



Working to Perfect the Flow of Energy

PJM Manual 28:

Operating Agreement Accounting

Revision: 75

Effective Date:

Prepared by:

Market Settlements Development
Department

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Section 5: Operating Reserve Accounting

Welcome to the *Operating Reserve Accounting* section of the *PJM Manual for Operating Agreement Accounting*. In this section, you will find the following information:

- A description of how Operating Reserve is provided and accounted for in the Day-ahead and Balancing PJM Energy Markets (see “*Operating Reserve Accounting Overview*”).
- How day-ahead and balancing credits are calculated for providers of pool-scheduled Operating Reserve (see “*Credits for Operating Reserve*”).
- How the total pool cost of day-ahead and balancing Operating Reserve, Synchronous Condensing, and Reactive Services are allocated (see “*Charges for Operating Reserve*”).

5.2.1 Credits for Pool-Scheduled Generating Resources

At the end of each Operating Day, PJM calculates the credits due each PJM Member for pool-scheduled generating resources.

PJM Actions:

- PJM retrieves the following information:
 - dispatcher generation scheduling and operations logs
 - resource offer data
 - scheduled MWh for generation offers cleared in day-ahead market
 - state estimator generation MWh, trued-up to match revenue meter generation MWh from PJM Power Meter (if available)
 - scheduled MWh for InSchedule “Generation” contracts, if applicable
 - generator dispatch rates, UDS basepoint MWh, and ramp-limited desired MWh
 - generator day-ahead and real-time LMPs
- PJM calculates the resource’s hourly day-ahead offer amount based on its day-ahead offer data and its cleared day-ahead Scheduled MWh for that hour.
- PJM accounting process applies the startup and hourly no-load bids if the start-up and no-load switch is set in the resource offer data and if the start-up bid is applicable for the MWh and status of the resource.

- Day-ahead credits for startup reflect the appropriate hot, intermediate, or cold state of the resource as it was scheduled in the day-ahead market.

- PJM calculates the resource's hourly day-ahead energy market value as:

$$\text{Scheduled MWh} * \text{Day ahead LMP}$$

- PJM calculates the daily Day-ahead Operating Reserve credits for each resource as follows:
 - Sum hourly day-ahead offer amounts, including applicable no-load and startup costs, for the day
 - Sum hourly day-ahead energy market values for the day
 - Day-ahead Operating Reserve credit equals any portion of the resource's total day-ahead offer amount in excess of its total day-ahead market value
- PJM sums the Day-ahead Operating Reserve generating resource credits for each PJM Member, taking into account joint-ownership of generating units.
- PJM determines eligibility for Balancing Operating Reserve credits for each generating resource from dispatcher logs. The following operating guidelines are used in the determination of Operating Reserve credits:
 - Resource must operate according to the on and off times requested by PJM, and units tripping during pool-scheduled periods of operation will retain their eligibility up through the hour in which the unit trips (unless the unit trips before half-past the hour, in which case the hour of the trip will not be eligible).
 - Resources that trip or fail to start are required to notify PJM per the Synchronization and Disconnection procedures in Manual 14D.
 - Resources that trip, are requested to restart by PJM, and return to operate as requested, are eligible to receive credits for the latter period of operation. Resources that trip or failed to start, are requested to restart by PJM for reliability, and operate as requested, are eligible for additional startup costs.
 - Resources that operate on a different schedule from the schedule that was accepted in the day-ahead market are ineligible for credits.
- PJM determines the resource's hourly Real-time MWh based on its state estimated generator bus MWh or its scheduled MWh via a unit-specific InSchedule "Generation" contract or its revenue meter value from PJM Power Meter, as applicable, for that hour.

- Generation resources that are scheduled in the Day-ahead Market are financially responsible for selling their output in real-time. Section 3.2.3(f-1)(ii) of the PJM OATT details provisions for lost opportunity credits for those combustion turbines (CTs) that were scheduled in the Day-ahead Market but are not called on by PJM to run in real-time (See Section 5.2.6 – Credits for Resources Reduced or Suspended due to a Transmission Constraint or for Other Reliability Reasons). CTs eligible to be called on in real-time must have a startup plus notification time of 2 hours or less for PJM to accurately economically assess the value of the unit and are therefore the only units eligible for these provisions. Any resource scheduled in the Day-ahead Market with a startup plus notification time of greater than 2 hours should assume that they are committed by PJM in real-time for the duration of the Day-ahead commitment and are therefore only eligible for the aforementioned make whole provisions if PJM denies the commitment of that unit in real-time for either economics or reliability.
- If a generation owner calls PJM to bring on a CT per its Day-ahead schedule and PJM does not permit the unit to operate in real-time either for reliability or economics, it may receive lost opportunity costs as described in section 3.2.3(f-1)(ii) of the OATT as it was not permitted to run by PJM in real-time (See Section 5.2.6 – Credits for Resources Reduced or Suspended due to a Transmission Constraint or for Other Reliability Reasons).
- If a CT is committed in the Day-ahead Market with a startup plus notification time of 2 hours or less at the time of the Day-ahead commitment and then extends its startup plus notification time to more than 2 hours, it will not be eligible to receive the aforementioned lost opportunity cost provisions in section 3.2.3(f-1)(ii) of the PJM Tariff.
- PJM determines the resource's hourly Operating Reserve Desired MWh based on its ramp-limited desired MWh or UDS basepoint MWh, when available. If available, UDS basepoint MWh is used when 1.) the UDS basepoint MWh are less than or equal to the ramp-limited desired MWh or 2.) the UDS basepoint MWh is greater than the ramp-limited desired MWh and the resource's Real-time MWh is greater than the ramp-limited desired MWh.
- PJM determines the resource's percent off dispatch as the lesser of the difference between the resource's Real-time MWh and the UDS basepoint MWh or the Real-time MWh and the ramp-limited desired MWh, if available. UDS LMP desired MWh is used to calculate a resource's percent off dispatch when 1.) data is unavailable due to technical difficulties or 2.) a resource's real-time economic minimum is greater than its day-ahead economic minimum by 5% or 5 MW, whichever is greater, or its real-time economic maximum is less than its day-ahead economic maximum 5% or 5MW, whichever is lower.
- If the resource's UDS basepoint MWh and ramp-limited desired MWh are not available or the percent off dispatch is greater than 20%, PJM determines the

resource's hourly UDS LMP Desired MWh based on its dispatch rate, applicable schedule's offer data, and minimum and maximum energy limits for that hour. 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 CTs, operating at PJM direction, the actual real-time output is used as the Operating Reserve Desired MWh value.

- PJM calculates the resource's hourly real-time energy offer amount based on its applicable schedule's offer data and its Real-time MWh for that hour. However, for any hour where the resource's Real-time MWh is greater than 110% of its Operating Reserve Desired MWh, Operating Reserve Desired MWh is used to determine the hourly real-time energy offer amount.
- PJM applies the startup and hourly no-load bids if the startup and no-load switch is set in the resource offer data and if the startup bid is applicable for the MWh and status of the resource.
- If applicable, when a resource is started during the day at the direction of PJM, the resource's real-time offer amount for that day includes its startup costs based on the appropriate hot, intermediate, or cold state of the resource. For resources that start generating for PJM from a condensing state, the applicable startup cost for that resource equals the amount submitted in writing to the PJM Market Settlement Operations Department to be in effect that Operating Day.
- If applicable, the resource's real-time offer amount includes its hourly no-load costs prorated for any hour during which it starts generating or stops generating as follows, using a 10% tolerance:

*If: Real time MWh < 0.9 * Scheduled Minimum MWh,*

Then: Hourly No Load is prorated by (Real time MWh / Scheduled Minimum MWh)

- PJM calculates the resource's hourly balancing energy market value as:

*(Real time MWh or Operating Reserve Desired MWh** – Day-ahead Scheduled MWh) * RT LMP*

***If a resource is committed in the Day-ahead market and a reduction in Real-time MWh from the DA Scheduled MWh is not the result of a PJM dispatch direction, the maximum of the Real-time MWh and the Operating Reserve Desired MWh (capped at the Day-ahead Scheduled MWh) will be used in the hourly balancing energy market value calculation, otherwise Real time MWh are used.*

- Balancing Operating Reserve credits are calculated by operating segment within an Operating Day. A resource will be made whole for the duration of the greater of the day-ahead schedule or scheduled soak time plus minimum run time (minimum down time for demand resources) and made whole separately for the block of hours it is operated at PJM's direction in excess of the greater of the day-ahead schedule or

- scheduled soak time plus minimum run time (minimum down time for demand resources). Startup costs (shut down costs for demand resources), as applicable, will be included in the segment represented by the longer of the day-ahead schedule or scheduled soak time plus minimum run time (minimum down time for demand resources).
- PJM calculates the daily Balancing Operating Reserve credits for each generating resource's operating segment as follows:
 - Sum hourly real-time offer amounts and include applicable no-load and startup costs for the segment
 - Sum hourly balancing energy market values for the segment
 - For each operating segment, Balancing Operating Reserve credit equals any portion of the resource's total real-time offer amount in excess of: 1) its total day-ahead market value, plus 2) its total balancing market value, plus 3) any Day-ahead Operating Reserve credits, plus 4) any Day-Ahead Scheduling Reserve Market revenues in excess of its offer plus opportunity cost, plus 5) any Synchronized Reserve Market revenue in excess of its offer plus opportunity cost plus energy use plus startup costs, plus 6) any Non-Synchronized Reserve Market revenue in excess of its opportunity costs, plus 7) any Reactive Services revenue.
 - For any operating day in which PJM declares a Maximum Generation Emergency or a Maximum Generation Emergency Alert, or schedules units based on the anticipation of a Max Generation Emergency or Maximum Generation Emergency Alert, if a generator's priced-based offer results in revenues for "economic" hours to produce an effective offer price greater than or equal to \$1000/MWh and is greater than a Market Seller's lowest available and applicable cost-based offer, that generator shall not receive any operating reserve credits in accordance with the PJM Operating Agreement sections 3.2.3 (l), (m), and (n).
 - For the Real-time market, PJM calculates an effective offer price by summing the Operating Reserve credits which would have been applicable absent this exemption, plus the Real-time LMP market value provided to the generator during "economic" hours, all divided by the sum of the generation MWh during those "economic" hours. "Economic" hours are defined as: 1) those hours in which the Real-time LMP is at or above the generator's offer price; 2) those hours that PJM dispatched the generator in excess of its soak time plus minimum run time and the generator's offer price is above the Real-time LMP; and, 3) those hours that a generator with a soak time plus minimum run time of less than or equal to 1 hour and more than one available starts per day is operated at the request of PJM.
 - PJM sums the Balancing Operating Reserve generating resource credits for each PJM Member, taking into account joint-ownership of generating units.

5.2.7 Credits for Resources Performing Annual Scheduled Black Start Tests

At the end of each month, PJM calculates the credits due to each PJM Member for resources performing annual black start tests. Compensation for energy delivered to the transmission system shall be provided for the unit's soak time plus minimum run time at the higher of the unit's cost-capped offer or real-time LMP plus start-up and no-load for up to two start attempts, if necessary. Compensation for tests where no energy was delivered to the transmission system shall be provided for the unit's start-up costs for up to two start attempts, if necessary.

PJM Actions:

- PJM retrieves the following information:
 - list of units performing annual scheduled black start tests (PJM Performance Compliance Department log)
 - resource cost-capped offer data
 - resource generation data
 - applicable real-time LMP
 - applicable start-up and no-load costs
- PJM sums the Balancing Operating Reserve annual black start test credits for all resources for each PJM Member.
- PJM Market Settlement Operations Department enters the appropriate adjustment into the current month's billing.