



PJM 205 Filing to Revise Tariff and Operating Agreement to Include Make-Whole Payments and Benefits Factor in Regulation Market

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No.	PJM Section Title	Reason for Change	Revisions for Compliance Filing II
1.	OATT Schedule 3		<p>Regulation and Frequency Response Service</p> <p>a. Regulation shall be supplied to meet the Regulation objective of a Regulation Zone from resources located within the metered electrical boundaries of such Regulation Zone. Resources offering Regulation shall comply with applicable standards and requirements for Regulation capability and dispatch specified in the procedures of the Office of the Interconnection<i>PJM Manuals</i>.</p> <p>b. The Office of the Interconnection shall obtain and maintain an amount of Regulation for each Regulation Zone equal to the Regulation objective for such Regulation Zone, as specified in its procedures<i>the PJM Manuals</i>.</p> <p>c. The Regulation range of a resource shall be at least twice the amount of Regulation assigned- as described in the procedures of the Office of the Interconnection<i>PJM Manuals</i>.</p> <p>d. A resource capable of automatic energy dispatch that is also providing Regulation shall have its energy dispatch range reduced from the Regulation range by at least twice the amount of the Regulation provided <i>with consideration of the Regulation limits of the resource, as specified in the PJM Manuals. The amount of regulation provided by a unit shall serve to redefine the normal minimum generation and normal maximum generation energy limits of that unit, in that the amount of regulation shall be added to the unit's normal minimum generation energy limit, and subtracted from its normal maximum generation energy limit.</i></p> <p>e. Qualified Regulation must satisfy the <u>measurement and</u> verification tests described in the procedures of the Office of the Interconnection<i>PJM Manuals</i>.</p> <p>h. The Office of the Interconnection shall dispatch resources for Regulation by sending Regulation signals and instructions to resources from which Regulation service has been offered, in accordance with the procedures of the Office of the Interconnection<i>PJM Manuals</i>. Those resources shall comply with Regulation dispatch signals and instructions transmitted by the Office of the Interconnection and, in the event of conflict, Regulation dispatch signals and instructions shall take precedence over energy dispatch signals and instructions. Those providing Regulation shall exert all reasonable efforts to operate, or ensure the operation of, their resources supplying load in the PJM Region as close to desired output levels as practical, consistent with Good Utility Practice.</p>



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2.	OA Schedule 1 / OATT Att K Appendix Section 1.7		<p>1.7.18 Regulation.</p> <p>(a) Regulation to meet the Regulation objective of each Regulation Zone shall be supplied from generation resources and/or Demand Resources located within the metered electrical boundaries of such Regulation Zone. Generating Market Buyers, and Market Sellers offering Regulation, shall comply with applicable standards and requirements for Regulation capability and dispatch specified in the PJM Manuals.</p> <p>(b) The Office of the Interconnection shall obtain and maintain an amount of Regulation for each Regulation Zone equal to the Regulation objective for such Regulation Zone, as specified in its PJM Manuals.</p> <p>(c) The Regulation range of a generation unit or Demand Resource shall be at least twice the amount of Regulation assigned <u>as described in the PJM Manuals.</u></p> <p><i>(d) A resource capable of automatic energy dispatch that is also providing Regulation shall have its energy dispatch range reduced from the Regulation range by at least twice the amount of the Regulation provided with consideration of the regulationRegulation limits of the resource, as specified in the procedures of the Office of the InterconnectionPJM Manuals. A generation unit capable of automatic energy dispatch that is also providing Regulation shall have its energy dispatch range reduced by twice the amount of the Regulation provided. The amount of Regulation provided by a generation unit shall serve to redefine the Normal Minimum Generation and Normal Maximum Generation energy limits of that generation unit, in that the amount of Regulation shall be added to the generation unit's Normal Minimum Generation energy limit, and subtracted from its Normal Maximum Generation energy limit.</i></p> <p>(e) Qualified Regulation must satisfy the <u>measurement and</u> verification tests described in the <u>procedures of the Office of the Interconnection</u>PJM Manuals.</p>



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3.			<p>(e) A Market Seller that wishes to make a resource available to sell Regulation service shall submit an offer for Regulation that shall specify the megawatt of Regulation being offered, which must equal or exceed 0.1 megawatts, the Regulation Zone for which such Regulation is offered, the price of the <i>capability</i> offer in dollars per MWh, <i>the price of the performance offer in Dollars per change in MW</i>, and such other information specified by the Office of the Interconnection as may be necessary to evaluate the offer and the resource's opportunity costs. The price of the offer <i>total of the performance offer multiplied by the historical average mileage used in the market clearing plus the capability offer</i> shall not exceed \$100 per MWh in the case of Regulation offered for all Regulation Zones. In addition to any market-based offer for Regulation, the Market Seller also shall submit a cost-based offer. A cost-based offer must be in the form specified in the PJM Manuals and consist of the following components as well as any other components specified in the PJM Manuals:</p> <ul style="list-style-type: none"> i. The costs (in \$/MW) of the fuel cost increase due to the heat rate increase resulting from operating the unit at lower megawatt output incurred from the provision of Regulation; ii. The cost increase (in \$/MW) in variable operating and maintenance costs resulting from operating the unit at lower megawatt output incurred from the provision of Regulation; and iii. An adder of up to \$12.00 per megawatt of Regulation provided <i>applied to the capability offer</i>. <p>Qualified Regulation capability must satisfy the <i>measurement and</i> verification tests specified in the PJM Manuals.</p>
4.	<p>OA Schedule 1 / OATT Att K Appendix 1 Section 3.2.2</p>	<p>Revised references to subsections. Note: any redlines in italics are pending from PJM's first compliance filing.</p>	<p>3.2.2 Regulation. (a) Each Internal Market Buyer that is a Load Serving Entity in a Regulation Zone shall have an hourly Regulation objective equal to its pro rata share of the Regulation requirements of such Regulation Zone for the hour, based on the <i>Internal</i> Market Buyer's total load (net of operating Behind The Meter Generation, but not to be less than zero) in such Regulation Zone for the hour ("Regulation Obligation"). An Internal Market Buyer that does not meet its hourly Regulation obligation shall be charged <i>the following</i> for Regulation dispatched by the Office of the Interconnection to meet such obligation at: (i) the capability Regulation market-clearing price determined in accordance with subsection (c)(h) of this section, ; (ii) plus the amounts, if any, described in subsection (f) of this section; <i>and (iii) the Internal Market Buyer's pro rata share of any performance credits paid to regulating resources calculated in accordance with subsection (g) and (h)-of this section.</i></p>



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		<p>Revised to add make-whole payments.</p> <p>Added "For the purposes of committing resources and setting the market clearing prices" for 206 filing. However, we may add separate subsections for committing resources and pricing.</p> <p>Yellow highlighted language needed to include the effect of the benefits factor on the lost opportunity cost in the clearing process.</p>	<p>(b) A-Each Market Seller and Generating Market Buyer <i>shall be credited for each of its resources</i> supplying Regulation in a Regulation Zone at the direction of the Office of the Interconnection in excess of its hourly Regulation obligation shall be credited such that the calculated credit for each increment of such Regulation <i>provided by each resource shall be the higher of (i) the Regulation market-clearing price in such Regulation Zone or (ii) the sum of the regulation offers for a resource, the unit-specific shoulder hour opportunity costs described in subsection (e) of this section, the unit-specific inter-temporal opportunity costs described in (INSERT SUBSECTION) of this section, and the unit-specific opportunity costs discussed in subsection (d) of this section.</i> the unit-specific opportunity cost of the generation resource supplying the increment of Regulation, as determined by the Office of the Interconnection in accordance with procedures specified in the PJM Manuals.</p> <p>(c) The total Regulation market-clearing price in each Regulation Zone shall be determined at a time to be determined by the Office of the Interconnection which shall be no earlier than the day before the Operating Day. <i>In accordance with the PJM Manuals, the total Regulation market-clearing price shall be calculated by optimizing the dispatch profile to obtain the lowest cost combination set of resources that satisfies the Regulation requirement.</i> The market-clearing price for each regulating hour shall be equal to the <i>average of all 5-minute clearing prices calculated during that hour. For the purposes of committing resources and setting the market clearing prices</i> the total Regulation market-clearing price shall include: (i) the performance Regulation market-clearing price in a Regulation zone that shall be calculated in accordance with subsection (g) of this section; (ii) the capability Regulation market-clearing price that shall be calculated in accordance with subsection (h) of this section; and (iii) a Regulation resource's highest sum of a resource's Regulation offer plus its estimated unit-specific opportunity costs <i>divided by the unit-specific benefits factor described in subsection (i) of this section, during the 5-minute period</i> determined as described in subsection (d) below from among the resources selected to provide Regulation. A resource's Regulation offer by any Market Seller that fails the three-pivotal supplier test set forth in section 3.3.2A.1 of this Schedule shall not exceed the cost of providing Regulation from such resource, plus twelve dollars, as determined pursuant to the formula in section 1.10.1A(e) of this Schedule.</p> <p>(d) In determining the Regulation 5-minute market clearing price for each Regulation Zone, the estimated unit-specific opportunity costs of a generation resource offering to sell Regulation in each regulating hour shall be equal to <i>the sum of the unit-specific opportunity costs (i) incurred during the</i></p>

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			<p>hour in which the obligation is fulfilled, plus costs (ii) associated with uneconomic operation during the hour preceding the initial regulating hour ("preceding shoulder hour"); plus costs (iii) associated with uneconomic operation during the hour after the final regulating hour ("following shoulder hour"). The unit specific opportunity costs incurred during the hour in which the Regulation obligation is fulfilled shall be equal to the product of (i) the deviation of the set point of the generation resource that is expected to be required in order to provide Regulation from the generation resource's expected output level if it had been dispatched in economic merit order times (ii) the absolute value of the difference between the expected Locational Marginal Price at the generation bus for the generation resource and the lesser of the available market-based or highest available cost-based energy offer from the generation resource (at the megawatt level of the Regulation set point for the resource) in the PJM Interchange Energy Market.</p> <p>The unit specific opportunity costs associated with uneconomic operation during the preceding shoulder hour shall be equal to the product of (i) the deviation between the set point of the generation resource that is expected to be required in the initial regulating hour in order to provide Regulation and the lesser of the resource's actual or expected output in the preceding shoulder hour when the resource is requested at a lower output than what is otherwise economic in order to provide Regulation, or, the higher of the resource's actual or expected output in the preceding shoulder hour when the resource is requested at a higher output than what is otherwise economic in order to provide Regulation, times (ii) the absolute value of the difference between the Locational Marginal Price at the generation bus for the generation resource in the preceding shoulder hour and the lesser of the available market based or highest available cost based energy offer from the generation resource (at the megawatt level of the Regulation set point for the resource in the initial regulating hour) in the PJM Interchange Energy Market, times (iii) the percentage of the preceding shoulder hour during which the deviation was incurred, all as determined by the Office of the Interconnection in accordance with procedures specified in the PJM Manuals.</p> <p>The unit specific opportunity costs associated with uneconomic operation during the following shoulder hour shall be equal to the product of (i) the deviation between the set point of the generation resource that is expected to be required in the final regulating hour in order to provide Regulation and the lesser of the resource's actual or expected output in the following shoulder hour when the resource is requested at a lower output than what is otherwise economic in order to provide Regulation, or, the higher of the resource's actual or expected output in the following shoulder hour when the resource is requested at a higher output than what is otherwise economic in order to provide Regulation, times (ii) the absolute value of the difference between the Locational Marginal Price at the generation bus for the generation resource in the following shoulder hour and</p>



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			<p><i>the lesser of the available market based or highest available cost based energy offer from the generation resource (at the megawatt level of the Regulation set point for the resource in final regulating hour) in the PJM Interchange Energy Market.</i></p> <p>Estimated opportunity costs for Demand Resources to provide Regulation are zero.</p>
		<p>Yellow highlighted language needed to re-implement the after-the-fact check for shoulder hour lost opportunity costs. The language of this section is the same as it is in today's tariff. This section was removed as part of PJM's 755 compliance filing.</p>	<p>(e) In determining the credit under subsection (b) to a Market Seller or Generating Market Buyer selected to provide Regulation in a Regulation Zone and that actively follows the Office of the Interconnection's Regulation signals and instructions, the unit-specific opportunity cost of a generation resource shall be determined for each hour that the Office of the Interconnection requires a generation resource to provide Regulation, and for the percentage of the preceding shoulder hour and the following shoulder hour during which the Generating Market Buyer or Market Seller provided Regulation. The unit-specific opportunity cost incurred during the hour in which the Regulation obligation is fulfilled shall be equal to the product of (i) the deviation of the generation resource's output necessary to follow the Office of the Interconnection's Regulation signals from the generation resource's expected output level if it had been dispatched in economic merit order times (ii) the absolute value of the difference between the Locational Marginal Price at the generation bus for the generation resource and the lesser of the available market-based or highest available cost-based energy offer from the generation resource (at the actual megawatt level of the resource when the actual megawatt level is within the tolerance defined in the PJM Manuals for the Regulation set point, or at the Regulation set point for the resource when it is not within the corresponding tolerance) in the PJM Interchange Energy Market. Opportunity costs for Demand Resources to provide Regulation are zero.</p> <p>The unit-specific opportunity costs associated with uneconomic operation during the preceding shoulder hour shall be equal to the product of (i) the deviation between the set point of the generation resource that is expected to be required in the initial regulating hour in order to provide Regulation and the lesser of the resource's actual or expected output in the preceding shoulder hour when the resource is requested at a lower output than what is otherwise economic in order to provide Regulation, or, the higher of the resource's actual or expected output in the preceding shoulder hour when the resource is requested at a higher output than what is otherwise economic in order to provide Regulation, times (ii) the absolute value of the difference between the Locational Marginal Price at the generation bus for the generation resource in the preceding shoulder hour and the lesser of the available market-based or highest available cost-based energy offer from the generation resource (at the megawatt level of the Regulation set point for the resource in the initial</p>



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			<p><i>regulating hour) in the PJM Interchange Energy Market, times (iii) the percentage of the preceding shoulder hour during which the deviation was incurred, all as determined by the Office of the Interconnection in accordance with procedures specified in the PJM Manuals.</i></p> <p><i>The unit-specific opportunity costs associated with uneconomic operation during the following shoulder hour shall be equal to the product of (i) the deviation between the set point of the generation resource that is expected to be required in the final regulating hour in order to provide Regulation and the lesser of the resource's actual or expected output in the following shoulder hour when the resource is requested at a lower output than what is otherwise economic in order to provide Regulation, or, the higher of the resource's actual or expected output in the following shoulder hour when the resource is requested at a higher output than what is otherwise economic in order to provide Regulation, times (ii) the absolute value of the difference between the Locational Marginal Price at the generation bus for the generation resource in the following shoulder hour and the lesser of the available market-based or highest available cost-based energy offer from the generation resource (at the megawatt level of the Regulation set point for the resource in final regulating hour) in the PJM Interchange Energy Market, times (iii) the percentage of the following shoulder hour during which the deviation was incurred, all as determined by the Office of the Interconnection in accordance with procedures specified in the PJM Manuals.</i></p>
			<p>(f) Any amounts credited for Regulation in an hour in excess of the Regulation market-clearing price in that hour shall be allocated and charged to each Internal Market Buyer in a Regulation Zone that does not meet its hourly Regulation obligation in proportion to its purchases of Regulation in such Regulation Zone in megawatt-hours during that hour.</p>
		<p>Added the highlighted revisions to incorporate the marginal benefits factor.</p> <p>All other revisions are to correct the clerical errors from PJM's first filing.</p> <p>Yellow highlighted language needed to specify the use of the benefits factor in the clearing and settlement for performance offers</p>	<p>(f) The Office of the Interconnection shall calculate the capability Regulation market clearing price for each Regulation Zone by subtracting the performance Regulation market clearing price described in subsection (f) from the total Regulation market clearing price described in subsection (e). This residual sets the capability Regulation market clearing price for that market hour.</p> <p>The owner of each Regulation resource that actively follows the Office of the Interconnection's Regulation signals and instructions will be credited for Regulation capability based on the assigned MW and the capacity Regulation market clearing price.</p> <p><i>(g) To determine the performance Regulation market-clearing price for each Regulation Zone, the Office of the Interconnection shall adjust the submitted performance offer for each resource in accordance with the historical performance of that resource, the expected amount of Regulation that resource will be dispatched based on the historical ratio of control signals calculated by the Office of</i></p>



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		and payments.	<p><u>the Interconnection, and the unit-specific benefits factor described in subsection (i) of this section for which that resource is qualified. The maximum adjusted performance offer of all cleared resources will set the performance Regulation market-clearing price.</u></p> <p><u>The owner of each Regulation resource that actively follows the Office of the Interconnection's Regulation signals and instructions, will be credited for Regulation performance based on the assigned MW(s), the performance Regulation market-clearing price, the amount of Regulation performance of the resource provides during the market hour, the marginal benefits factor described in subsection (i) for the Regulation dispatch signal assigned to the Regulation resource, and the accuracy with which each resource responds to the Office of the Interconnection's Regulation signals during the market hour.</u></p>
5.		<p>Deleted the first paragraph and added the third paragraph to correct clerical errors.</p> <p>Added "The Office of the Interconnection shall divide each Regulation resource's capability offer by the unit-specific benefits factor described in subsection (i) of this section for the purposes of committing resources and setting the market clearing prices" for PJM's second compliance filing.</p> <p>Yellow highlighted language added to incorporate the benefits factor in the clearing and settlement for capability offers and payments.</p>	<p>(g) In accordance with the processes described in the PJM Manuals, the Office of the Interconnection shall: (i) calculate inter-temporal opportunity costs for each applicable resource; (ii) include such inter-temporal opportunity costs in each applicable resource's offer to sell frequency Regulation service; and (iii) account for such inter-temporal opportunity costs in the Regulation market clearing price.</p> <p><u>(h) The Office of the Interconnection shall divide each Regulation resource's capability offer by the unit-specific benefits factor described in subsection (i) of this section for the purposes of committing resources and setting the market clearing prices.</u></p> <p><u>The Office of the Interconnection shall calculate the capability Regulation market-clearing price for each Regulation Zone by subtracting the performance Regulation market-clearing price described in subsection (g) from the total Regulation market-clearing price described in subsection (c). This residual sets the capability Regulation market-clearing price for that market hour.</u></p> <p><u>The owner of each Regulation resource that actively follows the Office of the Interconnection's Regulation signals and instructions will be credited for Regulation capability based on of a Regulation resource by multiplying the assigned MW and by the capacity Regulation market-clearing price, and by the marginal benefits factor described in subsection (i) for the Regulation dispatch signal assigned to the Regulation resource.</u></p>
6.			<p>(i) In accordance with the processes described in the PJM Manuals, the Office of the Interconnection shall: (i) calculate inter-temporal opportunity costs for each applicable resource; (ii) include such inter-temporal opportunity costs in each applicable resource's offer to sell frequency Regulation</p>

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			<i>service; and (iii) account for such inter-temporal opportunity costs in the Regulation market-clearing price.</i>
7.		Added the highlighted revisions to incorporate the benefits factor. This section is referenced in several places above.	<p>(i) [FOR COMPLIANCE FILING, INSERT PROCESS FOR CALCULATING UNIT-SPECIFIC BENEFITS FACTOR.]</p> <p>The Office of the Interconnection shall calculate a marginal benefits factor for each of the dynamic regulation signal and traditional regulation signal in accordance with the PJM Manuals. The marginal benefits factor for the dynamic regulation signal shall equal the unit-specific benefits factor of the last MW selected to provide regulation from a Regulation resource following the dynamic regulation signal. The marginal benefits factor for the traditional regulation signal shall be equal to one.</p>
8.	OA Schedule 1 / OATT Att K Appendix Section 3.2.2A	Yellow highlighted language needed to properly incorporate the benefits factor into the three-pivotal-supplier test.	<p>Offer Price Caps.</p> <p>3.2.2A.1 Applicability.</p> <p>(a) Each hour, the Office of the Interconnection shall conduct a three-pivotal supplier test as described in this section. Regulation offers from Market Sellers that fail the three-pivotal supplier test shall be capped in the hour in which they failed the test at their cost based offers as determined pursuant to section 1.10.1A(e) of this Schedule. A Regulation supplier fails the three-pivotal supplier test in any hour in which such Regulation supplier and the two largest other Regulation suppliers are jointly pivotal.</p> <p>(b) For the purposes of conducting the three-pivotal supplier test pursuant to this section, the following applies:</p> <p><i>(i) The three-pivotal supplier test will include in the definition of available supply all offers from resources capable of satisfying the Regulation requirement of the PJM Region for which the capability cost-based offer plus the performance cost-based offer plus any eligible opportunity costs is no greater than 150 percent of the clearing price that would be calculated if all offers were limited to cost (plus eligible opportunity costs).</i></p> <p><i>(ii) The three-pivotal supplier test will apply on a Regulation supplier basis (i.e. not a resource by resource basis) and only the Regulation suppliers that fail the three-pivotal supplier test will have their Regulation offers capped. A Regulation supplier for the purposes of this section includes corporate affiliates. Regulation from resources controlled by a Regulation supplier or its affiliates, whether by contract with unaffiliated third parties or otherwise, will be included as Regulation of that</i></p>

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			<p>Regulation supplier. Regulation provided by resources owned by a Regulation supplier but controlled by an unaffiliated third party, whether by contract or otherwise, will be included as Regulation of that third party.</p> <p><u>(iii) Each supplier shall be ranked from the largest to the smallest offered MW of eligible regulation supply adjusted by the unit-specific benefits factor in each hour. Suppliers are then tested in order starting with the three largest suppliers. For each iteration of the test, the two largest suppliers are combined with a third supplier, and the combined supply is subtracted from total effective supply. The resulting net amount of eligible supply is divided by the regulation requirement for the hour to determine the residual supply index. Where the residual supply index for three pivotal suppliers is less than or equal to 1.0, then the three suppliers are jointly pivotal and the suppliers being tested fail the three pivotal supplier test. Iterations of the test continue until the combination of the two largest suppliers and a third supplier result in a residual supply index greater than 1.0, at which point the remaining suppliers pass the test. Any resource owner that fails the TPS Test will be offer-capped.</u></p>