Modeling Generation Senior Task Force Update & Recommendation

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Modeling Generation Senior Task Force Meeting
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Background

- 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.

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Update on Senior Task Force Work Efforts

- 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

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Near-Term Solution Options Considered

- Add additional segments to the Energy Offer Curve beyond the 10 currently available to increase resource configuration modeling capabilities
  - ***Not endorsed by the MGSTF for implementation***
- Provide market participants with the ability to submit Hourly Differentiated Segmented Ramp Rates for resources in both the Day Ahead and Real Time Markets
  - ***Endorsed by the MGSTF for implementation***
- 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
  - ***Endorsed by the MGSTF for implementation***

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Near-Term Solution Options Implementation Details

- 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

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MGSTF Implementation Proposal

- 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
- Implement Near-Term Solutions of Hourly Differentiated Segmented Ramp Rates and Soak Time
  - Develop and present Tariff and manual language for review and endorsement by the MGSTF, MRC and MC

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Proposed Next Steps

- 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 for Hourly Differentiated Segmented Ramp Rates and Soak Time

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Additional Implementation Details

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Hourly Differentiated Segmented Ramp Rates

- 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

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Hourly Differentiated Segmented Ramp Rates Impacted Documents

- 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

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Soak Time Parameter Development History & Needed Updates

- 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

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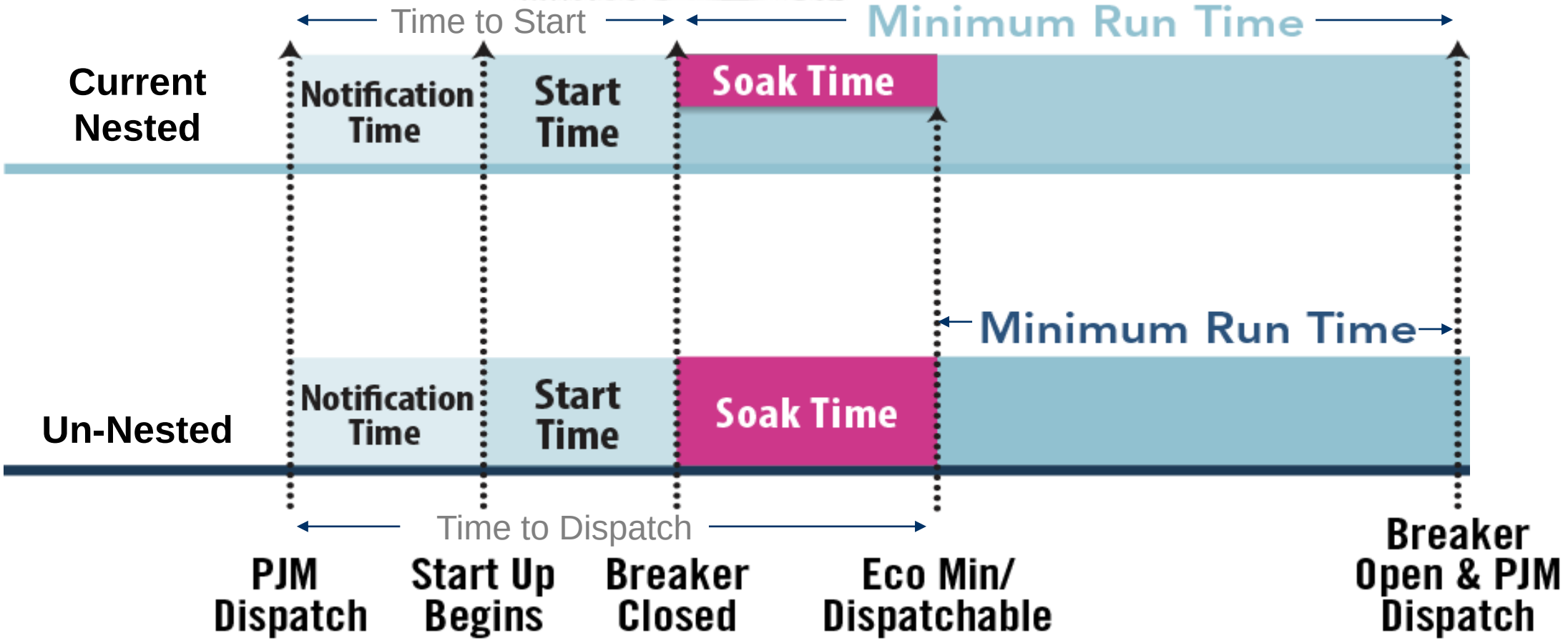
Soak Time Proposal Un-Nests Min Run Time Value Used Today



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Soak Time Definition

- ***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)*

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Minimum Run Time Definition Changes

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.*

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Soak Time Implementation Details

- Market Sellers would provide hourly MW and costs for Soak Time in Markets Gateway
- DA MW hourly awards would be the MWs submitted into Markets Gateway
- Settlements would use hourly Soak Time 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

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Soak Time Proposal Impacted Documents

- 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
- Markets Gateway User Guide

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Soak Time Impacted Documents

- Open Access Transmission Tariff
  - Section 1
  - Attachment K – Appendix
  - Schedule 6A
- Operating Agreement
  - Section 1
  - Schedule 1
  - Schedule 2

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Soak Time Manual 15 Changes

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

2.5.1 Soak Cost Definitions

- **Soak Cost** ($/MWh) – the 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 unit's soak heat input, toatl fuel-related cost, Performance Factor, Soak MWh, maintenance adder, operating costs, and emissions adders.

  SoakCost ($/Start) $_h$=

  {SoakHeatInput (Mbtu/(hr)$_h$ * PerformanceFactor + MaintenanceAdder($/Mbtu)
  +OperatingCost($/Mbtu)] *TFRC($/MBtu) + MaintenanceAdder($/Hr)]}/ Soak MWh$_h$

  +[MaintenanceAdder($/MWh) + OperatingCost($/MWh)]

  +EmissionsCosts($/MWh)

- **Soak Heat Input –** Hourly fuel consumed from breaker closing to unit dispatchable
- **Soak MWh –** Hourly MWh produced from breaker closing to unit dispatchable
- **Maintenance Adder** – See Section 2.6
- **Operating Cost** – See Section 2.3.7
- **Emissions Costs** – See Section 2.3.5.

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