Approval

Approval Date: ~~10/02/2013~~
Effective Date: ~~10/01/2012~~

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Current Revision

Revision ~~62~~ 63 (~~10/01/2012~~):

Conforming changes to Section 6 describing how penalties are assessed to a resource that fails to provide the amount of Tier 2 Synchronized Reserve it was assigned or self-scheduled to provide when a synchronized event occurs as well as the allocation of these penalties. These changes are effective 1/1/2014 per Docket #ER13-297.

Conforming changes to Section 5 per Docket #ER13-2413 clarifying the requirements that must be satisfied in order for wind resources to be eligible to receive lost opportunity cost credits, effective 11/19/2013.

~~Conforming changes to Section 4 outlining settlements for Performance Based Regulation Credits and Charges per Docket #ER12-1204. Specifically, the credit changes include removal of the Marginal Benefits Factor for Regulation Capability Credit and Regulation Performance Credit and the application of the Mileage Ratio Multiplier for Regulation Performance Credit. Changes for the charge include specifics around the regulation obligation. Please note per the FERC Order these changes are retroactively effective to the Performance Based Regulation implementation date of October 1, 2012.~~

- written confirmation of actual costs incurred by participants due to cancellations (to be received within 45 days of date invoice was received by participant for the month in question)

- PJM credits each PJM Member for cancellations based on the actual costs incurred and submitted in writing to the PJM Market Settlement Operations Department. Eligibility is confirmed using resource generation data and dispatcher logs. The cancellation credit equals the actual costs incurred, capped at the appropriate start-up cost as specified in the generating resource's offer data.
- PJM sums the Balancing Operating Reserve cancellation credits for all pool-scheduled resources for each PJM Member.
- PJM Market Settlement Operations Department enters the appropriate adjustment into the current month's billing.

5.2.5 Credits for Resources providing Quick Start Reserve

At the end of each month, PJM calculates the credits due to each PJM Member for resources providing quick start reserve (under emergency conditions).

PJM Actions:

- PJM retrieves the following information:
  - list of units called on to provide quick start reserve for reliability (dispatcher log)
  - resource offer data
  - resource generation data
  - written confirmation of actual costs incurred by participants (to be received within 45 days of date invoice was received by participant for the month in question)
- PJM credits each PJM Member for resources providing quick start reserve based on the actual costs incurred and submitted in writing to the PJM Market Settlement Operations Department. Eligibility is confirmed using resource generation data and dispatcher logs.
- PJM sums the Balancing Operating Reserve quick start resource credits for all pool-scheduled resources for each PJM Member.
- PJM Market Settlement Operations Department enters the appropriate adjustment into the current month's billing.

5.2.6 Credits for Resources Reduced or Suspended due to a Transmission Constraint or for Other Reliability Reasons

At the end of each Operating Day, PJM calculates the credits due to each PJM Member for resources incurring lost opportunity costs associated with following PJM's request to reduce or suspend the output of a generating resource due to a transmission constraint or for other reliability reasons.

Pool-scheduled generators whose output is reduced or suspended and the hourly integrated real-time LMP at the unit's bus is higher than its offer corresponding to the level of output

requested by PJM are credited hourly in an amount equal to: (Desired MWh – Actual MWh) * (Real-time LMP – Incremental Offer Rate at Actual MWh). The Desired MWh used in this calculation is based on the hourly integrated real-time LMP at the generator's bus and adjusted for any effective regulation or synchronized reserve assignments and is limited to the lesser of the unit's economic maximum or the unit's maximum facility output as specified in the Interconnection Service Agreement. If a unit does not have an Interconnection Service Agreement with PJM, the Desired MWh is limited to the unit's economic maximum. Pool-scheduled combustion turbine units scheduled to produce energy in the day-ahead market, but are not called on by PJM and do not operate in real-time, are credited hourly in an amount equal to the higher of: (Real-time LMP – Day-ahead LMP) * Day-ahead scheduled MWh; or (Real-time LMP – Incremental Offer Rate at Day-ahead scheduled MWh) * Day-ahead scheduled MWh.

Pool-scheduled or self-scheduled wind generators whose output is reduced or suspended at the request of the Office of the Interconnection and the hourly integrated, real-time LMP at the unit's bus is higher than the unit's offer corresponding to the level of output requested by PJM are credited hourly in an amount equal to: (Desired MWh – Actual MWh) * (Real-time LMP – Incremental Offer Rate at Actual MWh). The Desired MWh used in this calculation is the lesser of the point on the unit's offer curve corresponding to the hourly integrated real-time LMP at the generator's bus adjusted for effective regulation or synchronized reserve assignments or the PJM forecasted output for the unit. The Desired MWh is also limited to the lesser of the unit's economic maximum or the unit's maximum facility output as specified in the Interconnection Service Agreement. If a unit does not have an Interconnection Service Agreement with PJM, the Desired MWh is limited to the unit's economic maximum.

Pool-scheduled or self-scheduled wind generators are only eligible for the above-referenced credit if they:

- Operated the resource according to PJM Manual and Tariff requirements for wind resources (PJM Manual 14D: Generator Operational Requirements)
- Have SCADA capability to transmit and receive instructions from PJM

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If PJM experiences a technical issue (e.g. computer system failure or disruption or failure of communications equipment) resulting in an erroneous forecast, PJM and the market participant will determine a mutually agreeable settlement value. Recommendations for reconciliation include but are not limited to:

- Using the average forecast values as determined by PJM wind forecasting tool from before and after the technical issue to determine forecast value during the issue
- Using the forecast value as determined by PJM wind forecasting tool from before the technical issue for the first half of the duration of the technical issue and forecast value from after the technical issue for the latter half of the duration of the technical issue
- Using Market Seller's forecast value during the technical issue

PJM Actions:

- PJM retrieves the following information:
  - list of units and timeframes reduced or suspended for a transmission constraint or other reliability reason (dispatcher logs and Market Operations eligibility data)

- 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 eMTR (if available)
- scheduled MWh for InSchedule "Generation" contracts, if applicable
- generator day-ahead and real-time LMPs
- assigned regulation MWh, performance scores and marginal benefit factors
- assigned synchronized reserve MWh
- hourly integrated wind forecast from PJM's wind forecasting tool
- maximum facility output MW from Interconnection Service Agreements

- PJM sums the Balancing Operating Reserve lost opportunity cost credits for all reduced or suspended generating resources for each PJM Member.

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 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.

5.2.8 Credits for Resources Providing Reactive Services

At the end of each month, PJM calculates the credits due each PJM Member for reactive services. Generators whose active energy output is altered at the request of PJM for the

Section 6: Synchronized Reserve Accounting

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

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

6.1 Synchronized Reserve Accounting Overview

Accounting for Synchronized Reserve is performed on an hourly basis. Synchronized Reserve shall be supplied from resources located within the metered boundaries of PJM. Resources participating in the reserve market are divided into two tiers. Tier 1 is comprised of all those resources on-line following economic dispatch and able to ramp up from their current output in response to a synchronized reserve event. Tier 2 consists of the additional resources that are synchronized to the grid and operating at a point that deviates from economic dispatch (including condensing mode) to provide additional synchronized reserve not available from Tier 1 resources. Synchronized Reserve resources include generators and demand side response resources.

The total PJM Synchronized Reserve Requirement is defined as the amount of 10-minute reserve that must be synchronized to the grid in accordance with the applicable NERC Council standards.

Tier 1 synchronized reserve credits are awarded to all resource owners whose resources increased output or decreased consumption in response to a synchronized reserve event (with the exception of those resources that were assigned Tier 2 synchronized reserve). Effective 10/1/2012, Tier 1 synchronized reserve resources are also compensated when the Non-Synchronized Reserve Market Clear Price is non-zero. Tier 2 synchronized reserve credits are awarded to all resource owners that have assigned self-scheduled or pool-scheduled synchronized reserve.

Prior to 10/1/2012, Tier 1 synchronized reserve credits are equal to the integrated increase in MWh output or decrease in MWh of consumption from each resource over the length of a synchronized reserve event times the synchronized energy premium less the hourly integrated LMP. The synchronized energy premium is defined as the average of the 5-minute LMPs calculated during the synchronized reserve event plus $50/MWh

Effective 10/1/2012, when the Non-Synchronized Reserve Clearing Price is zero Tier 1 synchronized reserve credits are equal to the integrated increase in MWh output or decrease in MWh of consumption from each resource over the length of a synchronized reserve event times the synchronized energy premium less the hourly integrated LMP. The

synchronized energy premium is defined as the average of the 5-minute LMPs calculated during the synchronized reserve event plus $50/MWh.

Effective 10/1/2012, when the Non-Synchronized Reserve Clearing Price is non-zero Tier 1 synchronized reserve credits are equal to the lesser of the integrated increase in MWh output or decrease in MWh of consumption from each resource over the length of a synchronized reserve event or the Tier 1 estimate attributed to the resource multiplied by the Synchronized Reserve Market Clearing Price. During hours where no synchronized reserve event occurs, the Tier 1 resource will be compensated for the Tier 1 estimated amount.

The synchronized reserve offer price for Tier 2 resources will be capped at a maximum value of the unit's Operating and Maintenance cost (as determined by the Cost Development Task Force) plus $7.50/MWh.

Generator resources on-line and providing Tier 2 are made eligible for make-whole payments to recover applicable start-up, no-load and minimum energy costs in the Balancing Operating Reserve billing line item. Demand response resources which respond to a synchronized reserve event, and are eligible for make-whole payments to recover shutdown cost will be made-whole in the Operating Reserve for Load Response billing line item.

Resources that are assigned regulation when a synchronized reserve event is initiated will be compensated based on the amount of response provided beyond their regulation commitment, as well as for any response in excess of their regulation high limit or economic maximum (whichever is lower). Additional details can be found in PJM Manual 11, Section 4.2.11.

Each PJM Member LSE 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 synchronized reserve obligation based on their hourly real-time load ratio share and applicable reserve zone's requirements during that hour. During hours when the Synchronized Reserve Clearing Price is the same throughout the reserve zone, an LSE's synchronized reserve obligation is equal to its real-time load ratio share times the amount of synchronized reserve assigned for the entire reserve zone. During hours when congestion causes the Synchronized Reserve Clearing Price to separate, each LSE's synchronized reserve obligation is equal to its real-time load ratio share within its reserve zone or sub-zone and the amount of synchronized reserve assigned in that reserve zone or sub-zone.

Participants may fulfill their synchronized reserve obligations by: owning Tier 1 resources from which PJM obtains synchronized reserve, entering bilateral arrangements with other PJM market participants or purchasing synchronized reserve from the PJM synchronized reserve market.

6.2 Credits for Synchronized Reserve

At the end of each hour, PJM calculates the credits due each PJM Member for Synchronized Reserve.

PJM Actions:

- PJM retrieves the following information:
  - Synchronized Reserve Ramp rate for Tier 1 resources

- Synchronized Reserve maximum for Tier 1 resources
- Synchronized Reserve availability for Tier 2 resources
- Synchronized Reserve assigned quantity for Tier 2 resources (MW)
- Synchronized Reserve offer price for Tier 2 resources ($/MWh)
- Energy use for condensing Tier 2 resources
- Condense-to-generate startup cost
- Synchronized Reserve bilateral transactions
- 5-minute interval LMP data
- Total PJM synchronized reserve requirement as determined in whole MWh for each hour of the operating day
- Synchronized Reserve Clearing Price ($/MWh)
- Non-Synchronized Reserve Clearing Price ($/MWh)

- PJM calculates the hourly Synchronized Reserve credits for each Tier 1 resource as follows:
  - Prior to 10/1/2012, Tier 1 synchronized reserve credits are equal to the integrated increase in MWh output or decrease in MWh of consumption from each resource over the length of a synchronized reserve event multiplied by the difference between the synchronized energy premium and the hourly integrated LMP. The synchronized energy premium is defined as the average of the 5-minute LMPs calculated during the synchronized reserve event plus $50/MWh. If the hourly integrated LMP is greater than the synchronized energy premium, the Tier 1 credit is zero.
  - Effective 10/1/2012, during hours where the Non-Synchronized Reserve Market Clearing Price is zero for the same reserve zone or sub-zone that a Tier 1 resource is located, Tier 1 synchronized reserve credits are equal to the integrated increase in MW generator output (or decrease in MW consumption for demand side response resources) from each resource over the length of a synchronized reserve event multiplied by the difference between the synchronized energy premium and the hourly integrated LMP. The synchronized energy premium is defined as the average of the 5-minute LMPs calculated during the synchronized reserve event plus $50/MWh. If the hourly integrated LMP is greater than the synchronized energy premium, the Tier 1 credit is zero.
  - Effective 10/1/2012, when the Non-Synchronized Reserve Clearing Price is non-zero for the applicable reserve zone or subzone, Tier 1 synchronized reserve credits are equal to the applicable reserve zone or sub-zone Synchronized Reserve Market Clearing Price multiplied by the lesser of the integrated increase in MWh output or decrease in MWh of consumption from each resource over the length of a synchronized reserve event and the estimated Tier 1 the resource could have provided. During hours when no synchronized reserve event occurs in the applicable reserve zone or sub-zone, the Tier 1 resource will be compensated using the estimated Tier 1 amount.

- In cases where a synchronized reserve event spans two or more hours, the response from each resource will be integrated according to the length of the response in each hour for the purpose of calculating the Tier 1 credit. Details on the amount of increase in output (or decrease in MW consumption for demand side response resources) can be found in Manual 11: Energy & Ancillary Services Market Operations, Section 4.

- PJM calculates the hourly Synchronized Reserve credits for each Tier 2 resource as follows:
  - These credits are awarded to resource owners that have either assigned self-scheduled or pool-scheduled synchronized reserve.
  - Synchronized reserve credits for resources assigned self-scheduled synchronized reserve equal the Tier 2 clearing price times the resource's self-scheduled synchronized reserve capability less any shortfall due to failure to provide assigned capability during a synchronized reserve event.
  - Synchronized reserve credits for resources that are assigned pool-scheduled synchronized reserve are the higher of: the Tier 2 clearing price times the resource's assigned synchronized reserve capability less any shortfall due to failure to provide assigned capability during a synchronized reserve event or the resource's synchronized reserve offer times its assigned synchronized reserve capability less any shortfall due to failure to provide assigned capability during a synchronized reserve event (plus opportunity cost, energy use costs, and startup costs incurred, for generators), as applicable.

6.3 Charges for Synchronized Reserve

The total cost of providing Synchronized Reserve for each hour is the sum of the credits provided to PJM Members for supplying Synchronized Reserve in that hour. The hourly cost of Tier 1 and Tier 2 Synchronized Reserve is allocated separately and charged to PJM Members.

PJM Actions:

- PJM calculates for each hour the Total Cost of Synchronized Reserve by summing the following credits for all PJM Members:
  - Total Tier 1 credits for Synchronized Reserve ($)
  - Total Tier 2 credits for Synchronized Reserve ($)
- PJM calculates for each hour each participants synchronized reserve obligation as determined by applying the real-time load ratio share (adjusted for load responsibility) in the applicable reserve zone or sub-zone to the total synchronized reserve assigned for that hour and then adding bilateral sales and subtracting bilateral purchases. Note that LSEs whose reserve obligations are satisfied through an agreement to share reserves with external entities subject to the requirements in NERC Reliability Standard BAL-002 will not have a synchronized reserve obligation. Synchronized reserve charges are then determined for both the amount of Tier 1

applied to each participant's obligation and the amount of Tier 2 each participant purchased from the market.

- PJM calculates for each hour the Tier 1 charges by allocating the total cost of Tier 1 credits to each PJM Member based on their ratio share of Tier 1 synchronized reserve allocated to obligation. The amount of Tier 1 applied to each participant's obligation is equal to the amount of Tier 1 estimated prior to the operating hour as part of the market clearing process on that participant's own resources up to the amount of obligation, plus the remaining obligation ratio share of any excess Tier 1 estimated on the resources of generation owners in excess of their individual obligations.
- PJM calculates for each hour the Tier 2 charges as follows:
  - The appropriate hourly Tier 2 clearing price times the participant's synchronized reserve obligation MW less any Tier 1 synchronized reserve applied to obligation.
  - The appropriate hourly Tier 2 clearing price for each LSE is the clearing price for the sub-zone or Reserve Zone for which the LSE's load is located. Loads located in a sub-zone will pay that sub-zone's clearing price. Loads not located in a sub-zone will pay the corresponding Reserve Zone clearing price.
  - The participant's share of any unrecovered costs incurred by assigned Tier 2 pool-schedule resources, including those Tier 2 resources assigned in addition to that which was estimated prior to a given hour, over and above the Tier 2 clearing price
  - The amount of unrecovered costs allocated to each participant is determined based on each participant's ratio share of Tier 2 synchronized reserve purchased from the market. A participant's purchases from the market equals their synchronized reserve obligation MW less any Tier 1 synchronized reserve applied to obligation, less any self-scheduled Tier 2 MW.
  - The cost of Tier 2 resources assigned by PJM during the operating hour in addition to that which resulted from the Tier 2 clearing process due to reduced availability of Tier 1 Synchronized Reserve are allocated to those entities for which less Tier 1 was available during the hour that was estimated prior to the hour, in proportion to the reduction in Tier 1 availability. If there are no entities with a reduction in Tier 1 availability, the cost of these resources assigned during the hour is allocated based on a participant's purchases from the market as described in the preceding bullet.
  - Tier 2 resources that fail to provide assigned Tier 2 capability during a synchronized reserve event incur a retroactive obligation to refund at SRMCP the amount of the shortfall measured in MW for all of the hours the resource was assigned over the immediate past interval, the duration of which is equal to the lesser of the average number of days between events as determined by the annual review of the last 2 years, or the number of days since the resource last failed to respond with its assigned or self-scheduled Synchronized Reserve amount in response to a synchronized reserve event. ~~synchronized reserve obligation in the amount of the shortfall for the 3 consecutive, same peak days occurring at least 3 business days following the synchronized reserve event. Off-peak days are defined as weekends and PJM holidays, and on-peak days are all~~

~~others.~~ The penalty charges calculated above are allocated based on a participant's ratio share of the synchronized reserve obligation MW less any Tier 1 synchronized reserve applied to obligation on the hour(s) of the synchronized reserve event for the sub-zone or Reserve Zone for which the synchronized reserve event occurred. If the event spans multiple hours, the penalty charges will be prorated hourly based on the duration of the event within each hour. Participants that incur a penalty and also have an applicable synchronized reserve obligation during the hours(s) of the synchronized reserve event shall not be included in the allocation of such penalties. Additional details on verification and non-performance can be found in Manual 11: Energy & Ancillary Services Market Operations, Section 4: Overview of the PJM Synchronized Reserve Market.

6.4 Reconciliation for Synchronized Reserve Charges

PJM will calculate reconciled Synchronized Reserve charges for EDCs and Retail Load Aggregators (a.k.a. Electric Generation Suppliers) for past months' billings that were based on load ratio shares. The reconciliation kWh data must be supplied to PJM by the EDCs, and represents the difference between the scheduled Retail Load Responsibility InSchedule (in MWh) and the "actual" usage based on metered data. This hourly kWh data must be reported separately for each applicable InSchedule contract.

PJM calculates the Synchronized Reserve charge reconciliations by multiplying the kWh data (de-rated for transmission losses) by the Synchronized Reserve billing determinants for that hour. The hourly Synchronized Reserve charge billing determinants (in $/MWh) for each reserve zone and sub-zone is calculated by dividing the total hourly Synchronized Reserve charges in that reserve zone or sub-zone by the total PJM real-time load (de-rated for transmission losses) in that reserve zone or sub-zone for that hour. These charge reconciliations are then totaled for the month for each EDC or Retail Load Aggregator. Note that the reconciliation for Synchronized 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.