Operating Agreement

1. DEFINITIONS

Condense Startup Cost:

"Condense Startup Cost" shall mean the costs to transition from offline state to operate in condensing mode. Condense Startup Cost shall consist primarily of the cost of fuel, as determined by the unit's start heat input (adjusted by the performance factor) times the fuel cost. It also includes operating costs, Maintenance Adders, emissions allowances/adders, and station service cost. Condense Startup Cost shall be capped at the applicable Start-Up Cost of the Cost-Based Offers.

Condense to Generate Cost

"Condense to Generate Cost" shall mean the costs to transition from operating in condensing mode to operating in generating mode. Condense to Generate Cost shall consist primarily of the cost of fuel, as determined by the unit's start heat input (adjusted by the performance factor) times the fuel cost. It also includes operating costs, Maintenance Adders, emissions allowances/adders, and station service cost. Condense to Generate Cost shall be capped at the applicable Start-Up Cost of the Cost-Based Offer.

Condense Energy Use

"Condense Energy Use" shall mean the power used by a condensing resource while operating in condensing mode. The value must be less than or equal to the actual power consumed as observed in real time.

3.2.3 Operating Reserves

(i) At the end of each Operating Day, Market Sellers shall be credited for Condense Startup Cost and Condense Energy Use times the real-time LMP ~~on the basis of their offered prices~~ for synchronous condensing for purposes other than providing Synchronized Reserve, Secondary Reserve, or Reactive Services, as well as the credits calculated as specified in Section 3.2.3(b) for those generators committed solely for the purpose of providing synchronous condensing for purposes other than providing Synchronized Reserve, Secondary Reserve, or Reactive Services, at the request of the Office of the Interconnection.

3.2.3A Synchronized Reserve

(f) (i) In determining the credit under subsection (b) to a generation resource, except a generation resource that is operating as a synchronous condenser, selected to provide Synchronized Reserve in the Day-ahead Synchronized Reserve Market, or an Economic Load Response Participant resource that is selected to provide Synchronized Reserve in the Day-ahead Synchronized Reserve Market for the same operating hour in which such resource receives a day-ahead commitment to provide energy, the opportunity cost of a resource shall be determined for each operating hour that the Office of the Interconnection requires a resource to provide Synchronized Reserve and shall be in accordance with the following equation:

(A x B) - C

Where:

A = The Day-ahead Locational Marginal Price at the generation bus of the generation resource or the applicable pricing point for the Economic Load Response Participant resource;

B = The deviation of the resource's energy output or load reduction necessary to supply a Day-ahead Synchronized Reserve assignment from the resource's energy expected output or load reduction level if it had been assigned in economic merit order to provide energy or reduce load; and

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 Synchronized 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.

For a generation resource that is operating as a synchronous condenser, the resource's unit-specific opportunity cost shall be determined as follows: [Condense eEnergy ~~uU~~se ~~for providing synchronous condensing~~ multiplied by A] plus [the applicable ~~c~~Condense ~~s~~Start-up ~~c~~Cost divided by the number of hours the resource is assigned Synchronized Reserve].

(ii) In determining the credit under subsection (b) to a generation resource, except a generation resource that is operating as a synchronous condenser, selected to provide Synchronized Reserve in the Real-time Synchronized Reserve Market in excess of the resource's Day-ahead Synchronized Reserve Market assignment and that actively follows the Office of the Interconnection's signals and instructions, the unit-specific opportunity cost of that generation resource shall be determined for each Real-time Settlement Interval that the Office of the Interconnection requires that generation resource to provide Synchronized Reserve and shall be in accordance with the following equation:

(A x B) - C

Where:

A = The Real-time Locational Marginal Price at the generation bus of the generation resource;

B = The deviation of the generation resource's output necessary to supply Synchronized Reserve in real-time, reduced by the amount of Synchronized Reserve the resource failed to respond during a Synchronized Reserve Event during the Operating Day, in excess of its Day-ahead Synchronized 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; and

C = The energy offer integrated under the applicable energy offer curve for the generation resource's output necessary to supply Synchronized Reserve in real time from the lesser of the generation resource's output necessary to provide a Day-ahead Synchronized 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.

For a generation resource that is a synchronous condenser, the resource's unit-specific opportunity cost shall be determined as follows: [additional Condense eEnergy ~~u~~Use in excess of day-ahead Condense eEnergy ~~u~~Use ~~for providing synchronous condensing~~ in real-time multiplied by A] plus [any applicable ~~c~~Condense ~~s~~Start-up ~~c~~Cost~~s~~ due to additional ~~c~~Condense ~~s~~Start-up~~s~~ Cost in real-time in excess of day-ahead ~~c~~Condense ~~s~~Start-up~~s~~ Cost allocated to each Real-time Settlement Interval as described in PJM Manuals].

3.2.3A.01 Secondary Reserve

(f) (i) In determining the credit under subsection (b) to a generation resource, except a generation resource that is a synchronous condenser, selected to provide Secondary Reserve in the Day-ahead Secondary Reserve Market or an Economic Load Response Participant resource that is selected to provide Secondary Reserve in the Day-ahead Secondary Reserve Market in the same operating hour in which such resource receives a day-ahead commitment to provide energy, the opportunity cost of a resource shall be determined for each operating hour that the Office of the Interconnection requires a resource to provide Secondary Reserve and shall be in accordance with the following equation:

(A x B) – C

Where:

A = The Day-ahead Locational Marginal Price at the generation bus of the generation resource or the applicable pricing point for the Economic Load Response Participant resource;

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 less any Day-ahead Synchronized Reserve Market assignment; and

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 less any Day-ahead Synchronized Reserve Market assignment.

For a generation resource that is a synchronous condenser, the resource's unit-specific opportunity cost shall be determined as follows: [Condense eEnergy ~~u~~Use ~~for providing synchronous condensing~~ multiplied by A] plus [the applicable ~~c~~Condense ~~s~~Start-up ~~c~~Cost divided by the number of hours the resource is assigned Secondary Reserve].

(ii) In determining the credit under subsection (b) to a generation resource, except a generation that is a synchronous condenser, selected to provide Secondary Reserve in the Real-time Secondary Reserve Market in excess of the resource's Day-ahead Secondary Reserve Market assignment and that actively

follows the Office of the Interconnection's signals and instructions, the unit-specific opportunity cost of that generation resource shall be determined for each Real-time Settlement Interval that the Office of the Interconnection requires that generation resource to provide Secondary Reserve and shall be in accordance with the following equation:

(A x B) – C

Where:

A = The Real-time Locational Marginal Price at the generation bus of the generation resource;

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 less any Real-time

Synchronized Reserve Market assignment; and

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 less any Real-time Synchronized Reserve Market assignment.

For hydroelectric resources, the unit-specific opportunity costs for each hydroelectric resource in spill conditions as defined in the PJM Manuals will be the real-time Locational Marginal Price at that generation bus multiplied by the additional megawatts assigned to supply Synchronized Reserve in real-time in excess of its Day-ahead Secondary Reserve Market assignment.

The unit-specific opportunity costs for each hydroelectric resource that is not in spill conditions as defined in the PJM Manuals and has a day-ahead energy commitment greater than zero shall be the greater of zero and the difference between the real-time Locational Marginal Price at the generation bus for the hydroelectric resource and the average real-time Locational Marginal Price at the generation bus for the appropriate on-peak or off-peak period as defined in the PJM Manuals, excluding those hours during which all available units at the hydroelectric resource were operating multiplied by the additional megawatts assigned to supply Secondary Reserve in real-time in excess of its Day-ahead Secondary Reserve Market assignment.

The unit-specific opportunity costs for each hydroelectric resource that is not in spill conditions as defined in the PJM Manuals and does not have a day-ahead energy commitment greater than zero shall be zero.

For a generation resource that is a synchronous condenser, the resource's unit-specific opportunity cost shall be determined as follows: additional Condense eEnergy ~~u~~Use in excess of day-ahead Condense eEnergy ~~u~~Use ~~for providing synchronous condensing in real-time~~ multiplied by A plus [any applicable

~~c~~Condense ~~s~~Start-up ~~c~~Cost~~s~~ due to additional ~~c~~Condense ~~s~~Start-up~~s~~ Cost in real-time in excess of day-ahead ~~c~~Condense ~~s~~Start-up~~s~~ Cost allocated to each Real-time Settlement Interval as described in PJM Manuals]. If the generation resource is operating as a synchronous condenser and also has a Real-time Synchronized Reserve assignment, resource's unit-specific opportunity cost in the Secondary Reserve Market shall be zero.~~,~~

3.2.3B Reactive Services

(i) The amount of Synchronized Reserve provided by generating units maintaining reactive reliability shall be counted as Synchronized Reserve satisfying the overall PJM Synchronized Reserve requirements. Operators of these generating units shall be notified of such provision, and to the extent a generating unit's operator indicates that the generating unit is capable of providing Synchronized Reserve, shall be subject to the same requirements contained in section 3.2.3A regarding provision of Synchronized Reserve. At the end of each Operating Day, to the extent a condenser operated to provide Reactive Services also provided Synchronized Reserve, a Market Seller shall be credited for providing synchronous condensing for the purpose of maintaining reactive reliability at the request of the Office of the Interconnection, in an amount equal to the higher of (i) the Synchronized Reserve Market Clearing Price for each Real-time Settlement Interval a generating unit provided synchronous condensing multiplied by the amount of Synchronized reserve provided by the synchronous condenser or (ii) the sum of ~~(A) the generating unit's cost to provide synchronous condensing, calculated in accordance with the PJM Manuals,~~ (A~~B~~) the product of the Condense Energy Use~~MW energy usage for providing synchronous condensing~~ multiplied by the real time LMP at the generating unit's bus, (B~~C~~) the generating unit's Condense ~~s~~Start-up ~~c~~Cost ~~of providing synchronous condensing~~, and (C~~D~~) the unit-specific lost opportunity cost of the generating resource supplying the increment of Synchronized Reserve as determined by the Office of the Interconnection in accordance with procedures specified in the PJM Manuals. To the extent a condenser operated to provide Reactive Services was not also providing Synchronized Reserve, the Market Seller shall be credited only for the generating unit's cost to condense, as described in (ii) above. The total Synchronized Reserve Obligations of all Load Serving Entities under section 3.2.3A(a) in the zone where these condensers are located shall be reduced by the amount counted as satisfying the PJM Synchronized Reserve requirements. The Synchronized Reserve Obligation of each Load Serving Entity in the zone under section 3.2.3A(a) shall be reduced to the same extent that the costs of such condensers counted as Synchronized Reserve are allocated to such Load Serving Entity pursuant to subsection (l) below.

3.2.3C Synchronous Condensing for Post-Contingency Operation.

(b) The amount of Synchronized Reserve provided by synchronous condensers associated with post-contingency operation shall be counted as Synchronized Reserve satisfying the applicable Synchronized Reserve Requirements. Operators of these generation units shall be notified of such provision, and to the extent a generation unit's operator indicates that the generation unit is capable of providing Synchronized Reserve, shall be subject to the same requirements contained in section 3.2.3A regarding provision of Synchronized Reserve. At the end of each Operating Day, to the extent a condenser operated in conjunction with post-contingency operation also provided Synchronized Reserve, a Market Seller shall be credited for providing synchronous condensing in conjunction with post-contingency operation at the

request of the Office of the Interconnection, in an amount equal to the higher of (i) the Real-time Synchronized Reserve Market Clearing Price for each applicable interval a generation resource provided synchronous condensing multiplied by the amount of Synchronized Reserve provided by the synchronous condenser or (ii) the sum of ~~(A) the generation resource's applicable interval cost to provide synchronous condensing, calculated in accordance with the PJM Manuals,~~ (A~~B~~) the ~~applicable interval~~ product of the Condense Energy Use~~megawatts of energy used to provide synchronous condensing~~ multiplied by the real-time LMP at the generation bus of the generation resource, (B~~C~~) the generation resource's Condense ~~s~~Start-up ~~c~~Cost ~~of providing synchronous condensing~~, and (C~~D~~) the unit-specific lost opportunity cost of the generation resource supplying the increment of Synchronized Reserve as determined by the Office of the Interconnection in accordance with procedures specified in the PJM Manuals. To the extent a condenser operated in association with post-contingency constraint control was not also providing Synchronized Reserve, the Market Seller shall be credited only for the generation unit's cost to condense, as described in (ii) above. The total Synchronized Reserve Obligations of all Load Serving Entities under section 3.2.3A(a) in the zone where these condensers are located shall be reduced by the amount counted as satisfying the PJM Synchronized Reserve requirements. The Synchronized Reserve Obligation of each Load Serving Entity in the zone under section 3.2.3A(a) shall be reduced to the same extent that the costs of such condensers counted as Synchronized Reserve are allocated to such Load Serving Entity pursuant to subsection (d) below.

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4.2.5.3 Reserve Market Capability for Synchronous Condensers

Synchronous Condensers can submit the following additional offer parameters:

• Condense Energy Us~~e~~age ~~for reserve condensing resources (MW): This is the amount of instantaneous energy a condensing resource consumes while operating in the condensing mode. The value submitted as part of the Reserve offer must be less than or equal to the actual energy consumed as observed in real time~~.

• Condense to Gen~~erate.~~ Cost~~: This is the cost of transitioning a condenser to generating mode. The value submitted for this cost must be less than or equal to the condensing Startup Cost~~.

• Condense Startup Cost~~: This is the actual cost associated with getting a resource from a completely off-line state into the condensing mode including fuel, O&M, etc~~.

~~• Condense Hourly Cost: This is the hourly cost to condense and is equal to the actual, variable O&M costs associated with operating a resource in the condensing mode, including any fuel costs. It does not include any estimate for energy consumed~~

• Condense Notification Time: The amount of advance notice, in hours, required to notify the operating company to prepare the resource to operate in synchronous condensing mode. The default value is zero hours.

• Reserve as Condenser: This is used to identify if a resource can be committed from offline state for Synchronized Reserve or Secondary Reserve as a condenser.

• Condense Available Status: This indicates a resource's availability to provide voltage and/or reactive support. This value is not directly related to the Synchronized Reserve or Secondary Reserve Markets.

4.4.4 Opportunity Costs for Condensers in the Reserve Clearing

Condense Energy ~~u~~Use for each condensing resource is entered in MW by the owner via the Markets Gateway system as part of the Reserve Offer. Estimated energy use is calculated as part of the merit order price as follows:

E .U. = forecasted LMP x Condense Eenergy ~~u~~Use ~~MW~~ / synchronized reserve capability

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6.7 Synchronized Reserve: Costs to Condense

Synchronous Condensers can submit the following offer parameters:

• Condense Start-up Cost: The unit costs to transition from offline state to operate in condensing mode. Condense Startup Cost shall consist primarily of the cost of fuel, as determined by the unit's start heat input (adjusted by the performance factor) times the fuel cost. It also includes operating costs, Maintenance Adders, emissions allowances/adders, and station service cost. Condense Startup Cost shall be capped at the applicable Start-Up Cost of the Cost-Based Offers ~~if applicable, shall be applied when a unit moves from cold to condensing operations and when a unit moves from condensing operations to energy generation, but shall not be applied when a unit moves from energy generation to condensing operations~~.

• Condense to Generate Cost: The unit costs to transition from operating in condensing mode to operating in generating mode. Condense to Generate Cost shall consist primarily of the cost of fuel, as determined by the unit's start heat input (adjusted by the performance factor) times the fuel cost. It also includes operating costs, Maintenance Adders, emissions allowances/adders, and station service cost. Condense to Generate Cost shall be capped at the applicable Start-Up Cost of the Cost-Based Offer.

• Condense Energy Use: Power used by a condensing resource while operating in condensing mode. The value must be less than or equal to the actual power consumed as observed in real time ~~Actual cost of power consumed during condensing operations at real time bus LMP as determined by Market Settlements. MW consumed must be included in the offer~~.

7.7 Synchronized Reserve: Hydro Unit Costs to Condense

• Condensing Startup ~~c~~Cost: The unit costs to transition from offline state to operate in condensing mode. Condense Startup Cost shall consist primarily of the cost of fuel, as determined by the unit's start heat input (adjusted by the performance factor) times the fuel cost. It also includes operating costs, Maintenance Adders, emissions allowances/adders, and station service cost. Condense Startup Cost shall be capped at the applicable Start-Up Cost of the Cost-Based Offers ~~if applicable, start costs shall be applied~~

~~when a unit moves from cold to condensing operations and when a unit moves from condensing operations to energy generation, but shall not be applied when a unit moves from energy generation to condensing operations~~.

• Condense to Generate Cost: The unit costs to transition from operating in condensing mode to operating in generating mode. Condense to Generate Cost shall consist primarily of the cost of fuel, as determined by the unit's start heat input (adjusted by the performance factor) times the fuel cost. It also includes operating costs, Maintenance Adders, emissions allowances/adders, and station service cost. Condense to Generate Cost shall be capped at the applicable Start-Up Cost of the Cost-Based Offer.

• Condense Energy Use: Power used by a condensing resource while operating in condensing mode. The value must be less than or equal to the actual power consumed as observed in real time.

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5.2.1 Credits for Pool-Scheduled Generating Resources

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 resource's real-time offer amount for that day includes the applicable ~~c~~Condense to ~~g~~Generat~~eion~~ ~~c~~Cost for that resource.

5.2.3 Credits for Synchronous Condensing

PJM calculates each eligible resource's condensing cost for each period by multiplying the ~~duration (in five minute intervals) by the hourly cost to condense plus~~ Condense ~~e~~Energy ~~u~~Use as specified in the offer data ~~cost~~ times the applicable day-ahead or real-time LMP (depending on which market the unit was committed for condensing) divided by twelve ~~as specified in the offer data~~.

When a resource is requested to start condensing from an off state, a condensing credit is provided equal to the resource's ~~c~~Condensing ~~s~~Startup ~~c~~Cost as specified in the offer data.

PJM calculates the daily synchronous condensing cost for each resource by summing all five minute interval ~~c~~Condens~~eing and~~ ~~e~~Energy ~~u~~Use costs, including applicable Condense ~~s~~Startup ~~c~~Costs, for the day.

5.2.8 Credits for Resources Providing Reactive Services

Generators operating as synchronous condensers for the purpose of maintaining reactive reliability at the request of PJM, are credited for each five minute interval of condensing an amount equal to the higher of: 1) the Synchronized Reserve Market Clearing Price for the five minute interval divided by 12 multiplied by the amount of synchronized reserve provided (i.e., economic maximum limit of the unit); or 2) the sum of the unit's offered ~~cost to c~~Condense~~,~~ ~~e~~Energy ~~u~~Use cost, Condense ~~s~~Start-up ~~c~~Cost, and the unit-specific lost opportunity cost of the resource supplying the increment of Synchronized Reserve divided by 12.

6.2.3 Synchronized Reserve Lost Opportunity Cost Credit

• For the following resource types, the Day-ahead Synchronized Reserve Opportunity Cost is calculated as follows:

  • Resources committed to provide synchronized reserves in synchronous condensing mode = (Day-ahead Condense ~~e~~Energy Use~~usage to provide Synchronous Condensing~~ * DA LMP at the generation bus) + (Day-ahead Condense Start~~-~~up ~~c~~Cost~~s~~ / Number of Hours assigned Synchronized Reserve)

• For the following resource types, the Real-time Synchronized Reserve Opportunity Cost is calculated as follows:

  o Resources providing synchronized reserves in synchronous condensing mode = ((Real-time Condense ~~e~~Energy Use~~usage to provide Synchronous Condensing~~ – Day-ahead Condense ~~e~~Energy Use~~usage to provide Synchronous Condensing~~) * RT LMP at the generation bus) + any additional ~~c~~Condense ~~s~~Start-up ~~c~~Cost~~s~~ in excess of Day-ahead Condense Start-up ~~c~~Cost~~s~~

19.2.3 Secondary Reserve Lost Opportunity Cost Credit

Resources committed to provide secondary reserves in synchronous condensing mode without a Day-ahead Synchronized Reserve Assignment = (Day-ahead Condense ~~e~~Energy Use~~usage to provide Synchronous Condensing~~ * DA LMP at the generation bus) + (Day-ahead Condense Start-up ~~c~~Cost~~s~~ / Number of Hours assigned Secondary Reserve)

Resources providing secondary reserves in synchronous condensing mode without a Real-time Synchronized Reserve assignment = ((Real-time Condense ~~e~~Energy Use~~usage to provide Synchronous Condensing~~ – Day-ahead Condense Eenergy Use~~usage to provide Synchronous Condensing~~) * RT LMP at the generation bus) + any additional ~~c~~Condense ~~s~~Start-up ~~c~~Cost~~s~~ in excess of Day-ahead Condense Start-up ~~c~~Cost~~s~~