PJM Manual 11:

Energy & Ancillary Services Market Operations

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Prepared by
Day-Ahead and Real-Time Market Operations

Current Revision

Revision 10~~6~~ (~~05/30/2019~~):

Update for FERC Order 814 Electric Storage Resource Participation Model

Added section 2.3.4B Energy Storage Resource (ESR) Participation Model and clarification throughout where appropriate

~~Language to address a credible gas contingency(s) in the calculation for increasing the Day-Ahead Scheduling Reserve Requirement:~~

- ~~Section 11.2.1 Day-Ahead Scheduling Reserve Market Reserve Requirement~~

~~Language added to clarify the reserve market eligibility of resources impacted by a credible gas pipeline contingency(s):~~

- ~~Section 4.2.1 Synchronized Reserve Market Eligibility~~
- ~~Section 4b.2.1 Non-Synchronized Reserve Resource Eligibility~~
- ~~Section 11.2.2 Day-Ahead Scheduling Reserve Market Eligibility~~

2.2 Energy Market Business Rules

2.3.3 Market Sellers

The following business rules apply to Market Sellers whether or not the resource is a Capacity Resource:

- Market Sellers can choose to self-schedule their generation into the Day-ahead Market or submit an offer into the Day-ahead Market and allow PJM to schedule their generation.
  - Resources enrolled in the Energy Storage Resource (ESR) participation model may self-schedule only. When self-scheduling ESR resources, Market Sellers must specify the hourly mode of operation as described in Section 2.3.4B and an operating range as described in Section 2.3.3.2.
- Self-scheduled generation shall submit an hourly operating range and can offer an associated price/MW pairs for consideration in dispatch
- Market Sellers can choose to self-schedule their generation into the Day-ahead Market or submit an offer into the Day-ahead Market and allow PJM to schedule their generation.
  - Resources enrolled in the Energy Storage Resource (ESR) participation model may only self-schedule.
- Self-scheduled generation shall submit an hourly MW schedule.
- Generation owners planning to run generation resources scheduled in the Day-ahead Markets are required to call the PJM Control Center at least 20 minutes prior to bringing the unit online. Generation owners of self-scheduled generation resources must also provide at least 20 minutes notice.
  - Resources enrolled in the ESR participation model with greater than 10 MW must contact the PJM Control Center prior to changing its mode of operation with at least 20 minutes notice.
- Generation resources that are scheduled in the Day-ahead Market have a financial obligation to sell their output in real-time.
  - Combustion Turbines that are scheduled in the Day-ahead Market and then not called on in real-time by PJM may be eligible for Credits for Canceled Pool-Scheduled Resources as defined in Section 5.2.4 of PJM Manual 28: Operating Agreement Accounting.
- Generation resources that are committed by PJM in advance of the Day-Ahead Energy Market will be offer capped and committed on the applicable available schedule at the time of the commitment. The cost-based schedule made available must follow the Generation Owner's Fuel Cost Policy as defined in PJM Manual 15: Cost Development Guidelines.
- If a generation resource is scheduled in the Day-ahead Market and wishes to deviate from that schedule (i.e. not run), the generation owner should contact the PJM Scheduling Coordinator to determine if this course of action is possible. The PJM Scheduling Coordinator will then:
  - If the PJM Scheduling Coordinator determines that the generation resource is not needed for reliability purposes for the operating day, the generation owner can decide not to run the resource and no forced outage is incurred. The generation

owner is responsible for all deviation and operating reserve charges.

- If the PJM Scheduling Coordinator determines that the resource is needed for reliability purposes, he/she will inform the generation owner. The generation owner may still elect to not run the resource, but a forced outage for the duration of the scheduled operation of the resource is generated. The generation owner is responsible for all deviation and operating reserve charges.

- The timing guideline for notifying PJM of deviations for pool scheduled resources is the sum of the resource's notification time plus the time to start. If this sum totals to zero, then the minimum notification time is 45 minutes prior to the scheduled operation of the resource. This allows PJM adequate time for determining if the resource is needed for reliability.

The following bullets describe the treatment of generation offers made into the Day-ahead and Real-time Energy Markets:

- Energy resources may offer into the Day-ahead Market or Real-time Market.
- If an Energy resource does not submit offer data, then the offer is assumed to be a zero MW quantity.
- A generator offer that is accepted for the Day-ahead Market automatically carries over into the Real-time market, unless superseded by a subsequent update.
- Any generator that was not selected in the Day-ahead Market may choose to self-schedule during the Rebid Period.

- Market Sellers with Market-based Rate Authority may elect to offer their generation resources as price-based resources. PJM must be notified of this election so that Markets Gateway can be configured to accept price-based offers for the selected resource. Once a Market Seller elects to offer a resource as a price-based resource, they may not change it back to a cost-based resource.

2.3.3.1 Capacity Resource Offer Rules:

- Generators that are Capacity Resources that have an RPM or FRR commitment for the next Operating Day shall submit offers into the Day-ahead Market, even if they are unavailable due to forced, planned, or maintenance outages.
- Generators that are Capacity Resources that have an RPM or FRR commitment for the next Operating Day and are self-scheduling shall submit offer data in the event that they are called upon during emergency procedures. Such offers shall be based on the ICAP equivalent of the cleared UCAP capacity commitment.
- Generation Capacity Resources that have an RPM or FRR commitment shall submit a schedule of availability for the next seven days and may submit non-binding offer prices for the days beyond the next Operating Day.
- Generation Capacity Resources that have notification, startup, and minimum run times that exceed 24 hours must submit binding price-based offer prices for the next seven days.
- The set of offer data last submitted for each Generation Capacity Resource shall remain in effect for each day until specifically superseded by subsequent offers; however, cost-based incremental energy offers above $1,000/MWh shall be capped at $1,000/MWh when automatically carried forward to subsequent Operating Days.
- Any hourly updates made to the Offer Updates or Detail Updates pages of Markets Gateway supersede the daily values on the Offer and/or Detail pages. Hourly updates made on the Offer Updates or Detail Updates pages are not carried over into the next operating day.
- If a Generation Capacity Resource is not scheduled in the Day-ahead Market, it may revise its offer and submit into the Real-time Market or it may self-schedule the resource.
- Generation Capacity Resources that have notification plus startup times that exceed 24 hours and have been called on by PJM dispatch in advance of the close of the Day-ahead Market bid period for the desired Operating Day must modify their notification and startup time prior to the close of the market bid period for that day in order to create the possibility for the unit to be committed in the Day-ahead Market.
- Intermittent Generation Resources, that are committed Capacity Resources, and Capacity Storage Resources shall meet the must offer requirement by either self-scheduling (Availability = Must Run) or may allow the Day-ahead Market to schedule by offering the unit as a dispatchable resource (Availability = Economic). Resources enrolled in the ESR participation model shall meet the must offer requirement by self-scheduling only.
- The hourly Day-ahead self-scheduled values for intermittent resources and Capacity Storage Resources may vary hour to hour from the capacity obligation value.

2.3.3.2 Generator Schedules

- Generation schedules are collections of generator parameter operating limits and offer data. There are three types of schedules that can be submitted:
  - Cost-based schedule: Cost-based schedules must comply with limits placed on certain parameters as defined in Section 2.3.4 of this Manual. In addition, Generation resource cost- based energy offers must be developed in accordance with Manual 15: Cost Development Guidelines and PJM's governing documents.
  - Price-based Parameter Limited Schedule (PLS): Price-based PLS schedules must comply with limits placed on certain parameters as defined in Section 2.3.4 of this Manual. Price-based PLS energy offers may be market-based.
  - Price-based schedule (non-PLS): Non-PLS Price-based schedules are not subject to the parameter limits defined in Section 2.3.4 of this Manual and may submit market-based energy offers.
  - Note: for purposes of this manual, price-based is used interchangeably with market-based.
- Each Generation Capacity Resource with an RPM or FRR commitment must make available into the Day-ahead and Real-time Markets:
  - at least one cost-based schedule
  - Price-based units must also make available a price-based Parameter Limited Schedule (PLS).
  - All price-based units have the option of submitting a second price schedule that is not parameter limited.
- Each Energy Resource that offers into the Day-ahead and Real-time Markets must make available:
  - At least one cost-based schedule
  - Price-based units must also make available a price-based schedule and/or a price-based Parameter Limited Schedule (PLS).
- A generator offer for a generating unit with combined cycle capability shall make available either the schedules for the CTs or the schedule for the combined cycle unit, not both. Only CTs may submit weather curves, which specify MW limits for CTs as a function of temperature.
  - Forecast points shall consist of a daytime temperature and a nighttime temperature.
  - There are separate weather curves for economic MW and for emergency MW.
- Each CT is assigned to a weather point, which is entered by the Operating Company. As generating units change ownership it may be necessary to add weather points. The default for the weather points is the PJM temperature forecast.

Operating Limit Business Rules

- The priority of generator offer operating limits are as follows: (1) Unit Hourly MW limits (Markets Gateway>Generator>Unit>Hourly), (2) Daily Unit Schedule Limits (Markets Gateway>Generator> Schedules>Detail), (3) Unit limits (Markets Gateway>Unit>Detail).

Daily unit schedule MW limits can be overridden by unit hourly MW limits. Weather curves for CTs apply to both unit limits and schedule limits.

- Certain Operating Limit parameters are subject to limitations as defined in Section 2.3.4 of this Manual.
- ESR model participants use economic/emergency minimum/maximum charge and discharge limits to represent their operating range to PJM. In the context of the ESR participant model, any references to economic and emergency limits can be translated to generator limits, under the three different operating modes, as follows:

	Charge mode	**Discharge mode**	**Continuous Mode**
Emergency Maximum	Emergency Minimum Charge	Emergency Maximum Discharge	Emergency Maximum Discharge
Economic Maximum	Charge Minimum	Discharge Maximum	Discharge Maximum
Economic Minimum	Charge Maximum	Discharge Minimum	Charge Maximum
Emergency Minimum	Emergency Maximum Charge	Emergency Minimum Discharge	Emergency Maximum Charge

- A unit bid includes an Economic Maximum point, which is the highest output on its bid curve that the unit is offering for economic dispatch. The Economic Max represents the highest unrestricted level of MW that the operating company will operate the unit, under its offer, for economic dispatch. The Economic Max point should be based on the actual capability of the unit to operate on its bid curve and should not be used to withhold a portion of the capacity of a unit from the Day-ahead Market.
- Reduction of Economic Max MW constitutes withholding in the Day-ahead Energy Market, if:
  - The Economic Max MW is higher in the bid for the Real-time Energy Market than in the bid for the Day-ahead Market, or;
  - There is no physical reason to designate a lower Economic Max in the bid for the Day-ahead Market bid than in the bid for the Real-time Market.
- The consequence of withholding a unit's capacity by reduction of Economic Max MW is:
  - The unit will be given an outage ticket which reflects a derating equal to the positive difference in Economic Max output designated in the bid for the Real-time Market and in the bid for the Day-ahead Market.
- CT's are permitted to provide an Economic Minimum less than the physical economic minimum value of the unit.
- When a unit or part of a unit is designated as Maximum Emergency (ME), this means that the referenced output levels may require extraordinary procedures and that the designated MW is available to PJM only when PJM requests Maximum Emergency Generation. Designation of a unit or a portion of a unit as ME should be based on the

real operating characteristics of the unit and not be used to withhold all or a portion of the capacity of a unit from the Day-ahead Market.

- Designation of all or part of a unit's capacity as Maximum Emergency (ME) constitutes withholding in the Day-ahead Market, if:
  - The capacity is not designated as ME in the bid for the Real-time Market, or;
  - There is no physical reason to designate the unit as ME.
- The consequence of withholding a unit's capacity under ME is:
  - The unit will be given an outage ticket which reflects a de-rating equal to the positive difference in capacity designated Maximum Emergency in the bid for the Day-ahead Market and capacity designated Maximum Emergency in the bid for the Real-time Market.

Generation Offer Business Rules

- Generation offers may consist of startup, no-load and incremental energy offer.
- Market Sellers can select the 'Switch to Cost Schedule' flag in Markets Gateway (Detail Updates tab) beginning on the day prior to the operating day until 10:30 and again starting at 18:30 through 65 minutes prior to the operating hour. Selecting this flag will make the price-based schedule(s) unavailable for the remainder of the operating day selected and will ensure any future commitments for the operating day are made on an available cost-based schedule. Once the Switch to Cost Schedule option is selected, the Market Seller will not have the option to resume using the price-based schedule for the remainder of the operating day.

Startup and No-load Business Rules:

- A price-based unit has the option to choose cost-based startup and no-load fees. A price-based unit that chooses the cost-based option may specify the startup and no-load fees for each hour and update those values in real-time in accordance with the rules defined in Section 9.1 of this Manual. A priced-based unit that chooses the price based option will continue to be able to change the startup and no-load fees twice a year.
- The choice between using cost-based and price-based startup and no-load fees can be made twice a year during the open enrollment window (on or before 1100 hours March 31 for the period April 1 through September 30 and on or before 1100 hours September 30 for the period October 1 through March 31). Period 1 is defined as the period of time beginning April 1 and ending September 30. Period 2 is defined as the period of time beginning October 1 and ending March 31. If a priced based unit chooses the cost-based startup and no-load fees option, the decision cannot be changed until the next open enrollment period takes place.
  - Resources enrolled in the ESR participation model cannot have startup and no load costs entered.

Incremental Energy Offer Business Rules:

- Generation resource cost-based incremental energy offers may exceed $1,000MWh, but may not exceed $2,000/MWh for the purpose of dispatch and calculating LMP.
- Cost-based incremental energy offers greater than $1,000/MWh, and less than $2,000/MWh, must be verified prior to being used in dispatch and the calculation of LMP as

described in section 2.3.6.2.

- Any cost-based offers greater than $1,000/MWh, which were not verified in time to set LMP, or any cost-based offers greater than $2,000/MWh may be eligible to receive credit for Operating Reserves. Market Sellers must submit all relevant documentation demonstrating the calculation of costs greater than $1,000/MWh to PJM and the MMU in accordance with Attachment D.
- Generation resource market-based incremental energy offers may not exceed $1,000/MWh unless cost-based incremental energy offer is greater than $1,000/MWh then the market-based incremental energy offer is capped at the lesser of the cost-based incremental energy offer or $2,000/MWh. In instances where the price-based incremental energy offer exceeds $1,000/MWh:
  - A reference cost-based schedule with which to compare the price-based schedule must be specified. The reference cost-based schedule should have the same fuel type as the price-based schedule.
  - The price-based schedule and the reference cost-based schedule must have the same offer slope selection and identical MW break points on their incremental energy offers in order to facilitate validation of the price-based offer.
  - The incremental energy offer price for each segment on the price-based schedule must be less than or equal to the incremental energy offer price of the corresponding segment on the reference cost-based offer.
  - The startup and no-load fees on the price-based offer must be less than or equal to those on the reference cost-based offer.
  - Any price-based incremental energy offers submitted above $1,000/MWh will be capped at $1,000/MWh if the above requirements are not met.
  - If, after validation, subsequent changes are made to the reference cost-based schedule that result in the price-based offer being out of compliance, any segments of the price-based incremental energy offer above $1,000/MWh will be capped at $1,000/MWh.

2.3.4B Energy Storage Resource (ESR) Participation Model

An Energy Storage Resource (ESR) is a resource capable of receiving electric energy from the grid and storing it for later injection to the grid and participates in the PJM Energy, Capacity and/or Ancillary Services markets as a Market Participant.

The Energy Storage Resource participation model is an optional model for ESRs to schedule their operation into PJM markets. Energy Storage resources participating in the model make their own commitment decisions in energy and can be dispatchable within their specified operating limits. Energy Storage resources that elect to be in the ESR participation model cannot also elect to be optimized by PJM in the pumped storage hydro optimizer . .

ESR Participation Model Election (i.e. Opt In/Opt Out)

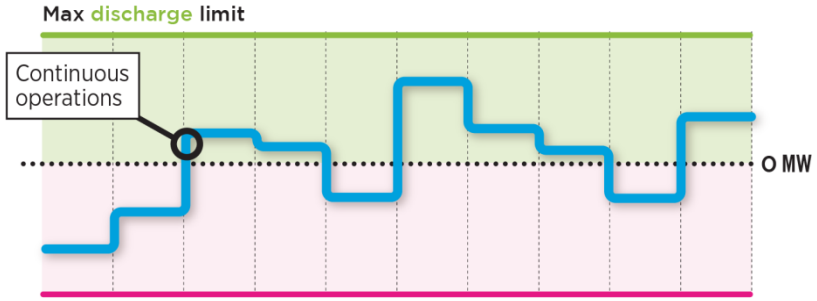
- Resources must opt into the Energy Storage Resource Participation Model by sending a request to Member Relations at custsvc@pjm.com.
- Once a resource opts in for ESR participation, the opt in status remains until an opt out request is received.

- Requests by resources wishing to opt in to the first day of the Energy Storage Resource Participation Model on December 3, 2019 must be received by October 1, 2019.
- Existing resources must send opt-in requests no later than September 30 for the upcoming January 1 to December 31 participation months.
- Resources within the new resource queue process must send an opt in request no later than three months in advance of their initial start in the energy markets.
- An opt out request for an existing resource must be sent to Member Relations at custsvc@pjm.com no later than September 30 to remove the resource for the upcoming January 1 to December 31 participation months.

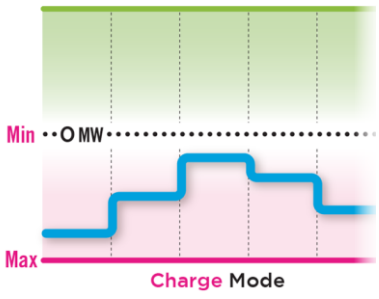
ESR Mode Designation

ESR model participants are not optimized for commitment decisions in Day-Ahead and Real-Time because they are managed directly by participants through specification of the four modes of operation:

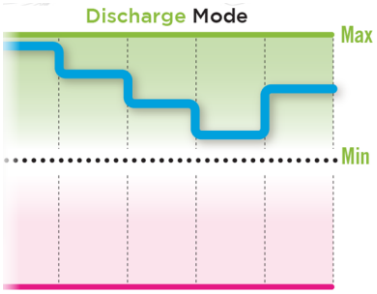
- **Continuous mode**: shall mean the mode of operation of an Energy Storage Resource model participant that includes both negative and positive MW quantities (i.e., the Energy Storage Resource model participant is capable of continually and immediately transitioning from withdrawing MW quantities from the grid to injecting MW quantities onto the grid). ESR model participants operating in Continuous Mode cannot specify a ramp rate as it is assumed to be unlimited Continuous mode requires Maximum Discharge Limit to be greater than or equal to zero and Maximum Charge Limit to be less than or equal to zero.



- **Charge mode**: shall mean the mode of operation of an Energy Storage Resource model participant that only includes negative MW quantities (i.e., the Energy Storage Resource model participant is only withdrawing MWs from the grid). Charge Mode requires that the Energy Storage Resource model participant's Minimum Charge Limit and Maximum Charge Limit be less than or equal to zero, and the Energy Storage Resource model participant is required to define a ramp rate.

- 

- **Discharge mode**: shall mean the mode of operation of an Energy Storage Resource model participant that only includes positive MW quantities (i.e., the Energy Storage Resource model participant is only injecting MWs onto the grid). Discharge Mode requires Minimum Discharge Limit and Maximum Discharge Limit to be greater than or equal to zero. A ramp rate is required in this operating mode.

- 

- **Unavailable**: Indicates that the resource is not available for energy.

These modes are to be used by both the Day-ahead and Real-time Markets. These modes are to be submitted by the market participant on an hourly basis through Markets Gateway by 11am the day before the operating day for Day-Ahead and 65 minutes before the operating hour for Real-Time.

2.3.7 Day-ahead Locational Marginal Price (LMP) Calculations

The following resources are eligible to set LMP values in the Day-ahead Market:

- All ~~pool-~~dispatchable ~~steam~~ units
- ~~Pool-scheduled CTs and diesels~~
- Dispatchable external resource offers
- Increment offers
- Committed Economic Load Response bids
- Price-sensitive demand bids and decrement bids.

- 'Up-to' congestion transactions .
- Generation resources with cost-based incremental energy offers in excess of $2,000/MWh are dispatched in economic merit order but are capped at $2,000/MWh for the purposes of calculating LMP.

Section 3: Overview of the PJM Regulation Market

Welcome to the Overview of the PJM Regulation Market section of the PJM Manual for Energy & Ancillary Services Market Operations. In this section you will find the following information:

- An overview description of the PJM Regulation Market (see "Overview of PJM Regulation Market").
- A list of the PJM Regulation Market Business Rules (see "PJM Regulation Market Business Rules").

3.1 Overview of the PJM Regulation Market

The PJM Regulation Market provides PJM participants with a market-based system for the purchase and sale of the Regulation ancillary service. Resource owners submit specific offers for Regulation Capability and Regulation Performance, and PJM utilizes these offers together with energy offers and resource schedules from the Markets Gateway System as input data to the Ancillary Service Optimizer (ASO) which is an hour-ahead Market Clearing Engine. ASO optimizes the RTO dispatch profile and forecasts LMPs to determine hourly commitments of Regulation to meet the requirement. In real-time PJM jointly optimizes the Regulation committed simultaneously with energy and reserves and calculates the five minute Regulation Market Clearing Price (RMCP) and Regulation Market Performance Clearing Price (RMPCP), which are used to derive the Regulation Market Capability Clearing Price (RMCCP)) every 5 minutes based on the current system conditions. These clearing prices are then used in market settlements to determine the credits awarded to providers and charges allocated to purchasers of the Regulation service.

PJM uses resource schedules, regulation, and energy offers from the Markets Gateway System as input data to the ASO to provide the lowest cost alternative for the procurement of Regulation for each hour of the operating day. The lowest cost alternative for this service is achieved through a simultaneous co-optimization with Synchronized Reserve, Non-Synchronized Reserve and energy. Within the co-optimization, an RTO dispatch profile is forecasted along with LMPs for the market hour. Using the dispatch profile and forecasted LMPs, an opportunity cost, adjusted by the applicable performance score and benefits factor, is estimated for each resource that is eligible to provide regulation. The estimated opportunity cost for Demand Resources is zero. The adjusted lost opportunity cost is added to the adjusted regulation capability cost and the adjusted regulation performance cost to make the adjusted total regulation offer cost. The adjusted total regulation offer cost is then used to create the merit order price. Resource owners may self-schedule Regulation on any qualified resource. The merit order price for any self-scheduled Regulation resource is zero. All available regulating resources are then ranked in ascending order of their merit order prices, and the lowest cost set of resources necessary to simultaneously meet the PJM Regulation Requirement, PJM Synchronized Reserve Requirement, PJM Primary Reserve Requirement and provide energy in that hour is determined. If there is an excess of self-scheduled and zero-cost offers over and beyond the Regulation requirement, PJM uses resource-specific historic performance scores, selecting those resources with the highest performance scores, as a tie-breaker to determine

which set of resources to commit to meet the Regulation requirement. The least cost set of regulation resources identified through this process are then committed. Prices for Regulation are calculated simultaneously with energy and reserve every 5 minutes by the Locational

Pricing Calculator (LPC). The highest merit order price associated with this lowest cost set of resources awarded regulation becomes the RMCP. The RMPCP is calculated as the highest adjusted performance offer from the set of cleared resources. The RMCCP is the difference between RMCP and RMPCP.

In the after-the-fact settlement, any resources self-scheduled to provide Regulation are compensated based on the processes described in PJM Manual 28: Operating Agreement Accounting.

3.2 PJM Regulation Market Business Rules

3.2.8 Hydro Units

Since hydro units operate on a schedule and do not have an energy bid, opportunity cost for these units is calculated as follows Only hydro units not enrolled in the ESR participation model are considered in the rules below.:

- During those hours when a hydro unit is in spill, the ED value is set to zero such that the opportunity cost is based on the full value of LMP. During the operating day, the operating company is responsible for communicating this condition to the PJM Scheduling Coordinator, and indicating this condition on the Regulation Updates page of the Markets Gateway System.
- If a hydro unit is committed day-ahead with MW greater than zero, the formula is the same as Section 3.2.7.Regulation Market Clearing and Dispatch above, except the ED value is an average of the LMP at the hydro unit bus for the appropriate on-peak (0700 - 2259) or off-peak (0000 – 0659, 2300 - 2359) period, excluding those hours during which all available units at the hydro plant were operating. If this average LMP value is higher than the actual LMP at the generator bus, the opportunity cost is zero. Day-ahead LMPs are used for the purpose of estimating opportunity costs for hydro units, and actual LMPs are used in the lost opportunity costs for settlement.
- If a hydro unit is brought on out of schedule to provide regulation or not committed in day-ahead market with MWs greater than 0, the opportunity cost is equal to the average LMP (calculated as stated above) minus the actual LMP at the generator bus. If the actual LMP is higher than the average, the opportunity cost is zero.
- When determined to be economically beneficial, PJM maintains the authority to adjust hydro unit schedules for those units scheduled by the owner if the owner has also submitted a regulation offer for those units and made the units available for regulation.
- An example of Regulation Hydro Lost Opportunity Cost Calculations can be found on the PJM website at https://pjm.com/~/media/markets-ops/ancillary/regulation-uplift-and-lost-opportunity-cost.ashx

Section 4: Overview of the PJM Synchronized Reserve Market

Welcome to the Overview of the PJM Synchronized Reserve Market section of the PJM Manual for Energy & Ancillary Services Market Operations. In this section, you will find the following information:

- An overview description of the PJM Synchronized Reserve Market (see "*Overview of PJM Synchronized Reserve Market*").
- A list of the PJM Synchronized Reserve Market Business Rules (see "*PJM Synchronized Reserve Market Business Rules*").

4.1 Overview of the PJM Synchronized Reserve Market

The PJM Synchronized Reserve Market provides PJM participants with a market-based system for the purchase and sale of the Synchronized Reserve ancillary service. Resource owners submit resource-specific offers to provide Synchronized Reserve, and PJM utilizes these offers together with energy offers and resource schedules from the Markets Gateway System, as input data to the Ancillary Service Optimizer (ASO). ASO then optimizes the RTO dispatch profile and forecasts LMPs to determine hourly commitments of the inflexible Synchronized Reserves. Although the ASO considers all available resources during its commitment process, the hourly commitments for Synchronized Reserve from the ASO are limited to inflexible resources only and may only represent a portion of PJM's Synchronized Reserve needs for the hour. In real-time PJM jointly optimizes the remaining RTO reserve needs simultaneously with energy and regulation and calculates a clearing price for Synchronized Reserve every 5 minutes based on the current system conditions. Five minute, real-time, Synchronized Reserve Market Clearing Prices (SRMCP) are used for market settlement.

Inflexible resources are defined as those resources that physically require an hourly commitment due to minimum run time constraints or staffing constraints. Inflexible resources include but are not limited to synchronous condensers that are operating in condensing mode solely for the purpose of providing Synchronized Reserves and Demand Resources that are prepared to curtail in response to a PJM reserve event.

PJM initially uses forecasted LMPs and resource schedules to estimate the amount of incidental Synchronized Reserve present on the PJM system due to economic dispatch and this capability is designated as Tier 1. Tier 1 is provided by any resource that is on line, following economic dispatch, and capable of increasing its output within ten (10) minutes following a call for a Synchronized Reserve Event. If the forecasted amount of Tier 1 estimated for a given duration is insufficient to meet the PJM Synchronized Reserve Requirement, PJM must commit resources to operate at a point that deviates from economic dispatch in order to provide the remainder of the requirement. The extra capacity that must be committed is designated Tier 2. ASO commits any inflexible resources that are forecasted to be economic to provide Synchronized Reserves during the operating hour. If the solution does not foresee the need to commit Tier 2 reserves or does not commit enough inflexible resources to meet the Synchronized Reserve requirement due to economics, PJM jointly optimizes the balance of the Tier 2 required in real-time with energy.

During each execution of RT SCED, additional Synchronized Reserves are committed to meet the Synchronized Reserve requirement based on current system conditions. IT SCED has the

ability to project conditions further out into the future and make a recommendation to commit additional inflexible resources for reserves where they are economic. RT SCED has the ability to re-dispatch online generating resources to meet the Synchronized Reserve requirement in addition to committing additional flexible resources to provide Synchronized Reserves should they be economic. Prices for Synchronized Reserves are calculated simultaneously with energy, regulation and non-synchronized reserve every 5 minutes by LPC. In the after-the-fact settlement, any resources cleared as self-scheduled to provide Synchronized Reserve are compensated at the applicable five minute SRMCP. Any pool-scheduled resources selected to provide Synchronized Reserve are compensated at the higher of the applicable five minute SRMCP or their real-time opportunity cost plus their Synchronized Reserve offer price. LSEs required to purchase Synchronized Reserve are charged their obligation ratio share of the hourly SRMCP Credits plus their percentage share of opportunity cost credits and Tier 1 credits.

4.2 PJM Synchronized Reserve Market Business Rules

4.2.1 Synchronized Reserve Market Eligibility

Synchronized Reserve offers must be submitted for those resources located electrically within the Synchronized Reserve Zone.

Resources not located electrically within the Synchronized Reserve Zone may not submit Synchronized Reserve offers.

In the event PJM forecasts a credible natural gas pipeline contingency(s), as described in PJM Manual 13: Emergency Operations, Section 3.9, PJM Dispatch will determine the eligibility of resources to provide Synchronized Reserve depending on the severity of the contingency and other system conditions in order to ensure system reliability is maintained.

Resources participating in the Synchronized Reserve market are divided into two Tiers:

- Tier 1 is comprised of all those resources on line following economic dispatch and able to ramp up from their current output in response to a Synchronized Reserve Event, or Demand Resources capable of reducing load, within 10 minutes.
- Tier 2 consists of:
    - additional capacity that is synchronized to the grid and operating at a point that deviates from economic dispatch (including condensing mode) to provide additional Synchronized Reserve not available from Tier 1 resources within ten (10) minutes; and
    - dispatchable Demand Resources that have controls in place to automatically drop load in response to a signal from PJM within ten (10) minutes.
- Tier 1 estimates for Demand Resources equals zero.
- Tier 1 estimates for other resource types that cannot reliably provide Synchronized Reserve service shall be set to zero MW during the market clearing process. Such resource types include, but are not limited to: Nuclear, Wind, Solar, Energy Storage Resources, and Hydro units. Owners of any specific resource(s) or these resource types may request an exception from the default zero MW estimated value of their resource(s) if they notify PJM that the resource(s) are able to reliably provide Tier 1 Synchronized Reserve. PJM only grants such requested exceptions on a prospective basis. A resource

is only credited for Tier 1 Synchronized Reserve if the resource was considered during

the market clearing process, unless such resource actually provides Tier1 Synchronized Reserve during a Synchronized Reserve Event. For further information on the exception process, please visit "Communication Process for Consideration of Some Resources for Tier 1" at this link: https://www.pjm.com/markets-and-operations/ancillary-services.aspx.

- All resources operating on the PJM system with the exception of those assigned as Tier 2 resources are by definition Tier 1 resources. Any resource capable of operating in condensing mode or physically able to operate with an output less than that dictated by economic dispatch must offer Tier 2. There is no qualification process for Tier 2 resources. However, compensation refunds exist as described in section 4.2.12 below for response by Tier 2 resources that is less than that which is committed.
- All on-line non-emergency generation resources providing energy are deemed to be available to provide Tier 1 Synchronized Reserve and Tier 2 Synchronized Reserve, as applicable to the capacity resource's capability to provide these services. During periods for which PJM has issued a Primary Reserve Warning, Voltage Reduction Warning or Manual Load Dump Warning, all other non-emergency generation capacity resources available to provide energy shall have submitted offers for Tier 2 Synchronized Reserves. PJM monitors compliance with the Tier 2 must offer requirement.
    - To monitor the Tier 2 must offer requirement, PJM checks to ensure that every generator subject to the must offer requirement has submitted a Tier 2 offer greater than or equal to 90% of its energy ramp rate for the ramp rate segment including its economic max, multiplied by 10 minutes. If the Tier 2 offer is less than that quantity, PJM will contact the generation owner regarding the Tier 2 offer.
- Regardless of online/offline state, all non-emergency generation capacity resources must submit a daily offer for Tier 2 Synchronized Reserve in Markets Gateway prior to the offer submission deadline (1415 the day prior to the operating day). Offer MW and other non-cost offer details can be changed during the operating day via the hourly update page (Synchronized Reserve Updates).
- Tier 2 offer quantities submitted for a capacity resource on the Synchronized Reserve Offer page in Markets Gateway are automatically carried over from one day to the next unless updated. Changes made on the Synchronized Reserve Updates page of Markets Gateway are not carried over into the next day. Any changes made to the Synchronized Updates page supersedes the values on the Offer page.
- The following information must be supplied through the Markets Gateway System:
    - Synchronized Reserve ramp rate for Tier 1 resources (MW/minute). A separate ramp rate may be submitted for multiple segments of a resource's MW range, and these ramp rates must be greater than or equal to the real-time economic ramp rate(s) submitted for the resource. Synchronized Reserve ramp rates that exceed economic ramp rates must be justified via submission of actual data from past Synchronized Reserve Events to PJM at Email: SRLimitations@pjm.com
        - Resource's energy ramp rate is used for Tier 2 MW calculation.
    - Synchronized Reserve maximum for Tier 1 resources: This value represents the maximum MW output a resource can achieve in response to a Synchronized Reserve Event. Synchronized Reserve maximum for Tier 1 resources is equal to the lesser of the economic maximum or synchronized reserve maximum for the resource. A resource owner may request a lesser synchronized reserve

maximum than the economic maximum if a physical limitation exists. Resource owners may submit a request for this modification via the communication process for consideration of resource physical limitation which can be found on the PJM website under "Modification to Synchronized Reserve Market to Better Reflect the Operating Characteristics of Participating Generating Units" at this location: https://www.pjm.com/markets-and-operations/ancillary-services.aspx.

- Generation resources, including Energy Storage resources enrolled in the ESR participation model, must be able to provide 0.1 MW of Tier 2 Synchronized Reserve Capability in order to participate in the Tier 2 Synchronized Reserve Market. Demand Resources must be able to provide 0.1 MW of Tier 2 Synchronized Reserve Capability in order to participate in the Tier 2 Synchronized Reserve Market.
- Synchronized Reserve availability for Tier 2 resources: Resources may be made unavailable to provide Tier 2 Synchronized Reserve only if they are physically unavailable. Otherwise, they must be made available or self-scheduled to provide Tier 2 Synchronized Reserve per the must offer requirement.
- Synchronized Reserve offer quantity for Tier 2 resources (MW): This quantity is defined as the increase in output achievable by the resource in ten (10) minutes, or the load reduction achievable in ten (10) minutes.
  - A non-emergency generation capacity resource that cannot reliably provide Synchronized Reserve service may submit an offer quantity of zero MW. The participant responsible for a given resource must be able to justify a zero MW offer quantity. Certain unit types including, but not limited to, Nuclear, Wind, Solar, and Energy Storage Resources, are expected to have zero MW Tier 2 Synchronized Reserve offer quantities.
- Synchronized Offer Price for Tier 2 resources ($/MWh): Synchronized Reserve offer prices are capped at a maximum value of the resource's O&M cost (as determined by the Cost Development Subcommittee) plus $7.50/MWh margin.
  - Offer Price cannot be a negative value
- All resources listed as available for Tier 2 Synchronized Reserve with no offer price have their offer prices set to zero.
- Energy use for condensing Tier 2 resources (MW): This is the amount of instantaneous energy a condensing resource consumes while operating in the condensing mode. The value submitted as part of the Synchronized Reserve offer must be less than or equal to the actual energy consumed as observed in real time.
- Should a resource be unable to participate in the Synchronized Reserve market in any given hour on the operating day, the following update should be made 65 minutes prior to the operating hour in the Synchronized Reserve Update screens of Markets Gateway (both updates must be made):
  - Set Offer MW to zero
  - Set Available status to Not Available
- Condense to gen cost: This is the cost of transitioning a condenser to the generating mode. The value submitted for this cost must be less than or equal to the condensing start cost.

- Shutdown Costs: These are the costs a Demand Resource incurs when reducing load in response to a Synchronized Reserve Event.
- Condense Startup Cost: This is the actual cost associated with getting a resource from a completely off-line state into the condensing mode including fuel, O&M, etc.
- Condense Hourly Cost: This is the hourly cost to condense and is equal to the actual, variable O&M costs associated with operating a resource in the condensing mode, including any fuel costs. It does not include any estimate for energy consumed
- Condense Notification Time: The amount of advance notice, in hours, required to notify the operating company to prepare the resource to operate in synchronous condensing mode. The default value is 0 hours.
- Spin as Condenser: This is used to identify if a combustion turbine or a hydro resource can be committed for Synchronized Reserve as a condenser.
- Condense Available Status: Indicates a resource's availability to provide voltage/ reactive support. This value is not directly related to Synchronized Reserve Market.

4.2.3 Hydro Units

Hydro units condensing to provide synchronized reserve during times when they were not scheduled to generate incur no opportunity cost. There may or may not be an energy use component, as indicated by the owner as part of the synchronized reserve offer. Only hydro units not enrolled in the ESR participation model are considered in the rules below.

- If a hydro unit is held to synchronized reserve condense or reduced to provide synchronized reserve during a time when it is scheduled to generate, it will incur opportunity cost. Since hydro units operate on a schedule and do not have an energy bid, opportunity cost for these units is calculated as follows:
- The formula is the same as that shown under 'Synchronized Reserve Commitment', O.C. = |LMP – ED| x GENOFF, except the ED value is the average value of the LMP at the hydro unit bus for the appropriate on-peak (0700 – 2259) or off-peak (0000 – 0659, 2300 - 2359) period, excluding those hours during which all available units at the hydro plant were operating. Day-ahead values are used for the purposes of committing Tier 2 resources, and actual LMPs are used in the after-the-fact settlement. If the average LMP value is higher than the actual LMP at the generator bus, the opportunity cost is zero.
- During those hours when a hydro unit is in spilling mode, the ED value is set to zero such that the opportunity cost is based on the full value of LMP. During the operating day, the operating company is responsible for communicating this condition on the Regulation Hourly Updates page in the Markets Gateway System.
- When determined to be economically beneficial, PJM maintains the authority to adjust hydro unit schedules for those units scheduled by the owner if the owner has also submitted a synchronized reserve offer for those units and made the units available for spin.
- An example of Tier 2 synchronized reserve lost opportunity cost calculation is very similar to that of regulation hydro lost opportunity cost calculation detailed on the PJM website at https://pjm.com/~/media/markets-ops/ancillary/regulation-uplift-and-lost-opportunity-cost.ashx

4b.2 Non-Synchronized Reserve Market Business Rules

4b.2.1 Non-Synchronized Reserve Resource Eligibility

Non-synchronized reserves may be provided only by generation resources electrically within the PJM RTO.

Non-synchronized reserve resources are defined as generation resources that meet the following eligibility requirements to provide non-synchronized reserve.

The Non-Synchronized Reserve capability of a generation resource shall be the increase in energy output or achievable by the generation resource within a continuous 10-minute period provided that the resource is not synchronized to the system at the initiation of the response

Examples of Non-Synchronized Reserve resources generally include:

- Shutdown run-of-river, pumped hydro, (With the exception of pumped hydro that is enrolled in the ESR model) industrial combustion turbines, jet engine/ expander turbines, combined cycle and diesels.
- Demand Resources will not be eligible to provide Non-Synchronized Reserve.
- Generation resources that have designated their entire output as emergency will not be considered eligible to provide ~~n~~Non-~~s~~Synchronized ~~r~~Reserves.
- Generation resources that are not available to provide energy will not be considered eligible to provide ~~n~~Non-~~s~~Synchronized ~~r~~Reserves.
- Energy Storage Resources enrolled in the ESR participation model are not eligible to provide Non-Synchronized Reserve.

In the event PJM forecasts a credible natural gas pipeline contingency(s), as described in PJM Manual 13: Emergency Operations, Section 3.9, PJM Dispatch will determine the eligibility of resources to provide Non-Synchronized Reserve depending on the severity of the contingency and other system conditions in order to ensure system reliability is maintained.

Section 9: Hourly Scheduling

Welcome to the Hourly Scheduling section of the PJM Manual for Energy & Ancillary Services Market Operations. In this section, you will find the following information:

- How schedules may be adjusted on an hourly basis (see "Hourly Scheduling Adjustments").
- How pre-planned operating schedules may be changed by PJM or PJM Members to reflect new conditions (see "Self-Schedule Adjustments").

9.1 Hourly Schedule Adjustments

At times Market Sellers may benefit from having the ability to differentiate and update their offers, and other associated parameters, on an hourly basis to more accurately reflect their true cost of generation or account for other operating conditions. This section discusses the timing, parameters, and process for updating schedules for use in the Real-time Energy Market.

Generat~~or~~sion and Demand Resources may alter their offers for use in the Real-time Energy Market during the following periods (real-time update periods):

- During the Generation Rebidding Period which is defined from the time the Office of Interconnection posts the results of the Day-Ahead Energy Market until 1415.
- Starting at 1830 (typically after the Reliability Assessment and Commitment (RAC) Run is completed) and up to 65 minutes prior to the start of the operating hour (T-65 min).

The following generation offer parameters may be updated during the real-time update periods, with exceptions as noted below:

- Incremental Offer Price
  - For Price-based offers, it may be increased or decreased for uncommitted hours, but may only be decreased for committed hours. When determining whether an update constitutes an increase or decrease, each segment of the updated offer curve will be compared to each segment of the incremental offer curve that existed for the schedule and hour at the time the resource most recently received a commitment for that hour.
  - For Cost-based offers, they may be increased or decreased for both committed and uncommitted hours.
- Incremental Offer MW
  - During the Generation Rebidding Period, Offer MW may only be updated for hours that did not receive a commitment in the Day-Ahead Market.
  - Following the close of the Generation Rebidding Period, no updates to the Incremental Offer MW may be made, regardless of resource commitment status.
- Emergency Minimum and Maximum MW Limits
  - These parameters are not subject to the T-65 min update deadline and may be updated through the end of the operating hour to which the updates apply.

- Economic Minimum and Maximum Limits
  - These parameters are not subject to the T-65 min update deadline and may be updated through the end of the operating hour to which the updates apply.
- Startup Cost (Cold, Intermediate, Hot) and No-Load Cost
  - Cost-based Startup and No-Load values (on either a price-based or cost-based schedule) may be increased or decreased for both committed and uncommitted hours.
  - Price-based Startup and No-Load values may not be updated outside of the open enrollment periods as specified in Section 2.3.3 of this Manual.
- Minimum Run Time
  - Hourly differentiated Minimum Run Time values are only considered for use during real-time commitment and dispatch.
  - Minimum Run Time may not be updated for any hour that has received a commitment in the Day-Ahead or Real-time Market.
- Notification Time
  - Hourly differentiated Notification Time values are only considered for use during real-time commitment and dispatch.
- Schedule Availability
  - During the Generation Rebidding Period, Schedule Availability may only be updated for schedules that did not receive a commitment in the Day-Ahead Market.
  - No updates to Schedule Availability may be made following the close of the Generation Rebidding Period, regardless of schedule commitment status, except for dual fuel resources.
    - Resources designated as “Dual Fuel Capable” in Markets Gateway may submit hourly differentiated schedule availability for cost-based schedules following the close of the Generation Rebidding Period, for uncommitted hours only, in order to communicate fuel availability.
- Switch to Cost Schedule Flag
  - May not be updated during the Generation Rebidding Period.
- Any hourly updates made to the Offer Updates or Detail Updates pages of Markets Gateway supersede the daily values on the Offer and/or Detail pages. Hourly updates made on the Offer Updates or Detail Updates pages are not automatically carried over into the next operating day.

The following Demand Resource offer parameters may be updated during the real-time update periods, with exceptions as noted below:

- Incremental Offer Price
  - Offer Price may not be updated for any hour that has received a commitment in the Day-Ahead or Real-time Market.

- Incremental Offer MW
  - During the Generation Rebidding Period, Offer MW may only be updated for hours that did not receive a commitment in the Day-Ahead Market.
  - No updates to Incremental Offer MW may be made following the close of the Generation Rebidding Period, regardless of resource commitment status.
- Economic Minimum and Maximum MW Limits
- Shutdown Cost
  - Shutdown Cost may not be updated for any hour that has received a commitment in the Day-Ahead or Real-time Market.
- Minimum Down Time Limit
  - Hourly differentiated Minimum Down Time is only considered for use during real-time commitment and dispatch.
  - Minimum Down Time may not be updated for any hour that has received a commitment in the Day-Ahead or Real-time Market.
- Notification Time
  - Hourly differentiated Notification Time is only considered for use during real-time commitment and dispatch.
  - Any hourly changes made on the Offer Updates or Hourly Updates screens in Markets Gateway supersede the values on the Offers and Parameter pages.

The following ESR participation model offer parameters may be updated during the real-time update periods, with exceptions as noted below:

- Mode selection (charge, discharge, continuous, unavailable)
- Economic Minimum and Maximum Charge Limits
  - These parameters are not subject to the T-65 min update deadline and may be updated through the end of the operating hour to which the updates apply
- Economic Minimum and Maximum Discharge Limits
  - These parameters are not subject to the T-65 min update deadline and may be updated through the end of the operating hour to which the updates apply
- Emergency Minimum and Maximum Charge Limits
  - These parameters are not subject to the T-65 min update deadline and may be updated through the end of the operating hour to which the updates apply
- Emergency Minimum and Maximum Discharge Limits
  - These parameters are not subject to the T-65 min update deadline and may be updated through the end of the operating hour to which the updates apply
- Hourly state of charge (for informational purposes only)

9.1.1 Intraday Offers Optionality

The ability to submit intraday offers in Markets Gateway is an optional feature. Market Sellers

who wish to submit updates to their generation resource offers after the close of the Generation Rebidding Period have to formally opt in in the resource's Fuel Cost Policy and in Markets Gateway. By default, generation resources are designated as opted out of intraday offers.

Market Sellers may still submit offers for a generation resource that has been opted out of intraday offers into the Day-Ahead Market and update those offers during the Generation Rebidding Period for any hours not committed in the Day-Ahead Market. However, the Market Seller cannot submit any offer parameter updates following the close of the Generation Rebidding Period, except as follows:

- Economic Minimum and Maximum Operating Limits, Emergency Minimum and Maximum Operating Limits and other information on the Unit Hourly Updates screen in Markets Gateway may still be updated through the end of the operating hour. Hourly differentiated Notification Time may be updated through T-65 minutes.
- Market Sellers that opt-out of Intraday Updates may not specify hourly differentiated Minimum Run Time values.
- Certain Regulation Offer parameters may be updated in real-time as specified in Section 3.2.2 of this Manual.
- Certain Synchronized Reserve Offer parameters may be updated in real-time as specified in Section 4.2.4 of this Manual.

For Market Sellers that have opted in, any intraday updates to cost-based offers must comply with the criteria defined in the resource's approved Fuel Cost Policy.

Market Sellers must specify the opt in/opt out election for each generation resource individually. The election to opt in to intraday offer updates must be specified in the generation resource's Fuel Cost Policy. The Market Seller's election in Markets Gateway must be consistent with the resource's Fuel Cost Policy. Market Sellers should opt the resource out of intraday offer updates in Markets Gateway if the resource's Fuel Cost Policy does not specify methods for intraday offer updates.

Opt in/opt out elections apply at a minimum on a monthly basis. Market Sellers must designate their election by midnight of the 15th day of the month prior to the month the election will begin. The election will continue until the user cancels. An exception to this deadline will apply to election changes that are driven by a change to the frequency of cost determination in the resource's approved Fuel Cost Policy. In this case, the election may be changed upon approval of the revised Fuel Cost Policy.

Section 11: Overview of the Day-Ahead Scheduling Reserve Market

11.1.1 Day-Ahead Scheduling Reserve Market Eligibility

Day-Ahead Scheduling Reserve Resources are defined as resources that meet the following eligibility requirements to provide Day-Ahead Scheduling Reserve:

Day-Ahead Scheduling Reserve Resources comprise of all those resources that can provide reserve capability that can be fully converted into energy within 30 minutes from the request of the PJM dispatcher at the time of the request and is provided by equipment which may not necessarily at the time of the request be electrically synchronized to the system.

A Day-Ahead Scheduling Reserve Resource may be:

- Equipment not electrically synchronized to the system. The equipment that generally qualifies in this category includes pumped hydro, industrial combustion turbines, jet engine/expander turbines, combined cycle and diesels; or
- Additional generating capacity that is synchronized to the grid and scheduled and can increase output in 30 minutes (including condensing mode and pumped hydro that is in pumping mode) to provide additional Day-Ahead Scheduling Reserve;

  or
- Load response resources registered in the Economic Load Response program that indicate that they can be dispatchable by PJM in real-time can reduce within 30 minutes.
- Load response resources that are considered "batch load" resources as defined in Section 1.3.1A.001 of the Operating Agreement, may participate in the Day-Ahead Scheduling Reserve market under the same conditions that exist for the Synchronized Reserve Market with respect to having already reduced prior to receiving a PJM dispatch instruction to do so. Such resources must remain off line for the duration of the PJM dispatch request in order to receive the Day-Ahead Scheduling Reserve market payment.
- Day-Ahead Scheduling Reserve Market offers may be submitted only for those resources located electrically within the PJM RTO. Resources that cannot reliably provide Day-Ahead Scheduling Reserve obligations in real-time shall be excluded from

the Day-Ahead Scheduling Reserve process. Such resources types include, but are not limited to: Nuclear units, run-of-river and self-scheduled pumped hydro units, Wind units, ESR model participants, Solar units, and non-energy resources such as batteries which do not have capability to provide the obligations of Day-Ahead Scheduling Reserve for entire hour. Owners of any specific resource(s) or these resource types may request an exception from the default non-eligibility to provide Day-Ahead Scheduling Reserve if they notify PJM that the resource(s) are able to reliably provide Day-Ahead Scheduling Reserve Obligation in real-time.

- Resources may participate and be compensated in both the Day-Ahead Scheduling Reserve and Synchronized Reserve Markets. In addition, resources may participate and be compensated in both the Day-Ahead Scheduling Reserve and Regulation Markets. However, since resources cannot participate in both the Synchronized Reserve and Regulation markets; no resources can participate in the Day-Ahead Scheduling Reserve, Synchronized Reserve AND Regulation markets and be compensated for all three.
- The following additional Demand Resource requirements must also be met in order to participate in the Day-Ahead Scheduling Reserve Market:
  - Demand resources' response controls must be approved by PJM prior to participation in the Day-Ahead Scheduling Reserve Market including ability to be dispatched by PJM's Security Constrained Economic Dispatch system.
  - Demand resources providing Day-Ahead Scheduling Reserve are required to provide telemetry that is capable of providing metering information at no less than a one minute scan rate.
- Metering information of demand resources is not required to be sent to PJM in real-time. Daily uploads at the close of the next business day after the operating day if an event has occurred are sufficient, as the response evaluation is performed after the fact.
- Demand resources may be aggregated and offered into the PJM Day-Ahead Scheduling Reserve Market as one combined resource if the appropriate telemetry is provided for the aggregated resource.
- Demand resource participation is limited to 25% of the RTO Day-Ahead Scheduling Reserve Requirement.
- Demand Resources are allowed to participate in the Day-Ahead Scheduling Reserve Markets if approved by the appropriate Regional Reliability Council.
- Dynamic Transfer resources are eligible to provide Day-Ahead Scheduling Reserve as per Attachment F of PJM Manual 12: Balancing Operations.

In the event PJM forecasts a credible natural gas pipeline contingency(s), a resource that is part of the credible natural gas pipeline contingency(s) is not eligible to be a Day-Ahead Scheduling Reserve Resource. Please refer to PJM Manual 13: Emergency Operations, Section 3.9 and the CEII portion of PJM Manual 03: Transmission Operations, Section 5 for details on the process for assessing gas infrastructure contingency impacts on the PJM RTO.

11.1.2 Day-Ahead Scheduling Reserve Market Rules

The following offer and operational information must be supplied through the Markets Gateway System:

- Day-Ahead Scheduling Reserve Availability.
- Day-Ahead Scheduling Reserve Offer Price - Offers to provide Day-Ahead Scheduling

[30-Minute] Reserve are in dollars/MW of reserve to be provided, and $0/MW is a valid offer.

- A valid generator or demand response energy offer must be available in the Day-Ahead Energy Market to participate.
- Energy resources need to have an energy offer available in the Day-Ahead Market to participate in the Day-Ahead Scheduling Reserve Market.

- All generator units submit Day-Ahead energy offers and meet the Day-Ahead Scheduling Reserve Market Eligibility requirements are considered available to provide Day-Ahead Scheduling reserve (Must offer requirement).
- All demand resources that submitt Day-Ahead energy offers and meet the Day-Ahead Scheduling Reserve Market Eligibility requirements may provide Day-Ahead Scheduling reserve (Markets Gateway System default = unavailable). Demand resources may voluntarily make themselves available to provide Day-Ahead Scheduling Reserve.
- Day-Ahead Scheduling Reserve Offer Quantity (MW) for Online Units is derived as the lesser of:
  - difference of the Economic Max – DA Dispatch Point scheduled
  - Ramp Rate * (30 minutes)
- Day-Ahead Scheduling Reserve Offer Quantity (MW) for Offline Units is derived as the lesser of:
  - Economic Max
  - Economic Min + (Ramp Rate * (30 minutes – Startup Time plus Notification Time in minutes))

