

## 2.3 Energy Market Business Rules

### 2.3.1 Bidding & Operations Time Line

The Day-ahead scheduling/bidding timeline for PJM Energy Markets consists of the following time frames:

- **11:00** — Day-ahead Market bid period closes. All bids and offers must be submitted to PJM. At 11:00 PJM begins to run the Day-ahead Market Clearing Engine to determine the hourly commitment schedules and the LMPs for the Day-ahead Market. The Day-ahead clearing results in the resource commitment profile that satisfies the fixed demand, cleared price-sensitive demand bids, cleared demand reduction bids, and PJM Day-ahead ~~Scheduling Reserve~~ (~~Operating Reserve~~) objectives, while minimizing the total production cost (subject to certain limitations) for energy and reserves. This commitment analysis also includes external bilateral transaction schedules and external resource offers into the PJM Day-ahead Market.
- **Prior to 13:30** – PJM posts the Day-ahead hourly schedules and LMPs in the Markets Gateway System. PJM also makes these results available in downloadable files, via the Markets Gateway System, or a dedicated communication link.
- **After Day-ahead Results posting up until 14:15** — PJM opens the Real-time Energy Market offer period. During this time, market participants can submit revised resource offers. However if the market participant self-scheduled their unit in the Day-ahead Market, they cannot change the unit status to economic in the rebid period.
- **14:15 –The Real-time Energy Market offer period closed.** PJM performs a second resource commitment known as the Reliability Assessment and Commitment (RAC) Run, which includes the updated offers, updated resource availability information and updated PJM load forecast information and load forecast deviation. The focus of this commitment is reliability and the objective is to minimize startup and no load costs for any additional resources that are committed.
- **14:15 –Operating Day** — PJM may perform additional resource commitment runs, as necessary, based on updated PJM load forecasts and updated resource availability information. PJM sends out individual generation schedules updates to specific generation owners only, as required.
- **18:30 –Operating Day** – Starting at 18:30 (typically after the Reliability Assessment and Commitment Run completes) and up to sixty-five (65) minutes prior to the operating hour, revised resource offers may be submitted to PJM.

### 2.3.2 Market Buyers

The following business rules apply to Market Buyers:

- Up-to congestion bids, increment offers, and decrement bids shall be supported in the Day-ahead Market only.
- A Market Buyer that is not an LSE or purchasing on behalf of an LSE is not required to purchase transmission service for purchases from the PJM Market to cover deviation from its sales in the Day-ahead Market.
- If a Market Buyer submits no Day-ahead bid information, then a zero MW quantity is assumed.

- Participants can submit PRD Curves per business rules in Section 12 of this Manual.

### 2.3.2.1 Fixed and Price Sensitive Demand Bid Business Rules

- The list of transmission zones, aggregates, and single buses at which demand bids are accepted is defined by PJM.
- Each Market Participant's profile (which is defined by PJM) shall specify the transmission zones or aggregates for which that participant is eligible to submit demand bids.
- Market Buyers may submit hourly demand quantities for which it commits to purchase energy at Day-ahead prices for consumption in the next Operating Day. Quantity bids must specify MW quantity and location (transmission zone, aggregate, or single bus).
- Demand bids are assumed to exclude losses (transmission zone losses and share of 500 kV losses).
- Price sensitive demand bids shall specify MW quantity, location (transmission zone, aggregate, or single bus), and the price at which the demand shall be curtailed.
- Price sensitive demand bids are accepted in single bid blocks only (One (1) Megawatt point with a corresponding price point only).
- Price sensitive demand bids may be submitted with a bid price of no greater than \$2,000/MWh plus the sum of the applicable Primary Reserve and Synchronized Reserve Penalty Factors from the first step of the demand curve not to exceed \$3,700/MWh.
- PJM shall apply Demand Bid ~~Screening~~ screening to all Demand Bids submitted in the Day-ahead Energy Market for each LSE, separately by Zone. PJM automatically rejects a LSE's Demand Bids if the total MW volume of such bids exceeds the LSE's Demand Bid limit for any hour in such Operating Day.
- On a daily basis, PJM updates and posts each LSE's Demand Bid Limit in each applicable Zone. Such Demand Bid Limit applies to all Demand Bids submitted by that LSE for each future Operating Day for which it submits bids.
- The Demand Bid Limit is calculated using the following equation:

$$\text{Demand Bid Limit} =$$

*greater of (Zonal Peak Demand Reference Point \* 1.3), or (Zonal Peak Demand Reference Point + 10MW)*

**Where:**

<b>Zonal Peak Demand Reference Point</b>	for each Zone: the product of (a) LSE's Recent Load Share, multiplied by (b) Peak Daily Load Forecast.
<b>LSE's Recent Load Share</b>	is the LSE's highest share of Network Load in each Zone for any hour over the previous seven (7) Operating Days.
<b>Peak Daily Load Forecast</b>	is PJM's highest available peak load forecast for each applicable Zone that is calculated on a daily basis.

- PJM may allow a LSE to submit bids in excess of its Demand Bid Limit when circumstances exist that cause, or are reasonably expected to cause, a LSE's actual load to exceed its Demand Bid Limit on a given Operating Day. Examples of such circumstances include, but are not limited to, changes in load commitments due to state sponsored auctions, mergers and acquisitions between PJM Members, and sales and divestitures between PJM Members.
- A LSE whose Demand Bids are rejected as a result of Demand Bid **Screening screening** may change the Demand Bids to reduce the total megawatt volume to a level that does not exceed the Demand Bid Limit. Re-submissions must occur prior to Market closing for the Operating Day.
- Price-sensitive demand can set LMP in the Day-ahead Market.

### 2.3.2.2 Increment and Decrement (Virtual) Bid Business Rules

- Market Buyers and Market Sellers may submit increment offers or decrement bids at any hub, node at which physical generation or load is settled, Residual Metered Load node and interface point not described in Tariff Attachment K – Appendix, Section 2.6(A)(b). The eligible bidding locations are posted at <https://www.pjm.com/markets-and-operations/energy.aspx>.
- Energy market transactions, except generation resource offers and price sensitive demand bids, may be submitted with an energy bid/offer price of no greater than \$2,000/MWh.
- PJM may require that a Market Participant shall not submit in excess of 3000 virtual bid/offer segments in the Day-ahead Energy Market, when PJM determines that such limit is required to avoid or mitigate significant system performance problems related to the volume of virtual bids.

### 2.3.2.3 Up-to Congestion Transaction Business Rules

- 'Up-to' congestion bids shall be no greater than \$50/MWh, and no less than -\$50/MWh. Any 'Up-to' congestion transaction that bids higher than \$50/MWh or less than -\$50/MWh will be rejected.
- PJM will maintain an up-to date list of source/sink combinations that will be available for 'Up-to' congestion bidding. The eligible 'Up-to' bidding locations are posted at <https://www.pjm.com/markets-and-operations/energy.aspx>.
- 'Up-to' congestion bids are cleared based on the total LMP price difference between the source and the sink.
- PJM may require that a Market Participant shall not submit in excess of 3000 'Up-to' congestion transactions in the Day-ahead Energy Market, when PJM determines that such limit is required to avoid or mitigate significant system performance problems related to the volume of transactions.

### 2.3.2.4 Electric Distribution Company (EDC) Activities

- For the Day-ahead Market, the Electric Distribution Company (EDC) shall specify the transmission zone, bus distributions, and aggregate bus distributions as a daily distribution. The default distribution for a transmission zone for the Day-ahead Market is

the state estimator distribution for that zone at 08:00 one week prior to the Operating Day (i.e. if next Operating Day is Monday, the default distribution is from 08:00 on Monday of the previous week). The default distribution for a residual metered load aggregate for the Day-ahead Market is the final Real-time distribution factors for the residual metered load aggregate at 08:00 one week prior to the Operating Day. See PJM Manual 28: Operating Agreement Accounting, Section 3 for additional details on residual metered load aggregates.

- The EDC may update the default distribution factors for a transmission zone only after the state estimator populates the default.
- EDCs shall submit a forecast of demand within their transmission zone. This is for reliability purposes only (and does not, therefore, require a binding bid).

### 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 of this Manual and an operating range as described in Section 2.3.3.2 of this Manual.
- Self-scheduled generation shall submit an hourly operating range and can offer an associated price/MW pair for consideration in dispatch.
- Generation owners planning to run generation resources scheduled in the Day-ahead Market are required to call the PJM Control Center at least twenty (20) minutes prior to bringing the resource online. Generation owners of self-scheduled generation resources must also provide at least twenty (20) minutes notice.
  - Resources enrolled in the ESR participation model with greater than ten (10) Megawatts must contact the PJM Control Center prior to changing its mode of operation with at least twenty (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

Master Coordinator to determine if this course of action is possible. The PJM Master Coordinator will either:

- o Determine that the generation resource is not needed for reliability purposes for the Operating Day and therefore, 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.
- o Determine that the resource is needed for reliability purposes and therefore, 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 forty-five (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 (i.e. non-Capacity 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 and 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 and 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 (7) days and may submit non-binding offer prices for the days beyond the next Operating Day.

- Generation Capacity Resources that have notification **or**, startup, and minimum run times that exceed twenty-four (24) hours must submit binding price-based offer prices for the next seven (7) 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.
- 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 twenty-four (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.
- Hydropower resources fall under the Intermittent Generation Resource category. Hydropower resources that are committed Capacity Resources, shall meet the must offer requirement by self-scheduling (Availability = Must Run).
- Pumped Storage Hydropower resources that are committed Capacity resources, shall meet the must offer requirement by either self-scheduling or may allow the Day-ahead Market to schedule by using the pumped storage optimization model, referred to in Attachment B of this Manual. They may also use the Energy Storage (ESR) Participation Model referred to in Section 2.3.4 of this Manual.

### 2.3.3.2 Generator Schedules

- Generation schedules are collections of generator parameter operating limits and offer data. There are three (3) types of schedules that can be submitted:
  - o 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.
  - o 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.
  - o 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.

- o 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:
  - o At least one cost-based schedule
  - o Price-based units must also make available a price-based Parameter Limited Schedule (PLS).
  - o 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:
  - o At least one cost-based schedule
  - o 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.
  - o Forecast points shall consist of a daytime temperature and a nighttime temperature.
  - o 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), and (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 (3) 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 a ramp rate, which is the MW/Minute increase or decrease of a unit being offered for economic dispatch. The ramp rate shall be based on the actual capability of the unit given the confines of the PJM software and shall not be used to withhold a portion of the capacity or ramping capability of a unit from the market. Hourly ramp rates must be updated regularly to account for latest ambient conditions.
- Hourly differentiated segmented ramp rates allow Generation Resources to reflect their ramping capability with greater granularity compared to a single ramp rate or daily segmented ramp rates. Generation Resources with discontinuities in their operating rate (e.g. duct burners, peak firing) should use hourly differentiated segmented ramp rates to reflect such operating modes.
- 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 Maximum represents the highest unrestricted level of MW that the operating company will operate the unit, under its offer, for economic dispatch. The Economic Maximum point shall be based on the actual capability of the unit to operate on its bid curve and shall not be used to withhold a portion of the capacity of a unit from the Day-ahead Market.
- Reduction of the Economic Maximum Megawatt constitutes withholding in the Day-ahead Energy Market, if:
  - o The Economic Maximum Megawatt is higher in the bid for the Real-time Energy Market than in the bid for the Day-ahead Market, or;
  - o There is no physical reason to designate a lower Economic Maximum 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 the Economic Maximum Megawatt is:
  - o The unit will be given an outage ticket which reflects a derating equal to the positive difference in the Economic Maximum 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 ME constitutes withholding in the Day-ahead Market, if:



- o The capacity is not designated as ME in the bid for the Real-time Market, or;
- o There is no physical reason to designate the unit as ME.
- The consequence of withholding a unit's capacity under ME is:
  - o 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 11:00 and again starting at 18:30 through sixty-five (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.
- 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.
  - o Refer to Section 2.3.4.6 of this Manual regarding updating the Minimum Run Time parameter in Markets Gateway for a combined cycle pseudo model block(s) when one or more pseudo modeled combined cycle blocks are not dispatched in Real-time.

#### Startup and No-load Business Rules:

- A price-based unit has the option to choose to submit 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 is 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 11:00 hours March 31 for the period April 1 through September 30 and on or before 11:00 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.
  - o 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 \$1,000/MWh, 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 of this Manual.
- 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 of this Manual.
- Generation resource market-based incremental energy offers may not exceed \$1,000/MWh unless the cost-based incremental energy offer is greater than \$1,000/MWh. If this is true, 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:
  - o 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.
  - o 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.
  - o 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.
  - o 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.
  - o 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.
  - o 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.
  - o **The maximum number of MW/Price segments that can be submitted per hour is twenty (20).**

#### 2.3.3.3 Aggregated Unit Business Rules

- Generating units that are connected to the system at the same electrical location may be aggregated and offered into the PJM market as a single unit.
- The aggregated unit must be offered into the PJM markets as a single unit with only one set of offer data, including startup, no load and incremental energy costs. This rule applies to all energy and ancillary service markets into which the unit is offered.

- Revenue quality meter data must be submitted to Power Meter on the basis of the aggregated unit.
- Real-time meter data is required for each physical unit in order to support the PJM state estimator model and to allow energy settlement on an individual unit level.
- Balancing Operating Reserve deviations for aggregated units are calculated based on the five (5) minute aggregated unit output as defined in PJM Manual 28: Operating Agreement Accounting.
- Balancing Operating Reserve Generator deviations for units deemed to be “not following dispatch” that occur at a single bus will be able to offset one another.
- A “single bus” will be any unit located at the same site and that has the identical electrical impacts on the transmission system. Units are deemed to have identical electrical impacts on the transmission system if they meet the following criteria:
  - o Units that have identical distribution factors to the system.
  - o Units that are on the same low side of the bus (i.e. connected at same voltage level).
- In the case of units on buses with a bus-tie breaker, if the bus-tie breaker was open less than 5% of the hours in the previous three (3) years, supplier netting of units will be allowed across this bus-tie breaker.
- PJM will maintain a list of units that are deemed to have identical electrical impacts on the transmission system to be used for Balancing Operating Settlement. PJM will review the list on an annual basis. Generators will be reviewed as needed during any new generation activation or reconfiguration process as defined in Section 7 of PJM Manual 14D: Generator Operational Requirements.
- Unit parameters do not have to be identical for the units’ deviation MW to offset one another.
- If multiple units are deemed “not following dispatch” at a single bus, the deviation MW and direction of each unit at that bus will be summed to determine the deviation MW at that bus.
- Units at a “single bus” must be owned or marketed by a single PJM Market Participant.
- Unit modeling changes in the PJM Markets Gateway system (unit type, aggregation level, for example), not including changes based on physical changes at the plant, can be made at the beginning of each quarter.
- Per the PJM Manual for Operating Agreement Accounting (M28), for settlement purposes, PJM determines the resource’s five (5) minute RT SCED LMP Desired MWh based on its dispatch rate, offer data, and minimum and maximum energy limits for that five (5) minute interval. For steam units, the lesser of the Day-ahead scheduled and Real-time economic minimum limits, and the greater of the Day-ahead scheduled and Real-time economic maximum limits, are used. For CT’s, operating at PJM direction, the actual Real-time output is used as the RT SCED LMP Desired MWh value.

### 2.3.3A External Market Sellers

An External Resource is a generation resource that is located outside the metered boundaries of PJM. External resources that are committed Capacity Resources must bid into the PJM Day-ahead Market as generation resources.

For an ~~external~~ ~~External~~ ~~resource~~ ~~Resource~~ to be offered into the Day-ahead Market a valid generator offer, as detailed in Section 2.3.3 of this Manual, is submitted in the Markets Gateway system and a valid energy schedule is submitted in the ExSchedule system.

External Market sellers report the following data for resource-specific offers, reported on the business day before the next Operating Day, up to seven (7) days in advance:

- Specific generation resource. If the resource is submitted at least thirty (30) days before the bid date, see PJM Manual 10: Pre-Scheduling Operations.
- Minimum and maximum energy for each hour.
- Minimum and maximum generation for each hour.
- Minimum and maximum run times.
- Resource availability for each hour.
- Availability of regulation upper and lower energy limits for each hour.
- Response and constraint data.
- Whether or not to use startup and no-load fees.

The Network Customer may request Network External Designated transmission service for the delivery of a designated network resource. Requests for service are subject to Available Transmission Capability (ATC) and other PJM [Regional Practices](#).

A valid NERC eTag is required for all hours that the external resource will be bid into PJM. The firm OASIS reservation assigned to the external resource shall be linked to the tag.

#### **2.3.3A.1 External Resource Day-ahead Market Requirements**

As specified in Section 2.3.1 of this Manual, all bids must be received by 11:00 (EPT). From 11:00 to 13:30 (EPT), the bids are evaluated. Results are posted in the Markets Gateway system by 13:30 (EPT). External Market Sellers are required to check the Markets Gateway system to see if the bid has been accepted.

For bids accepted in the Day-ahead Market, External Market Sellers must submit adjustments to the hourly profile of their tag in order to avoid balancing market MW deviations.

#### **2.3.3A.2 External Resource Reliability Assessment and Commitment Run Requirements**

If the unit is accepted in the Reliability Assessment and Commitment (RAC) Run, External Market Sellers must submit a NERC eTag that matches the hourly energy profile.

If the bid is not accepted in the Day-ahead Market the External Market Seller may choose to either modify an already existing tag to zero (0) MW, or take no action.

If the External Market Seller wishes to schedule the resource as a self-scheduled/must run resource they may choose to do so and must submit an eTag. The External Market Seller must also notify the PJM Generation Dispatcher that the resource is being self-scheduled into PJM as a contract.

#### **2.3.3A.3 External Resource Real-time Market Requirements**

If the bid is not accepted in the Day-ahead Market or Real-time Market, but is requested during the Operating Day, the PJM Generation Dispatcher will notify the External Market Seller who

will then submit an eTag to match the request. This tag is subject to all scheduling timing requirements and PJM interchange ramp limits.

#### **2.3.3.4 Public Distribution Microgrid Generators**

All existing Energy & Ancillary Services Market Business Rules apply to a Public Distribution Microgrid (PDM) Generator operating in grid-connected mode. Additional business rules apply to a Public Distribution Microgrid Generator operating in island mode:

- If the Public Distribution Microgrid load is reported to PJM as wholesale load when the PDM is islanded, the corresponding Public Distribution Microgrid Generator(s) should **PJM** update their availability in Markets Gateway to Must Run for corresponding intervals in order to reflect the islanded condition.
- If the Public Distribution Microgrid load is not reported to PJM as wholesale load when the PDM is islanded, the corresponding Public Distribution Microgrid Generator(s) should make themselves unavailable for all PJM markets for the corresponding intervals to reflect the islanded condition.
- When the PDM is in island mode, an operator of a Public Distribution Microgrid Generator shall de-assign it from any existing Ancillary Services commitments (performance will be assessed as normal), and shall ensure it is not assigned for ancillary services for future intervals unless it is certain it will not be islanded in those intervals.

Definitions and additional business rules for Public Distribution Microgrids can be found in PJM Manual 14D, Appendix B: Public Distribution Microgrid Business Rules and PJM Manual 14D, Appendix C: Voluntary Guideline on Public Distribution Microgrid Operations.

#### **2.3.4 Minimum Generator Operating Parameters – Parameter Limited Schedules**

Market Sellers of Capacity Resources are required to submit, per Section 2.3.3.2 of this Manual, as follows:

- For Price Based Units: (1) at least one cost-based schedule that is parameter limited, (2) a price-based Parameter Limited Schedule.
- For Cost Based Units: (1) at least one cost-based schedule that is parameter limited.

Certain parameters on cost-based and price-based PLS schedules are subject to defined limits. The following subsections provide details regarding which parameters are limited, the process to request exceptions to the limits, and the circumstances when such Parameter Limited Schedules are considered during commitment and dispatch.

##### **2.3.4.1 Parameter Limits**

Different limits may be applied to certain schedule parameters depending on a resource's Capacity commitment type and the applicable Delivery Year.

- All Capacity Resources are subject to unit specific operating limits for the following parameters:
  - o Turn Down Ratio
  - o Minimum Down Time

- o Minimum Run Time
  - o Maximum Daily Starts
  - o Maximum Weekly Starts
  - o Maximum Run Time
  - o ~~Start~~ Start-Up Time
  - o Notification Time
- PJM determines unit-specific parameter limits for each Capacity Resource based on the operating design characteristics and other constraints of that resource. The resource's unit-specific parameter limits will apply for that resource unless it is operating pursuant to an exception from those limits as described in Section 2.3.4.2 of this Manual.

#### 2.3.4.2 Unit Specific Parameter Adjustments

- Market Sellers that do not believe their individual resources can meet the unit-specific parameter limits determined by PJM due to actual operating constraints, can request that PJM establish adjusted unit-specific parameter limits for those resources. The Market Seller may request adjusted unit-specific parameter limits by providing all the necessary data, information and documentation to PJM in order to justify and support the adjusted limits through the Unit Specific Parameter Adjustment Process PJM SharePoint website to ~~unitspecificpls@pjm.com~~ by no later than the February 28 immediately preceding the first Delivery Year for which the adjusted unit-specific parameter limits are requested to commence. Technical information must be provided about the operational limits that support the requested adjustment. PJM shall notify the Market Seller if its request was approved or denied by no later than April 15. The effective date of approved adjustments shall be no earlier than June 1 of the first applicable Delivery Year. PJM will consult with the MMU and consider any input received in its determination of a resource's unit-specific parameter limits.
- Once PJM has made a determination of the unit-specific parameter limited schedule values for a Generation Capacity Resource, those values will remain applicable to the resource until such time as ~~the Office of the Interconnection~~ PJM determines that a change is needed based on changed operational capabilities of the resource.
- The operational limitations that support adjusted unit-specific parameter limits shall be (a) a physical operational limitation based on operating design characteristics of the resource or (b) other actual physical constraints that are not based on the characteristics of the resource, including contractual limitations. Economic constraints are not taken into consideration in the determination of the unit-specific parameter limits. Contractual limits may only be considered a physical constraint and not an economic constraint when based on a natural gas pipeline transportation contract that is for the best available service offered by the pipeline and available to the Market Seller rather than a lower cost option that provides less flexible service. For example, if a pipeline offers hourly nominations and/or no notice service, the resource's operational parameters will be based on those more flexible services that are available even if a less flexible service is procured.
- Only actual physical operational limitations, fuel contractual constraints, environmental limitations and other actual constraints on a resource will be considered for adjustment

requests. The following list is not an exhaustive list, but provides examples of the types of information and documentation PJM would request to support adjusted unit-specific parameter limits requests:

- o Start-Up Time Adjustments – Original Equipment Manufacturer (OEM) backup documentation, control room data, start-up/loading curves and a detailed start-up sequence listing the required steps along with the time required to perform each step.
- o Maximum Daily/Weekly Starts Adjustments – OEM backup documentation and/or detailed start-up and shutdown sequences that show why the default start parameters cannot be physically met.
- o Minimum Run Time Adjustments – OEM backup documentation for physical resource constraints that requires the unit to be operated for the requested time period.
- o Minimum Down Time Adjustments - OEM backup documentation and a detailed shut down sequence listing the required steps to bring the resource into a ready for start-up condition along with the time required to perform each step.
- o Notification Time Adjustments – A detailed sequence of events of the tasks required prior to start-up along with the time required to perform each step. In addition gas pipeline contracts may be submitted for review.
- o Turn Down Ratio Adjustments – OEM backup documentation describing the equipment limitation. Requests for adjustments to this parameter based on emissions permit limitations and related concerns will require inclusion of the applicable Air Permit as well as emissions data for justification.

#### **2.3.4.3 Parameter Limited Schedule Exceptions**

- There are three (3) different types of exceptions to the Parameter Limited Schedule Matrix default values:
  - o Temporary Exception – A one-time exception lasting for thirty (30) days or less during the twelve month period from June 1 to May 31.
  - o Period Exception – Lasting for at least thirty-one (31) days but no more than one year during the twelve month period from June 1 to May 31.
  - o Persistent Exception – Lasting for at least one year.
- Pursuant to Section II.B of Attachment M – Appendix of the Tariff, Period and Persistent Exception requests must be sent to [Parameters.Exceptions@pjm.com](mailto:Parameters.Exceptions@pjm.com) by no later than February 28 immediately preceding the twelve month period from June 1 to May 31 during which the exception is requested to commence.
- All Market Sellers that wish to submit a Parameter-Limited Schedule for resources with physical operational limitations that prevent the resources from meeting the minimum parameters may submit a request for an exception via Markets Gateway for evaluation.
- Each Market Seller seeking an exception must supply the required historical resource operating data in support of the Period or Persistent Exception and if the exception requested is based on new physical operational limits for the resource for which historical operating data is unavailable, the generation resource may also submit

technical information about the physical operational limits for Period Exceptions of the resource to support the requested parameters.

- Physical operational limitations for Period or Persistent Exceptions may include but are not limited to, metallurgical restrictions due to age and long term degradation; physical design modifications, operating permit limitations, operating limits imposed by federal, state or local regulatory requirements or insurance carrier requirements, consent decrees, manufacturer technical bulletins, or environmental permit limitations under non-emergency conditions.
- Each Market Seller requesting a Period or Persistent Exception based on new physical operational limitations for a resource may submit the technical information, required due to the unavailability of historical operating data, supporting the requested parameters, which must be based on the definition of physical operational limitations for Period or Persistent Exceptions of the resource.
- Each Temporary, Period or Persistent Exception request will indicate the expected duration of the requested exception including the date on which the requested exception period will end. If physical conditions at the unit change such that the exception is no longer required, the Market Seller is obligated to inform PJM and the MMU and the exception will be reviewed to determine if the exception continues to be appropriate.
- If a request for a period or Persistent Exception is received by February 28, the MMU will review the exception and provide the Market Seller and PJM with a determination in writing whether the request raises market power concerns by April 1, and PJM shall provide its determination whether the request is approved or denied by no later than April 15. Should PJM require additional technical expertise in order to evaluate the exception request, PJM will engage the services of a consultant with the required expertise. A generation resource shall notify the MMU and PJM when the temporary exception commences and terminates and provide to the MMU and PJM within three (3) days following such commencement documentation explaining in detail the reasons for the Temporary Exception, that includes:
  - o Unit Name.
  - o Parameter Limit Requested.
  - o Reason for Temporary Exception Request.
  - o eDart ticket.
  - o Justification for Temporary Exception Request, including required resource operating data in support of the exception.
  - o Date on which the exception period will end.
- If PJM does not receive a complete exception request, and the resource did not clear in the Day-ahead Energy Market, the resource schedule will be returned to its previous parameter limits.
- Physical operational limitations for Temporary Exceptions may include, but are not limited to, short term equipment failures, short term fuel quality problems such as excessive moisture in coal fired units, or environmental permit limitations under non-emergency conditions.



- Market Sellers may use exceptions to reflect physical operational limitations (e.g., operational flow orders) on natural gas pipelines and local natural gas distribution companies (LDC). These exceptions will be reviewed by PJM and the MMU and approved by PJM, in accordance with the applicable provisions of the Tariff and Operating Agreement.
- In addition, physical operational limitations for Temporary Exceptions may include any physical operational limitation for period exceptions that arises during the annual period from June 1 to May 31 to which period exceptions apply.
- Market sellers may indicate to PJM and the MMU those resources with the ability to operate on multiple fuels. Multiple-fuel resources may submit a Parameter Limited Schedule associated with each fuel type. All Parameter Limited Schedules must be submitted via Markets Gateway seven (7) days prior to the beginning of each period beginning June 1. Any exceptions required for any of the Parameter Limited Schedules submitted for multiple-fuel resources will be required to be submitted and approved via the exception process, by the applicable deadlines.
- If physical conditions at the resource change such that the exception is no longer required, the Market Seller is obligated to inform PJM and the MMU and the exception will be terminated.
- Market Sellers shall notify, in writing, the MMU and PJM of a material change to the facts relied upon by the MMU and/or PJM to support a Temporary, Period or Persistent Exception. The MMU will provide written notice of any change to its determination regarding the exception request within fifteen (15) days of receipt of such notice to PJM and the Market Seller. PJM will notify the Market Seller and MMU in writing, by no later than twenty (20) days after receipt of the Market Seller's notice, whether it is revoking or confirming its approval of the exception request.
  - o If PJM determines that its approval of the exception should be revoked or terminated for Capacity Resources without approved adjusted unit-specific values, the unit-specific values determined by PJM shall apply and for **Base Capacity Resources and Capacity Performance** Resources with approved adjusted unit-specific values, the adjusted unit-specific values shall apply. PJM shall notify the Market Seller three (3) business days before such revocation.

#### 2.3.4.4 Real Time Values

- Market Sellers can communicate the resource's current operational capabilities to PJM ~~before and~~ after the Day-ahead Energy Market closes through the 'Real Time Values' function in Markets Gateway.
- Real Time Values should be utilized when a resource cannot operate according to the unit specific parameters or approved Parameter Limit Exceptions.
- The parameters eligible for Real Time Value overrides consist of the following values:
  - o Turn Down Ratio
  - o Minimum Down Time
  - o Minimum Run Time
  - o Maximum Run Time

- o Start Up Time
- o Notification Time
- **Real Time Values shall only be submitted for actual physical unit limitations or those outside of management control. Supporting documentation for a Real Time Value submittal shall be provided to the MMU and PJM via [unitspecificpls@pjm.com](mailto:unitspecificpls@pjm.com) within three business days to demonstrate that operation outside of a Generation Capacity Resource's unit-specific parameters was the result of actual physical unit limitations or those outside of management control.**
- A Generation Capacity Resource that operates outside of its unit-specific parameters will not receive Operating Reserve Credits nor be made whole for such operation when not dispatched by ~~PJM~~ ~~the Office of the Interconnection~~, unless the Market Seller of the Generation Capacity Resource can justify to ~~the Office of the Interconnection~~ ~~PJM~~ that operation outside of such unit-specific parameters was the result of an actual constraint. Such Market Sellers shall provide to the MMU and ~~the Office of the Interconnection~~ ~~PJM~~ via [unitspecificpls@pjm.com](mailto:unitspecificpls@pjm.com) ~~unitspecificmakewhole@pjm.com~~ its request to receive Operating Reserve Credits and/or to be made whole for such operation, along with documentation explaining in detail the reasons for operating its resource outside of its unit-specific parameters, within thirty (30) calendar days following the issuance of billing statement for the Operating Day. The Market Seller shall also respond to additional requests for information from the MMU and ~~the Office of the Interconnection~~ ~~PJM~~. The MMU shall evaluate such request for compensation and provide its determination of whether there was an exercise of market power to ~~the Office of the Interconnection~~ ~~PJM~~ by no later than twenty-five (25) calendar days after receiving the Market Seller's request for compensation. ~~The Office of the Interconnection~~ ~~PJM~~ shall make its determination whether the Market Seller justified that it is entitled to receive Operating Reserve Credits and/or be made whole for such operation of its resource for the day(s) in question, by no later than thirty (30) calendar days after receiving the Market Seller's request for compensation.

#### **2.3.4.5 Consideration of Price-based Parameter-Limited Schedules in Commitment and Dispatch**

Generation Capacity Resources shall be eligible for commitment on Parameter-Limited Schedules:

- In the event that PJM: (i) declares a Maximum Generation Emergency; (ii) issues a Maximum Generation Emergency Alert, Hot Weather Alert, Cold Weather Alert; or (iii) schedules resources based on the anticipation of a Maximum Generation Emergency, Maximum Generation Emergency Alert, Hot Weather Alert or Cold Weather Alert for all or any part of such Operating Day; generation resources will be committed on the more economic schedule of their price based Parameter Limited Schedule and price based schedule.
- Under the above circumstance, if a Market Seller fails the Three Pivotal Supplier test in the Energy Markets, the Seller's resources will be committed on the schedule with the least cost among the cost-based schedule, price-based schedule and price-based Parameter Limited Schedule.

#### 2.3.4.6 Minimum Run Time for Pseudo Modeled Combined Cycle Units

The approved combined cycle ~~minimum~~ Minimum run Run time Time unit specific parameter includes the time necessary for start-up of the unit's steam turbine. Submitted cost-based and price-based PLS offers must be at least as flexible as the approved parameter limits for the resource, and if one or more of a pseudo modeled combined cycle block(s) is not dispatched in the Real-time with associated pseudo model block(s), Market Sellers must update the Minimum Run Time parameter of the second and any subsequent pseudo modeled blocks in Markets Gateway to remove the associated steam turbine start-up time that is included in the parameter limit. Such update must occur if and when the subsequent units are dispatched, if not before.

#### 2.3.4A Internal and External Bilateral Transactions

The following business rules apply to Transmission Customers:

- Transmission customers may submit external bilateral transaction schedules and may indicate willingness to pay congestion charges into either the Day-ahead Market or Real-time Market. In the Day-ahead Market, a transaction shall indicate willingness to pay congestion charges by submitting the transaction as an 'Up-To' congestion bid. Refer to Section 2.3.2.3 of this Manual for business rules pertaining to Up-To Congestion transactions.
- Internal bilateral transactions may be designated as Day-ahead or Real-time Market in PJM InSchedule.

The following business rules apply to any generator within the PJM metered boundary and are pseudo-tied into the MISO Balancing Authority:

- The Day-ahead Pseudo-Tie Transaction may only be submitted by Market Participants whose generator is within the PJM metered boundary and are pseudo-tied into the MISO Balancing Authority.
- The eligible source of the Day-ahead Pseudo-Tie Transaction is the generator location and the eligible sink is the MISO interface.
- The Market Participant may submit the Day-ahead Pseudo-Tie Transaction at each eligible location up to the transmission service reservation associated with the Pseudo-Tie.
- Day-ahead Pseudo-Tie Transaction bids shall be no greater than \$50/MWh and no less than -\$50/MWh. Any Day-ahead Pseudo-Tie Transaction that bids higher than \$50/MWh or less than -\$50/MWh will be rejected.
- Day-ahead Pseudo-Tie Transaction bids shall be supported in the Day-ahead Market only.
- Day-ahead Pseudo-Tie Transaction bids are cleared based on the total LMP price difference between the source and the sink.

#### 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 that~~ 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.

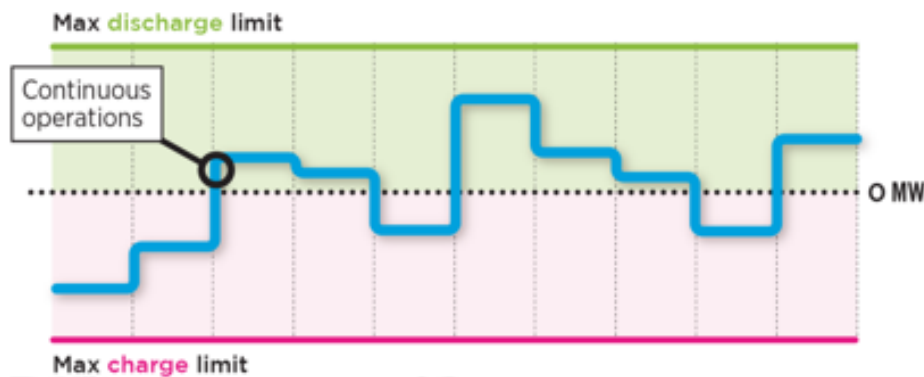
#### ESR Participation Model Election (i.e. Opt In/Opt Out)

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

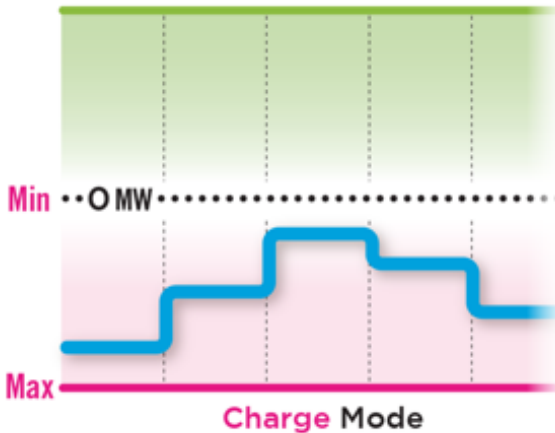
ESR model participants are not optimized for commitment decisions in Day-~~Ahead~~ **ahead** and Real-time because they are managed directly by participants through specification of the four modes of operation:

- 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 the Maximum Discharge Limit to be greater than or equal to zero and the Maximum Charge Limit to be less than or equal to zero.

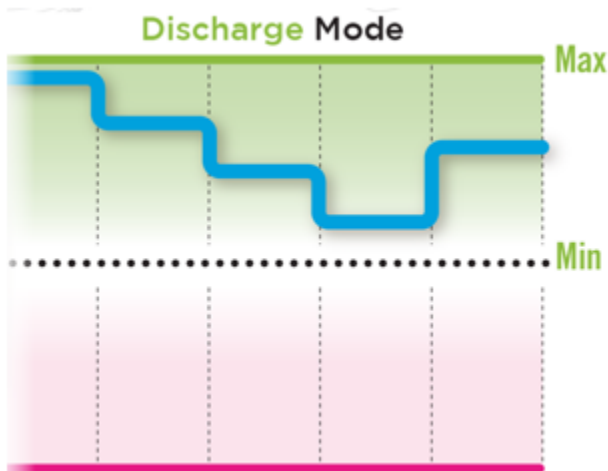


- Charge mode - shall mean the mode of operation of an Energy Storage Resource model participant that only includes negative MW quantities (i.e., the Energy Storage Resource

model participant is only withdrawing MWs from the grid). Charge Mode requires that the Energy Storage Resource model participant's Minimum Charge Limit and the 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 the Minimum Discharge Limit and the 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 11:00 the day before the Operating Day for Day-ahead and sixty-five (65) minutes before the operating hour for Real-time.

### 2.3.5 Curtailment Service Providers

The business rules that apply to Curtailment Service Providers are set forth in Section 10.2.2 of this Manual.

### 2.3.6 PJM Activities

The following business rules apply to PJM activities:

- PJM shall post on the Markets Gateway System, the PJM load forecast, total bid demand, and Day-ahead ~~Scheduling Reserve~~ ~~(Operating Reserve)~~ objective for each hour of the next Operating Day by 13:30 at the completion of the Day-ahead scheduling process.
- PJM shall post forecasts of total hourly demand for the next four (4) days and peak demand for the subsequent three (3) days.
- PJM shall post hourly LMP, Congestion Price, and Loss Price values for the next Operating Day at the completion of the Day-ahead scheduling process by 13:30.
- PJM shall post the schedule of demand, supply, and bilateral transactions for private viewing by Market Participants.
- PJM may perform supplemental resource commitments after the Day-ahead schedule is posted in order to maintain reliable operation. Such supplemental commitments are based on minimizing startup and no-load costs.
- During the various resource commitment analyses, PJM may limit its dependence on Combustion Turbines (CTs) to provide reserves in order to maintain reliable operational standards. Such limits shall be based on past performance of these resources.
- PJM Market Operators will commit in the Day-ahead Market any generation resources that were scheduled by PJM dispatch in advance of the Day-ahead Market and are still required for the Operating Day and therefore not cancelled. The scheduled hours for the pre-committed generation resource in the Day-ahead Market will at least include the hours where PJM dispatch has scheduled the resource as well as any additional hours where the resource was deemed to be economic as a result of the Day-ahead Energy Market solution.

#### 2.3.6.1 Market Power Mitigation

PJM tests for the concentration of local market power under transmission constrained conditions and applies measures to mitigate such power when detected. If transmission limits are identified during the Day-ahead scheduling process or during Real-time operations, the appropriate generators (those for which the owner fails the Three-Pivotal Supplier Test (“TPS Test”) as detailed in Section 6.4.1 paragraphs (e) and (f) of the PJM Operating Agreement) are offer-capped. Resources remain eligible to set LMP when offer-capped. Both pool-scheduled and self-scheduled resources are eligible for offer capping. The Three-Pivotal Supplier Test is performed in IT SCED, further described in in Section 2.5 of this Manual, as part of the dispatch run. Offer capping, as described below, is based on the results of the Three Pivotal Supplier Test.

Offer-capping is applied as follows:

- Resources are offer-capped at lesser of their cost-based or price-based schedules, including startup and no-load components. Specific details regarding determination of

cost-based offers may be found in PJM Manual 15: Cost Development Guidelines and Section 6.4.2 of the PJM Operating Agreement.

- For resources scheduled in the Day-ahead Market, the offer caps are applied at the time of commitment and apply for the length of time the unit is scheduled in the Day-ahead Market at the schedule that results in the lowest overall system production cost, in accordance with Section 6.4.1(a) of the Operating Agreement.
  - If the incremental energy offer, no load cost or startup cost for any portion of the offer capped hours is updated subsequent to the Day-ahead commitment, the offer caps are recalculated for each hour that was updated and apply at the schedule that results in the lowest dispatch cost for each updated hour, in accordance with Section 6.4.1(g) of the Operating Agreement; however, once the resource is dispatched on a cost-based offer, it remains on a cost-based offer regardless of the determination of the cheapest schedule.
- For resources scheduled in the Real-time Market, the offer caps are applied at the time of commitment and apply at the schedule which results in the lowest dispatch cost, in accordance with Section 6.4.1(g) of the Operating Agreement.
  - If the incremental energy offer, no load cost or startup cost for any portion of the offer capped hours are updated subsequent to the Real-time commitment, the offer caps will be recalculated for each hour that is updated and will apply at the schedule that results in the lowest dispatch cost for each updated hour in accordance with Section 6.4.1(g) of the Operating Agreement; however, once the resource is dispatched on a cost-based offer, it will remain on a cost-based offer regardless of the determination of the cheapest schedule.
- Non-CT resources, as well as CTs that are committed in the Day-ahead Market and are expected to run in the Real-time Market without additional notification from PJM Dispatch, that are offer-capped in the Day-ahead Market are offer-capped for those same hours in the Real-time Market and at the same schedule.
- Pool-scheduled CTs that are committed in the Day-ahead Market and are not expected to run in Real-time unless notified by PJM Dispatch and are offer-capped in the Day-ahead Market and are re-evaluated for market power at the time of commitment in the Real-time Market. Such resources are offer-capped in accordance with the results of the TPS Test that is conducted at the time of the Real-time commitment.
- Pool-scheduled resources brought on-line for economics prior to constrained conditions are not offer-capped at the time of commitment.
- Resources whose owners passed the TPS Test at the time of commitment remain uncapped and are not be subject to additional market power testing until the end of the initial capping determination period, which is defined as follows:
  - For pool-scheduled or self-scheduled resources committed in the Day-ahead Market, the end of their Day-ahead commitment.
  - For pool-scheduled resources committed in the Real-time Market (and not in the Day-ahead Market): the end of their minimum run time.
  - For self-scheduled units committed in the Real-time Market (and not in the Day-ahead Market): the end of the first hour of their commitment.

- Resources running in Real-time beyond the initial capping determination period are subject to evaluation for market power on an hourly basis and are offer-capped as follows:
  - o Resources operating on a price-based schedule whose owner pass the TPS Test will not be offer-capped and will remain on the price-based offer.
  - o Resources operating on a price-based schedule whose owner does not pass the TPS Test will be offer-capped.
  - o Resources operating on a cost-based schedule will remain on a cost schedule regardless of the results of the TPS Test.
- Once a unit is offer-capped in the Real-time Market it shall remain offer-capped until the earlier of:
  - o The resource's release from its commitment by PJM Dispatch.
  - o The end of the Operating Day.
  - o The start of the resource's next pre-existing commitment.

### **2.3.6.2 Resource Energy Offer Validation (for offers greater than \$1,000/MWh)**

#### Generation Resource Offer Screening Process

PJM uses a screening process to verify the reasonableness of each generation resource's cost-based Incremental Energy Offer segment in excess of \$1,000/MWh before it is considered eligible to be used in dispatch or the calculation of LMPs. This screening process is applicable to all generation resources including those that are Fast-Start capable. Fast-Start capable resources are subjected to an additional screening process as described in Section 2.3.6.3 of this Manual.

- Cost-based Incremental Energy Offers with prices above \$1,000/MWh are subject to the offer screening process at the time of submission.
- Day-ahead Market Incremental Energy Offers between \$1,000/MWh and \$2,000/MWh must be submitted prior to the close of the Day-ahead Market bid period to be screened for eligibility to set LMP in the Day-ahead Market.
- In Real-time, a resource's cost-based offer must be submitted at least sixty-five (65) minutes prior to the start of the operating hour in order for the Incremental Energy Offer segments between \$1,000/MWh and \$2,000/MWh to be screened for eligibility to set LMP.

PJM uses cost inputs provided by the Market Seller to calculate the Maximum Allowable Incremental Cost as outlined in Section 6.4.3 of Schedule 1 of the PJM Operating Agreement. Submission to MIRA, or other system(s) made available is considered submission to PJM and the MMU.

- The Market Seller shall provide heat inputs and performance factors in MIRA, or other system(s) made available for submission of such data. The heat inputs and performance factors should be provided at least one week prior to the Operating Day.

For each Incremental Energy Offer segment greater than \$1,000/MWh, PJM shall evaluate whether such offer segment exceeds the reasonably expected costs for that generation



resource by determining the Maximum Allowable Incremental Cost for each segment in accordance with Section 6.4.3 of Schedule 1 of the PJM Operating Agreement.

- If the cost submitted for the offer segment is less than or equal to the Maximum Allowable Incremental Cost value, then that segment is deemed verified and is eligible to be used in dispatch and to set LMP.
- If the cost submitted for the offer segment is greater than the Maximum Allowable Incremental Cost value, then the cost-based offer for that segment and all segments at an equal or greater price are deemed not verified. Such segments are capped at the greater of \$1,000/MWh or the price on the most expensive verified segment for the purposes of dispatch and setting LMP.
- PJM will notify the Market Seller of the verification status of each segment upon completion of the screen.
- Any subsequent update to a cost-based offer's incremental energy offer curve or no-load cost subjects the offer to the screening process upon submission of the update and the offer is capped based on the result of the updated screen.

#### Generation Resource Exception Process

If any segment of a resource's offer does not pass the offer screen, the Market Seller can submit an exception request. The exception process provides a Market Seller the ability to justify a resource's offer that did not pass the offer screen so that, if verified, it may be used in dispatch, be eligible to set LMP, or be eligible to receive Operating Reserve Credits. During the exception process, with timely input and advice from the MMU, PJM determines whether all segments of the resource's offer are compliant with the PJM-approved Fuel Cost Policy for all applicable hours using documentation provided by the Market Seller detailing the underlying costs. Exception process requests will be evaluated in the order in which they are received. In the event that a particular request does not have sufficient information or documentation, or the documentation is not provided in a sufficiently timely and organized manner, PJM will put the request on hold and process the next requests in the queue.

- Market Sellers shall submit exception requests pursuant to the "offer cap verification exception submission process" as documented on the Energy Offer Verification page on PJM.com. This process includes the completion of the Energy Offer Verification Exception Request form in Markets Gateway and supporting documentation detailing the underlying costs submitted to the PJM Connect website. ~~Template located on the Energy Offer Verification page on PJM.com and provision of supporting documentation detailing the underlying costs.~~ Necessary Documentation and Inputs for Verification of Exceptions include:
  - o PJM-approved Fuel Cost Policy with a numerical cost calculation example applicable to the Operating Day and to the resource.
  - o Prior submittal of all costs inputs in MIRA, or other system(s) made available for submission of such data, used to calculate the cost-based offer, other than the level of the cost of fuel.
  - o Documentation supporting the level of the cost of fuel, as defined by the applicable documentation requirements in the Market Seller's PJM-approved Fuel Cost Policy. The Market Seller shall separately identify the levels of the commodity cost of fuel,

- and if appropriate, fuel transportation costs, other fuel charges and other applicable adders.
- Upon receiving the Energy Offer Verification ~~Template~~ **Exception Request** and necessary supporting documentation and any other relevant information available, PJM, with timely input and advice from the MMU, will review the information against the Market Seller's Fuel Cost Policy to verify accuracy of the offer. Based on the review PJM will take one of the following actions:
    - o If the Market Seller does not provide complete information for the Energy Offer Verification Template or supporting documentation, PJM will notify the Market Seller that the information provided is incomplete. The Market Seller may then provide further documentation detailing the resource's underlying costs.
    - o If the information and documentation is sufficient to validate the level of the cost-based offer, PJM will approve the exception and deem the offer verified. PJM will then notify the Market Seller of the verification result. The offer becomes eligible to be used as part of dispatch and calculating LMP as soon as the verification decision is recorded in the PJM market systems
    - o If the information and documentation is insufficient to verify the level of the cost-based offer, PJM will deny the exception. For a denied exception, PJM will cap the cost-based offer at the greater of \$1,000/MWh or the highest segment verified in the exception process.

### **2.3.6.3 Fast-Start Capable Generation Resource Composite Energy Offer Screening Process for Composite Offers more than \$1,000/MWh**

Before the components of a Fast-Start Capable generation resource's offer are considered in the calculation of LMPs, PJM uses a screening process to verify the reasonableness of each Composite Energy Offer in excess of \$1,000/MWh calculated at the submitted applicable Economic Maximum and Minimum Run Time. In the event an hourly Economic Maximum or Minimum Run Time has been submitted, this will be used as the applicable Economic Maximum or Minimum Run Time; otherwise, the submitted Daily Offer will be used.

PJM will evaluate whether each Fast-Start Capable Resource's Composite Energy Offer greater than \$1,000/MWh exceeds the reasonably expected costs for that generation as follows:

1. PJM shall evaluate whether the Incremental Energy Offer and No-load Cost components exceed the reasonably expected costs for that resource as determined in accordance with the PJM Operating Agreement, Schedule 1, Section 6.4.3.
2. PJM shall evaluate whether the Start-Up Cost component exceeds the reasonably expected costs for that resource as determined in accordance with the PJM Operating Agreement, Schedule 1, Section 6.4.3A. If data required to calculate the reasonably expected startup costs is null or unavailable, the startup cost cannot be verified.

In addition, PJM will evaluate whether each Fast-Start Capable Resource's price-based Composite Energy Offer greater than \$1,000/ MWh exceeds the specified reference cost-based schedule as follows:

- The Start-Up Cost and the No-Load Cost for the price-based schedule is deemed to exceed the reasonably expected costs if the Incremental Energy Offer of the price-based

schedule exceeds the Incremental Energy Offer of the specified reference cost-based offer.

- The Start-Up Cost for the price-based schedule is deemed to exceed the reasonably expected cost if it (1) exceeds the Start-Up Cost of the specified reference cost-based offer or (2) exceeds the reasonably expected costs for that resource as described above.
- The No-Load Cost for the price-based schedule is deemed to exceed the reasonably expected cost if it (1) exceeds the No-Load Cost of the specified reference cost-based offer or (2) exceeds the reasonably expected costs for that resource as described above.

For information on the how the results of the screening process are used in the determination of Composite Energy Offers, refer to Section 2.7 of this Manual.

### 2.3.7 Mechanical/Technical Rules

A valid generator offer consists of the following elements:

- Use startup & no-load switch, with a default value of yes (1).
- Hourly startup and no-load costs, with default values of zero.
  - External resources can only submit startup and no-load costs if the entire output of the resource is available for PJM dispatch.
- Condense available switch, with a default value of no (0).
- Ramp rate, with a default value of 9999 MW/minute.
- Hourly economic max/min and emergency max/min are the unit-level economic and emergency MW limits, respectively.
- Daily minimum down time and start times, with default values of zero.
- Daily minimum run time and notification time for the Day-ahead Market, with the ability to update the hourly values for use in Real-time commitment and dispatch. The default values will be zero.
- Daily maximum run time and maximum number of starts per week, with default values of infinity.
- Use offer slope switch, with a default value of no (0).
- Hourly incremental offer curves, with default value of \$0. If the last MW point on the segment curve is less than the maximum emergency limit, then the curve is extended up to the emergency maximum limit using zero slope from the last incremental point on the curve.
- For those parameters that are allowed to vary hourly, in the absence of overrides specifying separate values for each hour (hourly differentiated offer data), the daily offer value is used.
- In order to qualify for exempt or bonus MW during a Performance Assessment Interval, in accordance with PJM Manual 18: PJM Capacity Market, Section 8.4A Non-Performance Assessment, each generation resource must have at least one available schedule. Each offer must have the following:
  - Economic Minimum value (zero or non-zero value).

- o Economic Maximum value (zero or non-zero value).
- o Emergency Maximum value (zero or non-zero value).
- o At least one segment on the incremental offer curve.

Valid offers for a Generation Capacity Resource consists of a parameter limited price-based schedule (if the resource is price-based) and at least one cost-based schedule.

Valid offers for a non-Capacity Generation Resource consists of a price-based schedule (if the resource is price-based) and at least one cost-based schedule.

Valid offers for demand bids, price sensitive and fixed, consist of the following items:

- MW, with a default value of 0 MW. Demand bids should not include losses.
- Location (transmission zone, aggregate, or single bus). Price at which the demand shall be curtailed (for price-sensitive bids).

### 2.3.8 Modeling

Fixed transactions, including increment offers, ~~and~~ decrement bids, and Up-To Congestion Transactions are modeled in the Resource Scheduling & Commitment (RSC). ~~Up-To Congestion Transactions are not modeled in the commitment, but are handled in the Day-ahead dispatch.~~

The Day-ahead security analysis treats increment offers as injections (generation) and decrement bids as withdrawals (loads).

External bilateral transactions sourcing at an interface bus are modeled as generation at the source bus location. This is the case for both dispatchable and non-dispatchable transactions.

External bilateral transactions sinking at an interface bus are modeled as a load at the sink bus location. This is the case for both dispatchable and non-dispatchable transactions.

Only fixed transactions and transactions involving external aggregate resources are modeled in the RSC for the Day-ahead Market.

### 2.3.9 Day-ahead Locational Marginal Price (LMP) Calculations

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

- All dispatchable units.
- 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.

### 2.3.10 Operating Parameter Definitions

Cold/Warm/Hot Notification Time - The time interval between PJM notification and the beginning of the start sequence for a generating resource that is currently in its cold/warm/hot temperature state. The start sequence may include steps such as any valve operation, starting feed water pumps, startup of auxiliary equipment, etc.

Cold/Warm/Hot Start-up Time - The time interval, measured in hours, from the beginning of the start sequence to the point after the generator breaker closure which is typically indicated by telemetered or aggregated state estimator MWs greater than zero for a generating resource in its cold/warm/hot temperature state. For a Combined Cycle unit it is the time interval from the beginning of the start sequence to the point after the first combustion turbine generator breaker closure which is typically indicated by telemetered or aggregated state estimator MWs greater than zero. The Start-start sequence may include steps such as any valve operation, starting feed water pumps, startup of auxiliary equipment, etc.

Other more detailed actions that could signal the beginning of the start sequence could include but are not limited to the operation of pumps, condensers, fans, water chemistry evaluations, checklists, valves, fuel systems, combustion turbines, starting engines or systems, maintaining stable fuel/air ratios, and other auxiliary equipment necessary for startup.

Minimum Run Time (hour) - The minimum number of hours a resource must run, in Real-time operations, from the time after the generator breaker closure which is typically indicated by telemetered or aggregated state estimator MWs greater than zero to the time of the 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 last generator breaker opening as measured by PJM's state estimator.

Turn Down Ratio – The ratio of a resource's economic maximum MW to its economic minimum MW.

Minimum Down Time (hour) - The minimum number of hours under normal operating conditions between resource shutdown and resource startup, calculated as the shortest time difference between the generator breaker opening and after the generator breaker closure, which is typically indicated by telemetered or aggregated state estimator MWs greater than zero. For Combined Cycle units this is the minimum number of hours between the last generator breaker opening and after the first combustion turbine generator breaker closure which is typically indicated by telemetered or aggregated state estimator MWs greater than zero.

Maximum Daily Starts - The maximum number of times that a resource can be started in an operating day under normal operating conditions.

Maximum Weekly Starts - The maximum number of times that a resource can be started in one week under normal operating conditions (168 hour period starting Monday 0001 hour).

Maximum Run Time (hour) - The maximum number of hours a resource can run over the course of an Operating Day as measured by PJM's state estimator.

Cold/Warm/Hot Soak Time (hour) - The minimum number of hours a resource must run, in Real-time operations, from the time after the generator breaker closure which is typically indicated

by telemetered or aggregated state estimator MWs greater than zero to the time the resource 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.

Soak Time may include items such as the time necessary to alleviate temperature gradients across boiler or turbine components, the startup and stable operation of environmental equipment, water chemistry evaluations and holds, the maintaining of stable fuel/air ratios, the addition of incremental fuel related or other auxiliary equipment, the starting of additional combustion turbines in a combined cycle, and the pressure matching of heat recovery steam generators.