Section 19: Secondary Reserve Accounting

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

- A description of how Secondary Reserves are provided and accounted for in the PJM Energy Markets (see "*Secondary Reserve* Accounting Overview").
- How credits are calculated for providers of Secondary Reserve (see "Credits for *Secondary* Reserve").
- How the total cost of Secondary Reserve is allocated (see "Charges for *Secondary* Reserve").
- How Secondary Reserve charge reconciliations are calculated (see "Reconciliation for *Secondary* Reserve Charges").

19.1 Secondary Reserve Accounting Overview

Secondary Reserve shall be supplied from resources located within the metered boundaries of PJM that are on-line or off-line and able to provide response within 10 and 30 minutes. Secondary Reserve resources include generators and Economic Load Response Participants.

The total PJM 30-minute Reserve Requirement is defined as the amount of reserves to be supplied from Synchronized and Non-Synchronized resource, available within 30-minutes. Additional details on the 30-minute Reserve requirements can be found in the PJM Manual 13: Emergency Operations

Secondary Reserve credits are awarded to resources in both the Day-ahead and Real-time Markets based on assignment and RT MW output. The Secondary Reserve offer price for a resource is $0.

Each Market Participant that is a Load Serving Entity (LSE) or secondary buyer that is not part of an agreement to share reserves with external entities subject to the requirements in NERC Reliability Standard BAL-002 incurs a Secondary Reserve Obligation based on their Load Ratio Share and applicable reserve location's assignments during that hour. During hours when the Secondary Reserve Market Clearing Price (SecRMCP) is the same throughout the entire RTO reserve zone, an LSE's Secondary Reserve Obligation is equal to its Load Ratio Share of the RTO reserve zone times the amount of Secondary Reserve assigned for all Real-time Settlement Intervals for the RTO Reserve zone. During hours when the SecCRMCP is different between the RTO Reserve zone and the Reserve sub-zone, an LSE's Secondary Reserve Obligation will be calculated based on their load in active sub-zone and/or the portion of the RTO Reserve Zone outside of the active sub-zone (the "non sub-zone"). The LSE's active sub-zone Secondary Reserve Obligation is equal to its Load Ratio Share within that active sub-zone times the amount of Secondary Reserve assigned in that active sub-zone. The LSE's

Secondary Reserve Obligation in the non sub-zone is equal to its Load Ratio Share in the non sub-zone times the amount of Secondary Reserve assigned in the non sub-zone portion of the RTO.

Participants may fulfill their Secondary Reserve obligations by entering bilateral arrangements with other PJM Market Participants, or purchasing Secondary Reserve from the PJM Secondary Reserve Market.

19.2 Credits for Secondary Reserve

Secondary Reserve credits are paid in both Day-ahead and Real-time Secondary Reserve Markets to Market Participants that supply their resource to PJM. The credits for the Day-ahead and Real-time Secondary Reserve Markets appear on the billing statement as two separate billing line items:

- Day-ahead Secondary Reserve Credits = Sum (Day-ahead Secondary Reserve Market Clearing Price Credits) for the days in the billing period
- Balancing Secondary Reserve Credits = Sum (Balancing Secondary Reserve Market Clearing Price Credits + Secondary Reserve Lost Opportunity Cost Credits) for the days in the billing period

Secondary Reserve credits for jointly-owned generators supplying Secondary Reserves are allocated to the owners based on their ownership share.

19.2.1 Day-ahead Secondary Reserve Market Clearing Price Credit

Day-ahead Secondary Reserve Market Clearing Price credits are paid to a resource that is assigned Secondary Reserve MWs by PJM within the Day-ahead Market to satisfy the 30-minute Reserve Requirement. If a Day-ahead Market Suspension occurs, Day-ahead Secondary Reserve Market Clearing Prices will be set to $0/MWh and Day-ahead Secondary Reserve assignments will be set to 0 MWh.

PJM Actions

- PJM retrieves the following information for Day-ahead Secondary Reserve Market Clearing Price credit:
  - Day-ahead Secondary Reserve assignments (MWh)
  - Day-ahead Secondary Reserve Market Clearing Price (DA SecRMCP) ($/MWh)
- PJM calculates for each hour the Day-ahead Secondary Reserve Market Clearing Price credit for each eligible resource by multiplying the Day-ahead Secondary Reserve MWs assigned by the Day-ahead Secondary Reserve Market Clearing Price.
  - Day-ahead Secondary Reserve Market Clearing Price Credit = Day-ahead Secondary Reserve MW * DA SecRMCP

19.2.2 Balancing Secondary Reserve Market Clearing Price Credit

Balancing Secondary Reserve Market Clearing Price credits are paid to a resource that is assigned Secondary Reserve within the Real-time Market to satisfy the 30-minute Reserve Requirement. During a Real-time Market Suspension, if PJM is assigning Secondary Reserves, Balancing Secondary Reserve Market Clearing Price Credits will be calculated using Real-time Secondary Reserve Market Clearing Prices calculated according to the rules in Manual 11, Section 4.4.6.

PJM Actions

- PJM retrieves the following information for Balancing Secondary Reserve Market Clearing Price credit:
  - Real-time Secondary Reserve assignments (MWh)
  - Economic Maximum MW
  - Real-time Secondary Reserve Maximum MW
  - Real-time MW output
  - Day-ahead Secondary Reserve assignments (MWh)
  - Real-time Synchronized Reserve assignments (MWh)
  - Real-time Secondary Reserve Market Clearing Price (RT SecRMCP) ($/MWh)
  - Secondary Reserve Shortfall MW
- PJM calculates for each Real-time Settlement Interval the Balancing Secondary Reserve Market Clearing Price credit for each eligible resource by taking the difference between the capped Real-time Secondary Reserve assignment and Day-ahead Secondary Reserve assignments and multiplying it by the RT SecRMCP, then dividing the product by 12.
  - Balancing Secondary Reserve Market Clearing Price Credit = ((Capped Real-time Secondary Reserve Assignment – Day-ahead Secondary Reserve Assignment – Secondary Reserve Shortfall MW) * RT SecRMCP) / 12
  - Capped Real-time Secondary Reserve Assignment = Minimum (Real-time Secondary Reserve MW, Max((Minimum (Economic Maximum MW, Real-time Secondary Reserve Maximum MW) – Real-time MW Output – Real-time Synchronized Reserve MW),0))
  - Secondary Reserve Shortfall MW =
    - For a real-time offline generation resource that does not reach Economic Minimum output within 30 minutes as instructed by PJM. Secondary Reserve Shortfall MW = Capped Real-time Secondary Reserve assignment. This shortfall MW will be applied to all prior intervals in which the resource was assigned to provide real-time Secondary Reserve starting at the later of (A) the last interval the resource was online or (B) the beginning of that Operating Day and continuing up to the interval the resource failed to come online.
    - For a real-time Economic Load Response that does not reduce by at least the Economic Minimum within 30 minutes as instructed by PJM, Secondary

Reserve Shortfall MW = Capped Real-time Secondary Reserve assignment. This shortfall MW will be applied to all prior intervals in which the resource was assigned to provide real-time Secondary Reserve starting at the later of (A) the last interval the resource reduced load at PJM's instruction or (B) the beginning of that Operating Day, through the earlier of (C) the next interval in which the resource is dispatched to reduce load or (D) the end of the Operating Day.

19.2.3 Secondary Reserve Lost Opportunity Cost Credit

PJM calculates a Secondary Reserve Lost Opportunity Cost Credit for pool-scheduled resources if the Secondary Reserve Lost Opportunity Cost (excluding any reduction for a stability limit) is greater than the total SecRMCP Credits (Day-ahead and Balancing) received through the Secondary Reserve Market for each Real-time Settlement Interval. If the resulting amount is negative, then the credit is $0.

If a Day-ahead Market Suspension occurs, Day-ahead Secondary Reserve prices and quantities will be zero. During a Real-time Market Suspension, if PJM is assigning Secondary Reserves, the Real-time Synchronized Reserve Opportunity Cost will be calculated using Real-time LMPs calculated per Manual 11, Section 2.21.

PJM Actions

- PJM retrieves the following information for the Secondary Reserve Lost Opportunity Cost credit:
  - Day-ahead Secondary Reserve Market Clearing Price Credit ($)
  - Balancing Secondary Reserve Market Clearing Price Credit ($)
  - Market Revenue Neutrality Offset ($) (as determined and calculated in Section 15 of this PJM Manual)
  - Secondary Reserve Opportunity Cost Credits Owed ($) (as determined and calculated in Section 15 of this PJM Manual)
- For each Real-time Settlement Interval, PJM calculates a Secondary Reserve Lost Opportunity Cost Credit for a resource if the costs associated with that resource are greater than the credits received by the resource.
  - Secondary Reserve Lost Opportunity Cost Credit = Max (Secondary Reserve Cost – Secondary Reserve Credit, 0)
- PJM calculates the cost side of the Secondary Reserve Lost Opportunity Cost Credit equation as follows:
  - Secondary Reserve Cost = (Day-ahead Secondary Reserve Opportunity Cost + Real- time Secondary Opportunity Cost) / 12
    - Day-ahead Secondary Reserve Opportunity Cost will equal (A * B) - C:
      - A = DA LMP at the generation bus or applicable Economic Load Response Participant resource pricing point

- B = The deviation of the resource's energy output or load reduction necessary to supply a Day-ahead Secondary Reserve assignment from the resource's expected energy output or load reduction level if it had been assigned in economic merit order to provide energy or reduce load in the dispatch run less any Day-ahead Synchronized Reserve Market assignment
- C = The Day-ahead Energy Market offer integrated under the applicable energy offer curve for the resource's energy output or load reduction necessary to provide a Day-ahead Secondary Reserve Market assignment from the resource's expected energy output or load reduction level if it had been assigned in economic merit order to provide energy or reduce load in the dispatch run less any Day-ahead Synchronized Reserve Market assignment
- For the following resource types, the Day-ahead Secondary Reserve Opportunity Cost is calculated as follows:
- Resources committed to provide secondary reserves in synchronous condensing mode without a Day-ahead Synchronized Reserve Assignment
  = (Day-ahead Condense Energy Use * DA LMP at the generation bus) + (Day-ahead Condense Start-up Cost / Number of Hours assigned Secondary Reserve)
- Resources providing secondary reserves in synchronous condensing mode with a Day-ahead Synchronized Reserve Assignment = $0
- Resources committed to provide secondary reserves in offline mode = $0
- Economic Load Response Participant resources that do not have a day- ahead commitment to provide energy in the same hour = $0

▪ Real-time Secondary Reserve Opportunity Cost will equal (A * B) – C:

- A = RT LMP at the generation bus or applicable resource pricing point
- B = The deviation of the generation resource's output necessary to supply Secondary Reserve in real-time in excess of its Day-ahead Secondary Reserve Market assignment and follow the Office of the Interconnection's signals and instructions from the generation resource's expected output level if it had been dispatched in economic merit order to provide energy in the pricing run less any Real-time Synchronized Reserve Market assignment
- C = The energy offer integrated under the applicable energy offer curve for the generation resource's output necessary to supply Secondary Reserve in real-time from the lesser of the generation resource's output necessary to provide a Day-ahead Secondary Reserve Market assignment or follow the Office of the Interconnection's signals and instructions from the generation resource's expected output level if it had been dispatched in economic

merit order to provide energy in the pricing run less any Real-time Synchronized Reserve Market assignment

- For the following resource types, the Real-time Secondary Reserve Opportunity Cost is calculated as follows:
- Resources providing secondary reserves in synchronous condensing mode without a Real-time Synchronized Reserve assignment = ((Real-time Condense Energy Use – Day-ahead Condense Energy Use) * RT LMP at the generation bus) + any additional Condense Start-up Cost in excess of Day-ahead Condense Start-up Cost
- Resources providing secondary reserves in synchronous condensing mode with a Real-time Synchronized Reserve assignment = $0
- Resources with a Real-time Secondary Reserve assignment that were cleared and committed as offline resources ~~in offline mode~~ = $0
- Hydro unit (providing secondary reserve in spill mode) = (RT LMP at the generation bus * (Real-time Secondary Reserve assignment – Day-ahead Secondary Reserve assignment)
- Hydro unit (non-spill mode with day-ahead energy commitment > 0) = (RT LMP at the generation bus - average RT LMP at the generation bus for the appropriate on peak / off peak period) * (Real-time Secondary Reserve assignment – Day-ahead Secondary Reserve assignment). If the average RT LMP value is higher than the RT LMP at the generator bus, then the Real-time Synchronized Reserve Opportunity Cost will equal zero.
- Where the “on peak” is defined as 0700 – 2259 and “off-peak” is defined as 0000 – 0659, 2300-2359, excluding those hours during which all available units at the hydro plant were operating
- Hydro unit (non-spill mode with no day-ahead energy commitment > 0) = $0
- Economic Load Response Participant resources = $0

- PJM calculates the credit side of the Secondary Reserve Lost Opportunity Cost Credit equation as follows:
  - Secondary Reserve Credit = (Day-ahead Secondary Reserve Market Clearing Price Credit / 12) + (Market Revenue Neutrality Offset + Secondary Reserve Opportunity Cost Credit Owed + Balancing Secondary Reserve Market Clearing Price Credit)
    - Day-ahead Secondary Reserve Market Clearing Price Credit = as determined and calculated in Section 19.2.1 of the PJM Manual
    - Market Revenue Neutrality Offset = as determined and calculated in Section 15 of this PJM Manual
    - Secondary Reserve Opportunity Cost Credit Owed = as determined and calculated in Section 15 of this PJM Manual

- Balancing Secondary Reserve Market Clearing Price Credit = as determined and calculated in Section 19.2.2 of the PJM Manual

19.3 Charges for Secondary Reserve

PJM allocates the cost of the total Day-ahead and Balancing Secondary Reserve credits paid to resources providing Secondary Reserve as charges to Market Participants with a Secondary Reserve Obligation in the RTO zone, active sub-zone or non sub-zone as described in section 6.1 of this PJM Manual. PJM calculates charges for the RTO Reserve Zone when there is no price separation between the RTO Reserve Zone and the active sub-zone, and calculates charges for the active sub-zone and non sub-zone portions of the RTO, rather than for the RTO Reserve Zone, when there is price separation.

Each Market Participant that is a Load Serving Entity (LSE) or secondary buyer that is not part of an agreement to share reserves with external entities subject to the requirements in NERC Reliability Standard BAL-002 incurs a Secondary Reserve Obligation based on their Load Ratio Share and applicable reserve zone's or reserve sub-zone's assignments during that hour. A Load Serving Entity (LSE) whose reserve obligations are satisfied through an agreement to share reserves with external entities subject to the requirements in NERC Reliability Standard BAL-002 does not have a Secondary Reserve Obligation.

PJM separately allocates the charges associated with Secondary Reserve Market Clearing Price Credits less any Secondary Reserve Shortfall Charges and Secondary Reserve Lost Opportunity Cost Credits and includes them on the billing statement as one billing line item:

- Secondary Reserve Charge = Secondary Reserve Market Clearing Price Charge + Secondary Reserve Lost Opportunity Cost Charge

19.3.1 Secondary Reserve Market Clearing Price Charge

PJM Actions

- PJM retrieves the following information for the Secondary Reserve Market Clearing Price Charge
  - Market Participant's Load Ratio Share (MWh)
  - Bilateral Secondary Reserve transactions (sales and purchases) (MWh)
  - Total PJM Day-ahead and Real-time Secondary Reserve assigned (MWh)
  - Day-ahead Secondary Reserve Market Clearing Price Credits ($)
  - Balancing Secondary Reserve Market Clearing Price Credits ($)
- PJM calculates for each hour the Secondary Reserve Market Clearing Price charges by RTO zone or active sub-zone and non sub-zone in which the load is located by multiplying the Total Secondary Reserve Market Clearing Price Credits in that location times the Market Participant's Secondary Reserve Obligation Share in that location.

- Secondary Reserve Market Clearing Price Charges = Total Secondary Reserve Market Clearing Price Credits * Secondary Reserve Obligation Share

- PJM calculates for each hour the Total Secondary Reserve Market Clearing Price Credits in the applicable location.
  - Total Secondary Reserve Market Clearing Price Credits = Day-ahead Secondary Reserve Market Clearing Price Credits + Balancing Secondary Reserve Market Clearing Price Credits
- PJM calculates each Market Participant's hourly Secondary Reserve Obligation Share by RTO zone or active sub-zone and non sub-zone based on their Load Ratio Share in that location, adjusted by bilateral Secondary Reserve sales and purchases.
  - Secondary Reserve Obligation Share = ((Load Ratio Share * Total PJM Real-time Secondary Reserve assigned) – Secondary Reserve MW Purchased + Secondary Reserve MW Sold) / Total PJM Real-time Secondary Reserve assigned
  - If the Total PJM Real-time Secondary Reserve assigned in an hour is zero, the Total PJM Day-ahead Secondary Reserve assigned is used to determine the Secondary Reserve Obligation Share.

19.3.2 Secondary Reserve Lost Opportunity Cost Charge

PJM Actions

- PJM retrieves the following information for Secondary Reserve Lost Opportunity Cost Charge:
  - Market Participant's Load Ratio Share (MWh)
  - Bilateral Secondary Reserve transactions (sales and purchases) (MWh)
  - Total PJM Real-time Secondary Reserve assigned (MWh)
  - Total PJM Secondary Lost Opportunity Cost Credits
- PJM calculates each Market Participant's hourly Secondary Reserve Lost Opportunity Cost Charges by RTO zone or active sub-zone and non sub-zone by multiplying the Total PJM Secondary Lost Opportunity Cost Credits in that location times the Secondary Reserve Purchases ratio share in that location.
  - Secondary Reserve Lost Opportunity Cost Charge = Total PJM Secondary Lost Opportunity Cost Credits * Secondary Reserve Purchases ratio share
- PJM calculates each Market Participant's hourly Secondary Reserve Purchases by RTO zone or active sub-zone and non sub-zone based on their Load Ratio Share in that location, adjusted by bilateral Secondary Reserve sales and purchases.
  - Secondary Reserve Purchases = ((Load Ratio Share * Total PJM Real-time Secondary Reserve assigned) – Secondary Reserve MW Purchased + Secondary Reserve MW Sold) / Total PJM Real-time Secondary Reserve assigned

- If the Total PJM Real-time Secondary Reserve assigned in an hour is zero, the Total PJM Day-ahead Secondary Reserve assigned is used to determine the Secondary Reserve Purchases Share.

19.4 Reconciliation for Secondary Reserve Charges

PJM will calculate reconciled Secondary Reserve charges for EDCs and Retail Load Aggregators (a.k.a. Electric Generation Suppliers) for past monthly billings on a two month lag that were based on Load Ratio Shares. The reconciliation kWh data must be supplied to PJM by the EDCs no later than the last day of the billing month that is two months after the original billing month. For example, all reconciliation data for January must be submitted by March 31 at 23:59. The reconciliation kWh data represents the difference between the scheduled Retail Load Responsibility or Wholesale Load Responsibility InSchedule and the "actual" usage based on metered data. This hourly kWh data must be reported separately for each applicable InSchedule contract.

PJM calculates the Secondary Reserve charge reconciliations by multiplying the kWh data (de-rated for transmission losses) by the Secondary Reserve billing determinant for that hour. The hourly Secondary Reserve charge billing determinant (in $/MWh) for each location (Reserve Zone or active sub-zone and non sub-zone) is calculated by dividing the total hourly Secondary Reserve charges in that location by the total PJM real-time load (de-rated for transmission losses) in that location for that hour. These charge reconciliations are then totaled for the month for each EDC or Retail Load Aggregator. Note that the reconciliation for Secondary Reserve charges for a month may be either a positive or a negative value, and may even be such that the reconciled load responsibility MWh results in a negative load quantity.