



# PJM Day-ahead Scheduling Reserve Market

(formerly known as Supplemental Reserve Market)

Version 6a (Modified for system implementation details)

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## Day-ahead Scheduling Reserve Market Definition and Purpose

1. The Day-ahead Scheduling Reserve Market is a construct for a market based mechanism for the procurement of supplemental, 30-minute reserves on the PJM System. The Day-ahead Scheduling [30-Minute] Reserve Market is a voluntary, offer-based market that will clear existing reserve requirements on a day-ahead, forward basis.
2. The Day-ahead Scheduling Reserve Market is designed to create an explicit value for an additional ancillary service in the PJM Markets, on a short-term basis. A Day-ahead Scheduling [30-Minute] Reserve market can provide a pricing method and price signals that can encourage generation and demand resources to provide Day-ahead Scheduling reserves and to encourage new resources to be deployed with the capability to provide such services.
3. The Day-ahead Scheduling Reserve Market is designed to interact with the current and proposed PJM Operating Reserve construct. While a clearing market for Day-ahead Scheduling [30-Minute] Reserves may reduce out-of-market payments to generators in the form of Operating Reserve credits, it will not eliminate them, and the remaining Operating Reserve costs will continue to be allocated.

## Day-ahead Scheduling Reserve Market Reserve Requirement

4. Current reserve requirements are detailed in PJM Manual M-13, Section 2, and vary according to the specific PJM region. The requirements for each region are combined to determine the overall requirement for the RTO, and the overall RTO requirement would form the basis for clearing the forward market.
5. The Day-ahead Scheduling Reserve Requirement will adhere to the requirements for Day-ahead Scheduling [30-Minute] Reserve defined by Reliability First Corporation and all applicable reliability councils for areas within the PJM RTO.
6. The PJM RTO Day-ahead Scheduling Reserve Requirement will be defined as the sum of the Day-ahead Scheduling Reserve requirements defined for all zones and areas within the PJM RTO, including any additional Day-ahead Scheduling reserves scheduled in response to an RTO-wide Hot or Cold Weather Alert or other reasons for conservative operations.
7. Future reserve requirements may be defined locationally based on operation criteria as documented in the PJM Manuals.



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## Day-ahead Scheduling Reserve Market Eligibility

8. Day-ahead Scheduling Reserve Resources are defined as resources that meet the following eligibility requirements to provide Day-ahead Scheduling Reserve:
  - a. Day-ahead Scheduling Reserve Resources comprise of all those resources that can provide reserve capability that can be fully converted into energy within 30 minutes from the request of the PJM dispatcher at the time of the request and is provided by equipment which may not necessarily at the time of the request be electrically synchronized to the system.
  - b. A Day-ahead Scheduling Reserve resource may be:
    - i. Equipment not electrically synchronized to the system. The equipment that generally qualifies in this category is shutdown run-of-river, pumped hydro, industrial combustion turbines, jet engine/expander turbines, combined cycle and diesels ; or
    - ii. Additional generating capacity that is synchronized to the grid and scheduled and can increase output in 30 minutes (including condensing mode and pumped hydro that is in pumping mode) to provide additional Day-ahead Scheduling Reserve;

or

  - iii. Load response resources must be registered in the Economic Load Response program, indicate that they can be dispatchable by PJM in real-time and be able to be reduced within 30 minutes.
  - iv. Load response resources that are considered “batch load” resources as defined in the Synchronized Reserve Market detailed in **PJM Manual for Scheduling Operations (M-11)** may participate in the Day-ahead Scheduling Reserve market under the same conditions as exist for Synchronized Reserve with respect to having already reduced prior to receiving a PJM dispatch instruction to do so. Such resources must remain off line for the duration of the PJM dispatch request in order to receive the Day-ahead Scheduling Reserve market payment.
9. Day-ahead Scheduling Reserve Market offers may be submitted only for those resources located electrically within the PJM RTO.



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10. Resources may participate and be compensated in both the Day-ahead Scheduling and Synchronized Reserve Markets. In addition, resources may participate and be compensated in both the Day-ahead Scheduling and Regulation Markets. However, since resources can not participate in both the Synchronized Reserve and Regulation markets, no resources can participate in the Day-ahead Scheduling Reserve, Synchronized Reserve AND Regulation markets and be compensated for all three.

## Day-ahead Scheduling Reserve Market Rules

11. The following offer and operational information must be supplied through the Two-Settlement Market User Interface (eMarket):
  - a. Day-ahead Scheduling Reserve Availability.
    - i. All generator units that have submitted energy offers with the parameters that make them capable of increasing energy output within 30 minutes are available to provide Day-ahead Scheduling reserve. Default = available.
    - ii. Demand resources may indicate if they are available to provide Day-ahead Scheduling reserve. Default = unavailable.
  - b. Day-ahead Scheduling Reserve Offer Quantity (MW) ~~for Online Units is~~ derived as the lesser of:
    - i. difference of the ~~EcoEmergency~~ Max – DA ~~Dispatch Pt Energy Award if scheduled committed Day-ahead~~
    - ii. Energy Ramp Rate \* (30 ~~minutes-minutes~~) – ~~[Startup + Notification Time]~~, if not ~~committed Day-ahead~~
  - c. ~~Day-ahead Scheduling Reserve Offer Quantity (MW) for Offline Units is:~~
    - i. ~~Emergency Max~~
  - e.d. ~~Day-ahead Scheduling Reserve Offer Price.~~
12. A valid generator or demand response energy offer must be available in the Day-ahead Energy Market to participate.
13. Non-capacity resources will need to have an energy offer available in the Day-ahead Market to participate in the Day-ahead Scheduling Reserve Market.
14. All generator units that are eligible and available to provide Day-ahead Scheduling reserve will be counted in the clearing of the RTO Day-ahead Scheduling Reserve Requirement. Demand resources may voluntarily make themselves available to provide Day-ahead Scheduling reserve.

## Day-ahead Scheduling Reserve Market Offer Period



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15. Market participants wishing to offer into the Day-ahead Scheduling Reserve Market must supply offer and operational data on a day-ahead basis, with offers due to PJM by 1200 EPT on the day before the operating day.
16. Offers to provide Day-ahead Scheduling [30-Minute] Reserve are in dollars/MW of Reserve to be provided, and \$0 is a valid offer.
17. Day-ahead Scheduling Reserve offers are locked as of 1200 EPT the day prior to operation. All generating units listed as available for Day-ahead Scheduling Reserve with no offer price will have their offer prices set to zero.

## Day-ahead Scheduling Reserve Market Clearing

18. PJM would clear the forward market for Day-ahead Scheduling Reserves via a simultaneous optimization with the energy market as part of the Day-Ahead Market mechanism.
19. The Operating Reserve objective utilized in the Day-Ahead Market and on which the Day-ahead Scheduling [30-Minute] Reserve market that would clear will be calculated based on the PJM load forecast for the upcoming operating day.
20. The market clearing would result in an hourly price for Day-ahead Scheduling [30-Minute] Reserve for the next day, and would be posted along with the resource-specific Day-ahead Scheduling [30-Minute] Reserve awards by 1600 EPT via the PJM eMarket User Interface.
21. A clearing price for Day-ahead Scheduling [30-Minute] Reserve would be calculated for each hour of the upcoming operating day based upon whether PJM was required to commit additional resources to meet the RTO Day-ahead Scheduling [30-Minute] Reserve requirement. The hourly clearing price would be based upon the offer prices submitted by the selected resources, together with any opportunity cost a resource incurs in the day-ahead market as a result of being backed down in the day-ahead scheduling process in order to provide reserve.
22. The Day-ahead Scheduling Reserve Market clearing price is set equal to the merit order price of the highest cost Day-ahead Scheduling Reserve resource necessary to meet the remaining requirement.
  - a. Resource merit order price (\$/MWhr) = resource Day-ahead Scheduling Reserve offer + resource Day-ahead Scheduling Reserve opportunity costs



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- b. Both generator startup costs and demand resource shutdown costs are divided over the expected commitment period for the resource, as part of the market clearing process. Neither of these costs are including in the clearing price.
  - c. Day-ahead Scheduling Reserve start-up costs are defined as applicable generator startup costs required to provide Day-ahead Scheduling Reserve or demand resource shutdown costs required to provide Day-ahead Scheduling Reserve.
  - d. Day-ahead Scheduling Reserve opportunity costs are defined as applicable generator opportunity costs required to provide Day-ahead Scheduling Reserve or applicable demand resource opportunity costs required to provide Day-ahead Scheduling Reserve. **[NOTE: Opportunity Costs have not been defined for Demand Resources in the Synchronized Reserve construct. When, and if they are defined for Synchronized Reserve, they can be defined for Day-ahead Scheduling Reserve.]**
  - e. The resource Day-ahead Scheduling Reserve offer is that which is submitted by the owner via eMarket by 1200 hours on the day preceding the operating day.
  - f. For each of these calculations, forecast LMP is the result of the Day-Ahead Market software.
23. All Day-ahead Scheduling Reserve clearing prices are posted on the eMarket user interface for public view at 1600 EPT.
24. All Day-ahead Scheduling Reserve award are posted on the eMarket user interface for private view at 1600 EPT.
25. Data posted at 1600 will include Day-ahead Scheduling Clearing Price, Day-ahead Scheduling Requirement, and Cleared MWs.

## Day-ahead Scheduling Reserve Market Operations

- 26. Those resources receiving a day-ahead award for Day-ahead Scheduling [30-Minute] Reserve would receive the hourly clearing price for the awarded MW amount as long as they were capable of providing the reserve in real time as scheduled.



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27. PJM may call on resources not otherwise scheduled to run in order to provide Day-ahead Scheduling Reserve, in accordance with PJM's obligation to minimize the total cost of energy, operating reserves, synchronized reserve, regulation, and other ancillary services. If a resource is called on by PJM for the purpose of providing Day-ahead Scheduling Reserve, the resource is guaranteed recovery of all costs including start-up, no-load and minimum energy costs. .
  
28. The hourly Day-ahead Scheduling Reserve clearing price is fixed once calculated and posted at 1600 EPT the day before the Operating Day.
  
29. Measurement of the performance of assigned resources will be as follows:
  - a. For resources with a start time of greater than 30 minutes, the resource is required to be on line and operating at PJM's direction during the timeframe (i.e. – all hours) of the award with a dispatchable range (Eco Max – Eco Min) at least as great as the supplement reserve award.
  - b. For resources with a start plus notification time of less than or equal to 30 minutes, the resource would be required to be available to the PJM operator for dispatch during the hours of the award and start within the specified notification plus start time if dispatched by PJM.
  - c. For Demand Resources, measurement is the difference between the demand resource's MW consumption at the time a resource is requested by PJM dispatch to reduce and its MW consumption after 30 minutes of the request. In order to allow for small fluctuations and possible telemetry delays, demand resources consumption at the start of the event is defined as the greatest telemetered consumption between one (1) minute prior to and one (1) minute following the issuance of the dispatch instruction. Similarly, a demand resource's consumption thirty minutes after the dispatcher request is defined as the lowest consumption measured between twenty nine (29) and thirty (31) minutes after the start of the request

**[WG: Measuring of Demand Resources. Intent is that DR resources will be held to the same standards for DR resources in the Synchronized Reserve Market.]**

## Day-ahead Scheduling Reserve Market Obligation Fulfillment



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30. Each Load Serving Entity (LSE) on the PJM system incurs a Day-ahead Scheduling Reserve obligation in kWh based on their real-time load ratio share of the Day-ahead Scheduling Reserve assigned. Each LSE's obligation is equal to its load ratio share within its RTO times the amount of Day-ahead Scheduling Reserve assigned in the RTO. Any PJM market participant may incur or fulfill a Day-ahead Scheduling Reserve obligation through the execution of a bilateral Day-ahead Scheduling Reserve transaction as described below.
31. Participants may fulfill their Day-ahead Scheduling Reserve obligations by:
  - a. Owning Day-ahead Scheduling Reserve resources from which the RTO obtains Day-ahead Scheduling Reserve ;
  - b. Entering bilateral arrangements with other market participants; or
  - c. Purchasing Day-ahead Scheduling Reserve from the Day-ahead Scheduling Reserve market.

## Day-ahead Scheduling Reserve Bilateral Transactions

32. Bilateral Supplement Reserve bilateral transactions must be entered by the buyer and subsequently confirmed by the seller through the Two Settlement MUI no later than ~~noon~~ 1600 [LMH: to be consistent with other markets] the day after the transaction starts. Bilateral transactions that have been entered and confirmed may not be changed; they must be deleted and re-entered. Deletion of a bilateral transaction is interpreted as a change in the end time of the transaction to the current hour, unless the transaction has not yet started.
33. Bilateral Day-ahead Scheduling Reserve transactions may be entered either in MW or as a percentage of the purchaser's obligation. The minimum MW value is .1 MW
34. PJM will calculate and post an indexes in order to provide an approximate value of Day-ahead Scheduling Reserve on which market participants may base prices for bilateral Day-ahead Scheduling Reserve bilateral transactions:

(Total hourly Supplemental Reserve cost)/(Total Supplemental Reserve assigned)

## Day-ahead Scheduling Reserve Market Settlement

35. Day-ahead Scheduling Reserve settlement is a zero-sum calculation based on the Day-ahead Scheduling Reserve provided to the market by generation and demand resource owners and purchased from the market by participants.



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36. Costs for Day-ahead Scheduling [30-Minute] Reserves would be allocated according to load ratio share. Similar to the Regulation and Synchronized Reserve markets, each Load-Serving Entity would carry an obligation to purchase Day-ahead Scheduling [30-Minute] Reserve equal to its load ratio share of the RTO requirement, and charges would be based on the MW obligation carried by each LSE. If in the future, Day-ahead Scheduling reserve requirements are defined locationally based on operating criteria, then the costs would be allocated locationally to load ratio share.
37. Day-ahead Scheduling Reserve charges for each participant are equal to:
  - a. the appropriate hourly Day-ahead Scheduling Reserve clearing price times the MW of Day-ahead Scheduling Reserve that which is purchased from the market plus;
  - b. the participant's share of any unrecovered costs incurred by assigned Day-ahead Scheduling Reserve resources over and above the Day-ahead Scheduling Reserve clearing price plus;
  - c. the participant's share of any unrecovered costs incurred by those resources PJM committed for the sole purpose of providing Day-ahead Scheduling Reserve plus;
38. The appropriate hourly Day-ahead Scheduling Reserve clearing price for each LSE is the clearing price for the zone in which the LSE's load is located.
39. Revenue from the Day-ahead Scheduling [30-Minute] Reserve Market will be applied against balancing operating reserve credits that correspond to the hour that the revenue was earned.



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## Non-Performance

40. There is no requirement for resources with Day-ahead Scheduling [30-Minute] Reserve awards to actually maintain the awarded amount of reserve capability in real time.
41. Day-ahead Scheduling [30-Minute] Reserve awards are required to follow PJM direction, in real time, as specified in the rules detailed in **Day-ahead Scheduling Reserve Market Operations section**, during the hours they received those awards.
42. Those resources receiving a day-ahead award for Day-ahead Scheduling [30-Minute] Reserve that are not available to provide that reserve in real time during the timeframe of the award will not receive the clearing price for the awarded MW amount for the hours the resource was assigned for that day.
  - a. For resources with a start time of greater than 30 minutes, this means resources that received an award but are not on line during the hours for which the award was received.
  - b. For resources with a start time + notification time of less than or equal to 30 minutes, this means resources that received an instruction from PJM to start during one of the hours for which the award was received but did not complete startup within specified startup and notification time from the time the PJM operator issued the instruction.
    - i. If unit with a Day-ahead Scheduling Award for any hour in a day is requested to start in an hour that it did not receive a Day-ahead Scheduling Award, the unit must start within the specified Notification + Startup time for that hour in order to receive the award for the day.
  - c. Those resources receiving a day-ahead award for Day-ahead Scheduling Reserve , that have a Real-time dispatchable range that is less than the resource's Day-ahead dispatchable range become ineligible to receive a Day-ahead Scheduling Reserve Market payment.



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## Demand Resources

43. Demand resources' response controls must be approved by PJM prior to participation in the Supplement Reserve Market including ability to be dispatched by PJM's Unit Dispatch System.
44. Demand resources providing Day-ahead Scheduling Reserve are required to provide telemetry that is capable of providing metering information at no less than a one minute scan rate.
45. Metering information of demand resources is not required to be sent to PJM in real time. Daily uploads at the end of the day if an event has occurred are sufficient, as the response evaluation is performed after the fact.
46. Demand resources may be aggregated and offered into the PJM Day-ahead Scheduling Reserve Market as one combined resource if the appropriate telemetry is provided for the aggregated resource.
47. Demand resource participation will be limited to 25% of the RTO Day-ahead Scheduling Reserve Requirement.
48. Demand Resources will be allowed to participate in the Day-ahead Scheduling Reserve Markets if approved by the appropriate Regional Reliability Council.