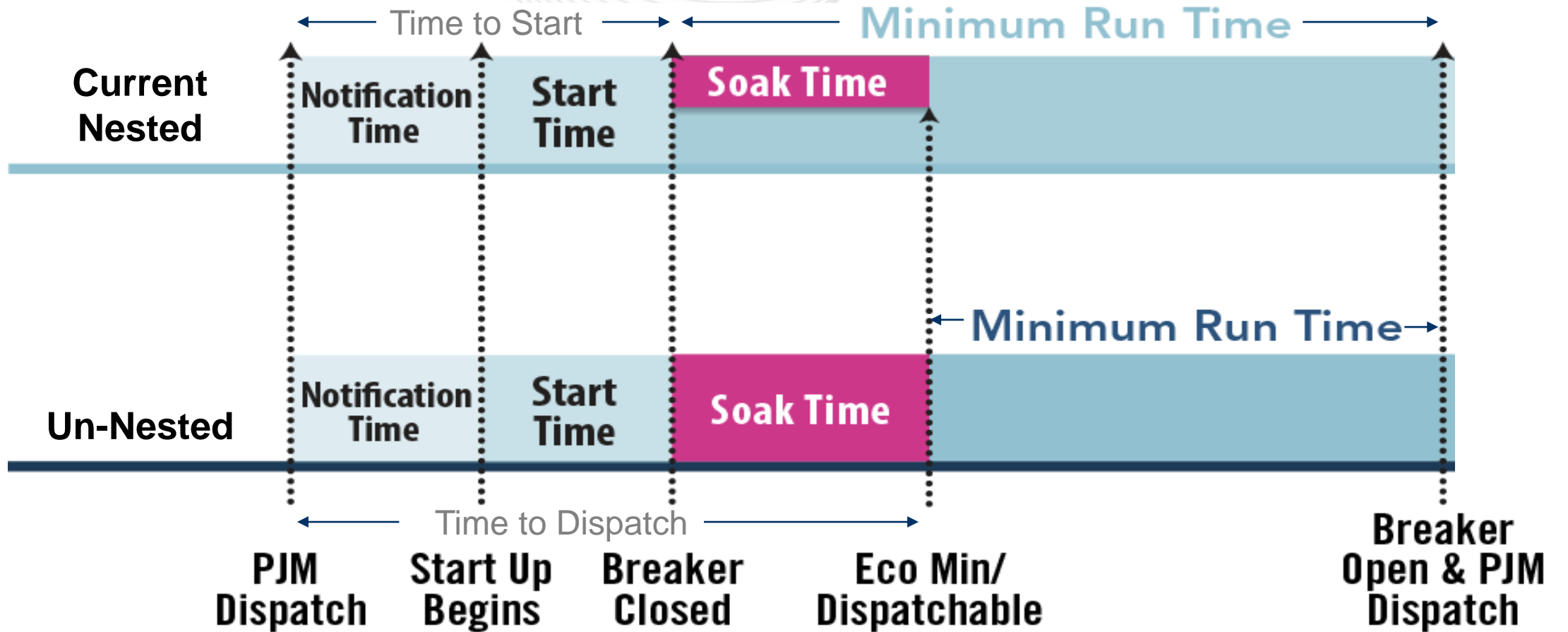
- *Hot/Warm/Cold **Soak Time (hour)** — The minimum number of hours a unit must run, in real-time operations, from the time after generator breaker closure which is typically indicated by telemetered or aggregated state estimator MWs greater than zero to the time the unit is dispatchable. For Combined Cycle units this is the minimum number of hours from the time just after the first combustion turbine generator breaker closure which is typically indicated by telemetered or aggregated state estimator MWs greater than zero and the time the unit is dispatchable.* *(Un-nested and new PLS Parameter)*

Minimum Run Time (hour) — *The minimum number of hours a unit must run, in real-time operations, from the time after ~~generator breaker closure which is typically indicated by telemetered or aggregated state estimator MWs greater than zero~~ the unit is dispatchable to the time of generator breaker opening, as measured by PJM's state estimator. For Combined Cycle units this is the time period after ~~the first combustion turbine generator breaker closure which is typically indicated by telemetered or aggregated state estimator MWs greater than zero and~~ the unit is dispatchable to the time of the last generator breaker opening as measured by PJM's state estimator.*

- Market Sellers will provide Soak MW profiles and Soak Costs for the soak period in Markets Gateway

- DA MW hourly awards would be the MWs submitted into Markets Gateway

- Settlements would use Soak Costs for make whole calculations

- Soak Time would be a new Unit Specific Parameter with new proxy values per technology type

  – Soak Time + New Min Run Time = Current Min Run Time

- Price-based Soak Time Costs would follow current rules for price-based Start-up and No-load

  – Can only be changed twice a year during open enrollment

- Dispatch would use Time to Dispatch in place of Time to Start for start of unit's Min Run Time

- Market Sellers can provide Soak MW profiles for hot, intermediate, and cold temperature states
  - Soak MW profiles will be daily values and not hourly dependent
  - Profiles will be submitted to PJM and IMM for review and will be developed using actual plant data
- Soak Costs will be the average hourly costs for the soak period by temperature state
  - Soak Costs will be an hourly value (Hour 1-24) to allow Market Sellers the ability to model gas day cost changes
  - Market Sellers can update Soak Costs intraday
  - Price-based Soak Costs will follow current rules for price-based Start-up and No-load
    - Can only be changed twice a year during open enrollment

- Manual 15 has been revised to include a new Soak Cost Section

2.5.1 Soak Cost Definitions

- **Soak Cost** ($/MWh) – the average hourly hot, intermediate, and cold temperature state costs to operate a the boiler, turbine, and generator during the soak period after breaker closure to dispatchable and is determined based on the sum of the unit's hourly soak heat input, Performance Factor, maintenance adder, operating costs, and emissions adders divided by the sum of the MWhs produced during the soak period.

$$\text{SoakCost (\$/MWh)}=$$

$$\sum_{Soak\ hour=1}^{n} [[\text{SoakHeatInput (Mbtu/(hr)*TFRC(\$/MBtu)*PerformanceFactor]}$$

$$+\text{MainetenanceAdder(\$/MWh)}$$

$$+\text{OperatingCost(\$/MWh)}$$

$$+\text{EmissionsCosts(\$/MWh)]} / \sum_{Soak\ hour=1}^{n} \text{Soak MWhs}$$

- **Soak Heat input –** Hourly fuel consumed from breaker closing to unit dispatchable
- **Maintenance Adder** – See Section 2.6
- **Operating Costs** – See Section 2.3.7
- **Emissions Costs** – See Section 2.3.5.
- **Soak MWhs** – Hourly MWhs produced during the soak time period

- Settlements will use the applicable temperature state average hourly Soak Costs for make whole calculations
  - No-Load will not be used for make whole calculations during soak period
- Soak Time Operating Reserve Credits rules
  - Total soak MWh are expected to be ±10% of the submitted profile
  - Soak MWhs will be compensated at Soak Cost up to 110% of total soak MWh
  - If the total MWh value for the soak time period is greater than 110% of the total soak time profile, the total soak time offer will be capped at the soak time profile MWh
  - If total soak MWh are less than 90% of the total soak profile, Operating reserves will floor the buyback MWh charges for each 5 minute interval at zero.

- Manuals
  - M11 Energy & Ancillary Services Market Operation
    - Sections 2.3.3, 2.3.4, 2.3.6, 2.3.7, 2.3.10, 4.1, 4.2.6, & 11.2.2
  - M12 Balancing Operations
    - Section 4.6.12
  - M15 Cost Development Guidelines
    - Section 2.4, 2.5, 3.5, 4.5, 5.5, 6.5, 7.5, 9.5, 10.5, 11.5
  - M28 Operating Agreement Accounting
    - Sections 5.2.1, 5.2.7, 5.3
- Markets Gateway User Guide

- Open Access Transmission Tariff
  - Section 1
  - Attachment K – Appendix
  - Schedule 6A

- Operating Agreement
  - Section 1
  - Schedule 1
  - Schedule 2 Section 1.1 (a)