Modeling Generation Senior Task Force Stakeholder Requirements

General	
Design Component	**Details**
Implementation	• Day-Ahead Solution time 2 hours or less. • Real Time/SCED Solution Time less than 3 minutes • IT SCED solution time less than 5 minutes • A configuration must be a subset of one unit ID only and a configuration will have all of the same characteristics as a unit today (One market unit ID per combined cycle unit) • Pseudo models will not be created • Ability to select amount of flexibility offered despite modeling details
Sequencing	• Any change in a unit's operating mode that requires a hold time/transition time would have to be modeled as a separate configuration • PJM can start up or shut down into/out of any valid configuration

Near Term	
Design Component	**Details**
Day Ahead	
DA modeling of additional segments on the Energy Offer Curve	• Startup and No-load costs may be differentiated hourly • Min run times may be differentiated hourly.
DA Modeling of Hourly Differentiated Ramp Rate Curve	• Allow Market Participants to submit hourly differentiated ramp rates for resources in both the Day Ahead and Real Time Markets. • Allow Market Participants the ability to change a resource's ramp rate Intraday to better manage resource configuration changes. • Provide Market Participants the ability to improve alignment with existing intraday offer logic rules that allow updates to be submitted up to 65 minutes prior to operating hour.
DA Modeling of Soak Time	• Hot/Warm/Cold Soak Times (hours) will be entered into Markets Gateway for each schedule. Market Gateway will also allow the entry of the unit's expected MWh for each hour. • The unit's DA award will reflect the market participant's submitted values for the soak time intervals.
Real Time	
RT modeling of additional segments on the Energy Offer Curve	• Startup and No-load costs may be updated hourly by the participant at least 65 minutes prior to start of operating hour reflecting the planned resource configuration • The ability to update startup and no-load costs is only available for units that elected cost-based startup and no-load. • 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, only non-committed hours. .
RT Modeling of Hourly Differentiated Ramp Rate Curve	• Allow Market Participants to submit hourly differentiated ramp rates for resources in both the Day Ahead and Real Time Markets. • Allow Market Participants the ability to change a resource's ramp rate Intraday to better manage resource configuration changes. • Provide Market Participants the ability to improve alignment with existing intraday offer logic rules that allow updates to be submitted up to 65 minutes prior to operating hour.

Long Term	
Design Component	**Details**
Day Ahead	
DA Modeling of Start-Up Time	• The Startup Time for each significant component/configuration of the plant, including megawatt quantity will be modeled. • The model should ensure that individual component/configuration schedules are simple to submit.
DA Modeling of Start-Up Cost	• Start costs for additional operational states and configurations – additional generators, duct burners, etc. will be allowed and reflected in resource offers. • Start cost for Combined Cycles may need further investigation/discussion
DA Modeling of No-Load Cost	• No-Load Costs should have the ability to be modeled for different states/configurations
DA Modeling of Fuel Switching Cost	• Create the ability to model fuel type or source switching using transition matrices and schedule switching and availability
DA Modeling of Soak Time	• Hot/Warm/Cold Soak Times (hours) will be entered into Markets Gateway for each schedule. Market Gateway will also allow the entry of the unit's expected MWh for each hour. • The unit's DA award will reflect the market participant's submitted values for the soak time intervals.
DA Transition Timing	• The model has the capability to capture timing for transitions • The DA Market expects to use the transition timing • Transition timing is not state dependent.
DA Transition Cost	• The model has the ability to handle both cost based and priced based transitions
DA Modeling of Operating Modes/Configurations (Duct Burners, Sprays, Peak Firing, etc.)	• Ability to model individual components including unique operating parameters • Identify decision points to commit duct firing or other configuration/operating mode options. • Ability to recognize operating modes/configurations (switching from 3x1 to 2x1). • Identify the process to incrementally commit or de-commit stages of a combined cycle unit.
Day Ahead Scheduling Reserve Eligibility	• PJM's model will have the capability to model the Startup Time for multiple fueled units. Eligibility of DASR during transition times is reflective of available MWs and timing.
DA modeling of additional segments on the Energy Offer Curve	• Startup and No-load costs may be differentiated hourly. • Min run times may be differentiated hourly.
DA Modeling of Hourly Differentiated Ramp Rate Curve	• Allow Market Participants to submit hourly differentiated ramp rates for resources in both the Day Ahead and Real Time Markets. • Allow Market Participants the ability to change a resource's ramp rate Intraday to better manage resource configuration changes. • Provide Market Participants the ability to improve alignment with existing intraday offer logic rules that allow updates to be submitted up to 65 minutes prior to operating hour.

Long Term (cont.)	
Design Component	**Details**
Real Time	
RT Modeling of Start-Up Time	• PJM has the capability to model start up time for multiple fueled units. • For PJM to model the Startup Times for different plant components, configurations, and states.
RT Modeling of Start-Up Cost	• Start costs for additional operational states and configurations – additional generators, duct burners, etc. – will be allowed and reflected in resource offers. • Startup costs will be associated with the current unit configuration/state. • Start cost for Combined Cycles may need further investigation/discussion
RT Modeling of No-Load Cost/Incremental Offer Curve	• No-Load Costs/Incremental Offer Curve should have the ability to be modeled for different states/configurations
RT Modeling of minimum run time for each step (additional CTs, duct, hydro units, etc.)	• PJM can start up or shut down into/out of any valid configuration. • Every operating mode/configuration has the same parameters that a market unit has. • Respect min run time only for downward transitions
RT Modeling of Operating Modes/Configurations (Duct Burners, Sprays, Peak Firing, etc.)	• Create the ability to optimize overlapping configurations assuming configurations for CCs are not limited to just number of CTs online. • RT Modeling of minimum run time for each step (additional CTs, duct, hydro units, etc.). • Any change in a unit's operating mode that requires a hold time/transition time would have to be modeled as a separate configuration. • Any change in a unit's operating mode that requires a hold time/transition time would have to be modeled as X number of fixed segments of output or ramp rate [in the incremental offer curve].
RT Transition Timing	• Any change in a unit's operating mode that requires a hold time/transition time would have to be modeled as a fixed output or ramp rate [in the incremental offer curve]. • PJM will reflect back SE MWs during transition periods • Transition timing is not state dependent.
RT Transition Cost	• The model has the ability to handle both cost based and priced based transitions
RT modeling of additional segments on the Energy Offer Curve	• Startup and No-load costs may be updated hourly by the participant at least 65 minutes prior to start of operating hour reflecting the planned resource configuration • The ability to update startup and no-load costs is only available for units that elected cost-based startup and no-load. • 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, only non-committed hours.
RT Modeling of Hourly Differentiated Ramp Rate Curve	• Allow Market Participants to submit hourly differentiated ramp rates for resources in both the Day Ahead and Real Time Markets. • Allow Market Participants the ability to change a resource's ramp rate Intraday to better manage resource configuration changes. • Provide Market Participants the ability to improve alignment with existing intraday offer logic rules that allow updates to be submitted up to 65 minutes prior to operating hour.
RT Modeling of Price/MW pairs	• Allow Market Participants to update hourly differentiated price/MW pairs in real-time.

Long Term (cont.)	
Design Component	**Details**
Modeling Enhancements	
Transition Sequence Optimization	• Hold periods and operation mode transitions which can be dynamic based on ambient temperature conditions - Check with GE • includes fuel switching (pipeline/dual fuel)
Modeling of Multiple Fuel Optimization and Utilization	• PJM optimizes available schedules for dispatch within the current construct • Each configuration will now have: 1 price schedule, 1 PLS schedule, *12 cost schedules • 1 price based schedule per fuel cost based schedule - requires additional discussion
Modeling of Fuel Market and Supply Limitations	
Features to Model Resource Flexibility	• Modeling pipeline switching • Modeling multiple fuel switching • Modeling firm/non-firm fuel transport and supply from each pipeline per generator (if possible) • Commercial implications of flexibility
Reserves	
Synchronized Reserve Eligibility/Modeling	• Capture the interactions between synchronized reserve and transitions in RT. • Capture time for transitions. • Capability to model units in transition to provide Synchronized Reserve • Capability to model opting out to provide synchronized reserves during transition • Capability to accurately represent expected output during transition in calculating synch reserves
Non-Synchronized Reserve Eligibility	• Resources must have the capability to provide a continuous 10 minute response • Add modeling capability in case 30 minute reserve product is developed
Telemetry	
Telemetry Requirements	• Telemetry should reflect the current configuration of unit. • Requires additional data (ICCP/Markets Gateway) points for unit configurations and when the unit is in a transitioning state
Other	
Regulation Capability	• Capability to model resource providing regulation during transition • Regulation Capability is configuration dependent
Unit Commitment Rules and Practices	• PJM optimizes unit commitment based on offers with multiple configurations. • Time to dispatch between operation mode transitions which can be dynamic based on ambient temperature conditions or notification time.
Ability to model individual components including unique operating parameters	• Definitions on new operating parameters and changes to existing operating parameters to reflect configuration modeling
Configuration Availability Management and Outage Reporting	• Ability to change availability of configurations and operating modes in RT or Day Ahead. • Gens to provide availability status of configurations • Ability for the market model reflect configuration outages for generation resources in eDart and Markets Gateway and link to EMS