187 FERC ¶ 61,173
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Willie L. Phillips, Chairman;
Allison Clements and Mark C. Christie.

PJM Interconnection, L.L.C. Docket No. ER24-1772-000

ORDER ACCEPTING TARIFF REVISIONS

(Issued June 14, 2024)

1. On April 16, 2024, pursuant to section 205 of the Federal Power Act[1] and Part 35 of the Commission's regulations,[2] PJM Interconnection, L.L.C. (PJM) filed proposed revisions to the PJM Open Access Transmission Tariff (Tariff) and the Amended and Restated Operating Agreement of PJM (Operating Agreement) to redesign PJM's Regulation market from a two-signal, single-product approach (RegA or RegD) to a two-product approach (Regulation-Up (RegUp) and Regulation-Down (RegDown)) (Regulation Proposal). PJM proposes a tariff revision effective June 16, 2024, as well as tariff provisions implementing a two-stage implementation, with some aspects of the proposal effective October 1, 2025, and others effective October 1, 2026, to permit necessary software changes.

2. In this order, we accept PJM's filing, and the proposed tariff records, to become effective June 16, 2024, October 1, 2025, and October 1, 2026, respectively, as requested.[3]

[1] 16 U.S.C. § 824d.

[2] 18 C.F.R. pt. 35.13 (2023).

[3] PJM proposes various effective dates for its tariff revisions. Appendix A lists the accepted tariff records and their effective dates.

I. Background

3. Regulation service is one of the tools system operators use to balance supply and demand on the transmission system in order to maintain reliable operations.[4] Regulation service is the injection or withdrawal of real power by facilities capable of responding appropriately to a transmission system operator's automatic generation control (AGC) signal.[5] When a balancing authority area experiences an energy deficiency, as measured by Area Control Error (ACE),[6] the system operator may direct Regulation resources to increase output or decrease energy withdrawals. When a balancing authority area experiences an energy surplus, the system operator may direct Regulation resources to decrease output or withdraw energy.

4. On October 20, 2011, the Commission issued Order No. 755[7] to remedy undue discrimination in the Regulation markets and ensure just and reasonable and not unduly discriminatory compensation for providing Regulation Service. Order No. 755 requires regional transmission organizations and independent system operators to compensate Regulation resources based on the actual service provided, including: (1) a capacity payment that includes the marginal unit's opportunity costs; and (2) a payment for performance that reflects the quantity of Regulation service provided by a resource when the resource is accurately following the dispatch signal.[8] As to the performance payment, Order No. 755 requires that a resource's performance must be based on the absolute

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[4] *Frequency Reg. Compensation in the Organized Wholesale Power Mkts.*, Order No. 755, 137 FERC ¶ 61,064, at P 1 (2011) (hereinafter referred to as Order No. 755), *reh'g denied*, Order No. 755-A, 138 FERC ¶ 61,123 (2012).

[5] Order No. 755, 137 FERC ¶ 61,064 at P 4. AGC is defined as a process designed and used to adjust a Balancing Authority Area's demand and resources to help maintain the Reporting Area Control Error in that Balancing Authority Area within the bounds required by applicable NERC Reliability Standards. *See* North American Electric Reliability Corporation, *Glossary of Terms Used in NERC Reliability Standards*, https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf (NERC Glossary).

[6] ACE is the "instantaneous difference between a Balancing Authority's net actual and scheduled interchange," taking into account the effects of frequency bias and correction for meter error. NERC Glossary, https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf.

[7] Order No. 755, 137 FERC ¶ 61,064.

[8] *See* 18 C.F.R. § 35.28(g)(8) (2023) (promulgated by Order No. 755).

amount of Regulation up and down that a resource provides in response to the system operator's dispatch signal, that is, absolute mileage.[9]

II. PJM's Filing

A. Overview of the PJM Regulation Market

5. PJM explains that Regulation is an essential reliability service that helps PJM balance supply and demand instantaneously, maintain system frequency, and keep PJM's ACE at or close to zero.[10] PJM also states that Regulation allows PJM to balance the grid when supply and demand fluctuate due to factors such as weather, wind or solar resource intermittency, interchange volatility, and generation fluctuations. PJM explains that, while it commits resources to provide Regulation on an hourly basis, during that hour, committed resources follow PJM's dispatch signals, which PJM can send every 2 to 10 seconds to keep the system in balance. PJM states that because changes in supply and demand are not precisely predictable, real-time mismatches between supply and demand will occur, resulting in non-zero ACE. PJM further explains that to maintain frequency throughout the Eastern Interconnection, it uses ACE to send Regulation resources an AGC signal to raise or lower output to correct for instantaneous changes in load and generation every few seconds when there is an imbalance between supply and demand. PJM states that the Regulation controller will send a signal for Regulation resources to move in the opposite direction of ACE to correct the imbalance.[11]

6. PJM states that in 2012 it introduced a performance-based Regulation market design in conjunction with a series of Order No. 755 compliance filings.[12] PJM explains that, under its current Regulation construct, resources are cleared and committed in PJM's Regulation market as one product, on an "Effective MW" basis, and then operationally can follow one of two signals: RegA or RegD. PJM states that it uses a traditional signal, called RegA, to dispatch slower, sustained-output resources with limited ramp rates but unlimited duration of generation output, such as steam and combustion resources.[13] PJM states that it uses a faster signal, called RegD, to dispatch faster, dynamic resources, with high ramp rates and rapid turnaround but limited

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[9] Order No. 755, 137 FERC ¶ 61,064 at P 133. Mileage can be considered the amount of work provided by each resource.

[10] PJM Transmittal at 5.

[11] *Id.* at 5-6.

[12] *Id.* at 6.

[13] *Id.* at 7.

duration, such as battery storage.[14] PJM explains that "inherent in this current market design are a number of complexities and inaccuracies in the market clearing, realized by the defined benefits factor curve (which attempts to provide an accurate rate of substitution between RegA and RegD) and the translation of RegD MW into RegA MW."[15]

B. Operational Issues with the Current Regulation Market Design

7. PJM explains that, with its changing resource mix that includes a greater proportion of intermittent resources (e.g., solar and wind), PJM, the independent market monitor (IMM), and stakeholders evaluated the current Regulation market and identified improvements that would: (1) increase transparency in market clearing prices and selection; (2) address notable inefficiencies resulting from the single-product design; and (3) allow the market to account for the ramp-up and ramp-down capabilities necessary to meet operational challenges posed by the changes to the composition of supply and demand.[16]

8. PJM asserts that the production characteristics of intermittent resources affect the need for Regulation to maintain system balance.[17] PJM adds that the uncertainty associated with these resource types, on a minute-to-minute basis, and even on an hour look-ahead basis in the real-time market, is not insignificant.[18] Further, PJM explains that the changing resource mix will affect the resources available to PJM to provide Regulation, which in turn will increase the value of the RegUp and RegDown services. PJM states that with the change in resource mix, the current Regulation construct will introduce inefficiencies in reliability and market clearing.[19] Thus, PJM argues, as additional forecast uncertainty is introduced into near-term operations and energy

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[14] RegA and RegD are not resource-type dependent, as any resource that can follow a given signal can qualify to provide Regulation service using that signal. PJM states that it has a number of resources today that are qualified and offer both RegA and RegD Regulation. *Id.* at 7.

[15] *Id.*

[16] *Id.* at 8.

[17] *Id.*

[18] *Id.* at 8-9 (citing *Modernizing Wholesale Elec. Mkt. Design*, 179 FERC ¶ 61,029, at P 2 (2022)).

[19] *Id.* at 9.

dispatch, the Regulation market will need to foster certain resource attributes and properly incentivize performance to maintain operations and reliability.[20]

9. PJM argues that using RegA and RegD signals to dispatch Regulation, but clearing them as a single product to meet a single reliability requirement, requires an accurate marginal rate of substitution between RegA and RegD signals, referred to as the "benefits factor," to be used in the clearing optimization to most efficiently commit resources in a manner aligned with PJM's operational needs.[21] PJM states that the purpose of the benefits factor is to facilitate the right mix of fast and slow resources and provide for the relative valuation of each to meeting the reliability goal. However, as PJM explains, the single product approach, which includes the benefits factor curve, hinders PJM's ability to monitor the Regulation being provided and unnecessarily complicates pricing and settlements.[22]

10. PJM asserts that while the defined benefits factor curve tries to approximate the "right mix" of resources, it is a static curve that does not change in response to system conditions, and therefore it is not always able to capture the real-time system conditions and the needed Regulation.[23] PJM explains that the current benefits factor curve was established with PJM's implementation of performance-based Regulation in 2012 and has not materially been updated to reflect any intervening Regulation market design changes.[24] PJM further adds that the benefits of the RegA and RegD construct are realized when the "right mix" of resources are providing Regulation service.[25] PJM argues that this mix is dependent on real-time system conditions that cannot accurately be observed at the time of commitment. PJM asserts that the current benefits factor captures an *average* trade-off based on study results and does not always capture the optimal set of Regulation resources to meet real-time system needs.[26]

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[20] *Id.*

[21] *Id.* at 11.

[22] *Id.*

[23] *Id.* at 7-8, 11.

[24] *Id.* at 8.

[25] *Id.* at 7.

[26] *Id.* at 11.

11. In addition, PJM explains that, under the current rules, resources are valued and committed based on the benefits factor but then compensated based only on the total MW they were assigned, with no consideration to the benefits factor of the resource or the marginal benefits factor for that commitment period.[27] PJM asserts that the inconsistent use of the benefits factor in pricing and settlements can minimize the effectiveness of pricing signals.[28] For example, PJM explains that, in clearing the Regulation market for a given interval, a benefits factor of "2" means that 1 MW of RegD can replace 2 MW of RegA, and such a Reg D resource would count as 2 MW to meet the Regulation requirement. However, when this RegD resource is settled, it would only be compensated for 1 MW,[29] which ultimately will send a different price signal to the resource than the assumed value in commitment and pricing that the resource provides to the system. According to PJM, this design can lead to over or under payment to Regulation resources.[30]

12. PJM explains that another issue with the current design is that the operational signals involve considerations beyond meeting Regulation (e.g., ACE control). The current design requires that RegA resources be moved (up or down) not for ACE control but to help maintain "neutrality" between the RegA and RegD resources.[31] PJM explains that "neutrality" is defined as keeping the RegD signal at net zero over a 30 minute period, which helps battery storage resources maintain a state of charge over each 30-minute period.[32] PJM states that the neutrality requirement: (1) introduces operational challenges; (2) hinders the Regulation market's ability to meet its reliability objective;

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[27] *Id.* at 12.

[28] *Id.*

[29] Because 1 MW of RegD can replace 2 MWs of RegA. *Id.*

[30] *Id.* (citing Monitoring Analytics, LLC, *2023 Quarterly State of the Market Report for PJM; January through September*, , at 572 (Nov. 9, 2023), https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2023/2023q3-som-pjm-sec10.pdf) ("RegD resources continue to be incorrectly compensated relative to RegA resources due to an inconsistent application of the marginal benefit factor in the optimization, assignment and settlement processes. If the regulation market were functioning efficiently and competitively, RegD and RegA resources would be paid the same price per effective MW.").

[31] *Id.* at 13.

[32] *Id.* at 13-14.

and (3) limits transparency to the market with respect to how much Regulation is needed and why.[33]

C. PJM's Proposed Regulation Revisions

13. In response to the operational issues discussed above, PJM proposes to move from a one-product market design to a two-product market design. Specifically, PJM proposes to replace the RegA and RegD signals with an approach under which PJM would send a singular dispatch signal that would identify whether PJM needs resources to provide one of two products: RegUp or RegDown.[34] PJM asserts that the new approach will increase the tools and flexibility available to PJM to manage ACE and allow PJM to separately procure and price RegUp and RegDown services, which necessitates corresponding changes to offer structure and price formation rules.[35] PJM also proposes to enhance the determination of both the lost opportunity cost that resources incur to provide Regulation instead of energy and the performance scoring used in commitment and compensation, to evaluate how well a resource is following PJM's Regulation signal.[36] In addition, PJM proposes to eliminate the benefits factor and to add enhancements and updates to the Regulation offer rules.[37]

14. PJM asserts that the Regulation proposal, altogether, will also provide enhanced market and economic efficiencies.[38] For example, PJM asserts that renewable resources would be able to offer and participate in RegDown services without having to first curtail to a lower economic set point.[39] Conversely, a generation resource operating at economic

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[33] *Id.* at 14.

[34] *Id.*

[35] *Id.* at 14-15.

[36] *Id.* at 15.

[37] *Id.* at 17. PJM also proposes several non-substantive revisions to correct improper punctuation, integrating previously accepted language from overlapping eTariff records, etc. PJM states that these changes are clerical in nature and do not alter the proposal approved by the Members Committee or its effectuation. *See Id.* at 4, n.6.

[38] *Id.* at 18-21.

[39] PJM states that this aspect of its proposal would open participation opportunities for resources, like solar and wind, that generally cannot be dispatched up, as they are often generating at maximum capability due to economics but can curtail output upon request. *Id.* at 18.

minimum would be able to offer RegUp services alone, without being uneconomically moved up to provide symmetric, bidirectional Regulation service, as is done today.[40]

15. In addition, PJM asserts that the proposed market clearing in a RegUp and RegDown market construct provides economic efficiencies through a more efficient economic dispatch.[41] PJM avers that such efficiencies can be achieved because most of the observed costs from PJM's Regulation service are associated with the resource's lost opportunity cost for providing Regulation when not economic relative to the energy price. PJM adds that bifurcating the current product into RegUp and RegDown will reduce the opportunity cost of each Regulation commitment and allow different resources to provide the service most economically. PJM states that it expects its proposed approach to minimize the overall lost opportunity cost.[42] PJM provides an example that compares the total production cost under the status quo (a simple two-unit system in the current bidirectional Regulation product market) against that expected under the new, two-product Regulation market (same system with the proposed RegUp and RegDown). The comparison shows that the proposed RegUp and RegDown solution produces lower total production cost and according to PJM, "much of that cost reduction is due to PJM being able to better isolate the least cost resource to provide RegUp or RegDown by minimizing the opportunity cost."[43] As further described below, PJM explains that the current Regulation market construct overstates a resource's lost opportunity cost and does not consider the resource's ramp rate, or whether the resource is consistently following the PJM energy dispatch signal. Thus, PJM proposes to consider the resource's tracking ramp rate limited expected output level if it had been dispatched for energy in economic merit order as part of the lost opportunity cost calculation.[44]

16. PJM also explains that its proposed Regulation market design is similar in concept and product design to that currently employed by the Southwestern Power Pool, Inc. (SPP) and California Independent System Operator Corporation (CAISO).[45] PJM argues

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[40] *Id.* at 18-19.

[41] *Id.* at 19.

[42] *Id.*

[43] *Id.* at 20.

[44] *Id.* at 43-44.

[45] *Id.* at 15 (citing *Sw. Power Pool Inc.*, 141 FERC ¶ 61,048 (2012), *order on reh'g*, 142 FERC ¶ 61,205 (2013); *Sw. Power Pool, Inc.*, 147 FERC ¶ 61,211 (2104) (SPP Order); *Cal. Indep. Sys. Operator Corp.*, 140 FERC ¶ 61,206 (2012) (CAISO Order); *Cal. Indep. Sys. Operator Corp.*, 142 FERC ¶ 61,233 (2013)).

that those regions have a resource mix with a high proportion of intermittent resources and the SPP and CAISO regional operators have capably managed their systems using a one-signal Regulation market design featuring separate regulation up and regulation down products.[46]

D. Implementation and Requested Effective Dates

17. PJM proposes to implement the proposed changes to the Regulation market over two phases.[47] Phase 1 includes changes to the offer structure, price formation, lost opportunity cost, and performance scoring. Phase 2 includes changes to implement the RegUp and RegDown products.

18. PJM states that the market rule changes associated with Phase 1 have shorter development lead times and should be ready for implementation and in effect by October 1, 2025.[48] PJM also contends that implementing the Phase 1 changes before the software and other changes necessary to implement the RegUp and RegDown products in Phase 2 is reasonable and appropriate because this approach will avoid the operational issues associated with the current market design described above and will provide time for PJM and market participants to become familiar with the RegUp and RegDown products.[49] PJM proposes to implement the RegUp and RegDown products in the Phase 2 in approximately two and half years and, therefore, PJM proposes an effective date of October 1, 2026 for the Phase 2 changes. PJM explains that a two-year developmental timeframe is required because PJM will need to make significant software changes to the market clearing engine.[50] PJM also states that such effective dates will allow PJM to orderly implement the market reforms after the summer operating season has passed.[51] PJM requests Commission action by June 14, 2024 to allow PJM to begin coding the

[46] *Id.*

[47] *Id.* at 16.

[48] *Id.*

[49] *Id.*

[50] *Id.*

[51] *Id.* at 4.

software changes necessary for the market enhancement effective by those requested effective dates.[52]

19. Below, in the Discussion section, we describe in more detail PJM's proposed Tariff revisions and address the proposed Tariff revisions by topic.

III. Notice of Filing and Responsive Pleadings

20. Notice of PJM's filing was published in the Federal Register, 89 Fed. Reg. 31,196 (Apr. 24, 2024), with interventions and comments due on or before May 7, 2024.

21. New Jersey Board of Public Utilities filed a notice of intervention. Timely motions to intervene were filed by: American Electric Power Service Corporation (AEPSC);[53] American Municipal Power, Inc.; Boston Energy Trading and Marketing LLC; Buckeye Power, Inc.; Calpine Corporation; Constellation Energy Generation, LLC; Convergent Energy and Power LLC; CPower, Inc.; Delaware Division of the Public Advocate; Dominion Energy Services, Inc. (Dominion);[54] Duquesne Light Company; FirstEnergy Service Company;[55] Monitoring Analytics, LLC, acting in its capacity as the Independent Market Monitor for PJM (IMM); Northern Virginia Electric Cooperative, Inc.; NRG Business Marketing LLC and Midwest Generation, LLC; Old Dominion Electric Cooperative; PJM Power Providers Group; Public Citizen, Inc.; Rockland Electric Company; and Southern Maryland Electric Cooperative, Inc.

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[52] *Id.* PJM also submitted one Tariff record, without substantive changes, with a June 16, 2024 effective date. *Id.* at 4 n.7.

[53] AEPSC moves to intervene on behalf of its affiliates Appalachian Power Company, Indiana Michigan Power Company, Kentucky Power Company, Kingsport Power Company, Ohio Power Company, Wheeling Power Company, AEP Appalachian Transmission Company, Inc., AEP Indiana Michigan Transmission Company, Inc., AEP Kentucky Transmission Company, Inc., AEP Ohio Transmission Company, Inc., AEP West Virginia Transmission Company, Inc., and AEP Energy Partners, Inc.

[54] Dominion moves to intervene on behalf of Virginia Electric and Power Company d/b/a Dominion Energy Virginia.

[55] First Energy Service Company moves to intervene as agent for its franchised public utility affiliates Ohio Edison Company, The Cleveland Electric Illuminating Company, The Toledo Edison Company, Pennsylvania Power Company, Pennsylvania Electric Company, Metropolitan Edison Company, Jersey Central Power & Light Company, Monongahela Power Company, and The Potomac Edison Company.

22. On May 7, 2024, Dominion filed comments and the IMM filed a protest. On May 23, 2024, PJM filed an answer. On June 7, 2024, the IMM filed an answer.

IV. Discussion

A. Procedural Matters

23. Pursuant to Rule 214 of the Commission's Rules of Practice and Procedure, 18 C.F.R. § 385.214 (2023), the notice of intervention and the timely, unopposed motions to intervene serve to make the entities that filed them parties to this proceeding.

24. Rule 213(a)(2) of the Commission's Rules of Practice and Procedure, 18 C.F.R. § 385.213(a)(2) (2023), prohibits an answer to a protest unless otherwise ordered by the decisional authority. We accept PJM's answer because it has provided information that assisted us in our decision-making process.

25. Rule 213(a)(2) of the Commission's Rules of Practice and Procedure, 18 C.F.R. § 385.213(a)(2) (2023), prohibits an answer to an answer unless otherwise ordered by the decisional authority. We accept the IMM's answer because it has provided information that assisted us in our decision-making process.

B. Substantive Matters

26. We find PJM's proposed Tariff revisions to be just and reasonable, and accept the Tariff revisions, effective October 1, 2025, and October 1, 2026, as requested,[56] as discussed below. As a preliminary matter, we find that PJM's proposed market clearing approach for Regulation service should result in efficient price signals for the provision of frequency Regulation. We find that separately procuring RegUp service and RegDown service, with a relatively shorter look-ahead period and performance score improvements, should allow PJM to better meet its system's needs based on operating conditions and result in market clearing prices that more accurately reflect resources' actual costs to provide Regulation - including opportunity costs (i.e., the cost of foregoing the opportunity to provide energy). Further, we find that PJM's proposal to consider a resource's ramp rate at the desired MW (i.e., a resource's expected output level if it had been dispatched in economic merit order) results in a more accurate opportunity cost calculation. We further find that this approach will allow the resource to follow the PJM energy dispatch signal more efficiently. We also find that the proposed revisions will provide more accurate compensation for resources providing Regulation service since the

[56] PJM filed a wide range of tariff records with different effective dates tied to those records. Appendix A to this order lists the tariff records that we are accepting in this order along with their effective dates.

performance payment[57] compensates a resource for both the amount of Regulation provided in response to the system operator's dispatch signal and the accuracy with which the resource follows its dispatch instructions.

27. Additionally, we find that PJM's proposed pricing and compensation approach based on a two-part payment structure (i.e., a capability payment and a performance payment) is just and reasonable and consistent with the requirements of Order No. 755. In Order No. 755, the Commission required "all RTOs and [independent system operators to] . . . institute a two-part payment for frequency Regulation and to account for a resource's accuracy in its compensation."[58] Under the Regulation Proposal, PJM has not proposed to change the capability payment, except to change the name of "accuracy" score to "performance" score. In addition, we find that PJM's proposed five-minute capability payment and five-minute mileage payment compensate resources both for the capacity that they make available to provide Regulation and for actually providing Regulation by following PJM's dispatch instructions. Further, we find that the Regulation Proposal will provide market and economic efficiencies by expanding the set of resources likely to offer into PJM's Regulation market because the separate RegUp and RegDown services will enable resources to offer Regulation service in a manner more consistent with their operating capabilities. Expanding the set of resources offering into the PJM Regulation market should increase competition and lower the costs that PJM incurs to meet its Regulation needs. Additionally, establishing separate RegUp and RegDown products should yield efficiencies because the separate products will increase PJM's ability to align its Regulation needs, which may not be symmetrical in the upward and downward directions, with the Regulation service PJM procures in the Regulation market.

28. We discuss specific contested issues below.

29. The Commission acknowledges the issues identified by the IMM's protest in this docket. However, given the record before us and as we have noted in this order, we do not believe the IMM's protest negates our accepting PJM's proposed revisions in this section 205 proceeding. We will continue to monitor as these proposed revisions are implemented; the IMM and market participants will be able to do the same and can make future filings with the Commission should they wish to bring any issues to the Commission's attention.

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[57] Under the Regulation Proposal, the performance payment will continue to reflect both the MW of Regulation provided (i.e., the mileage up or down or both) and how well the resource provided Regulation in the given interval (performance score).

[58] Order No. 755, 137 FERC ¶ 61,064 at P 77.

1. Tariff Changes Proposed in Phase 1

30. PJM proposes a new definition for a single "Regulation Requirement"[59] in Phase 1[60] and explains that the definition provides for a set value, based on the commitment interval, that will allow PJM to adjust the required MW of performance-adjusted Regulation capability if operational uncertainty is greater than expected.[61] PJM asserts that this requirement is reasonable because it ensures that PJM procures sufficient amounts of Regulation.[62] PJM also states that this proposed requirement similarly allows PJM to acquire a set MW value of Regulation to be maintained in a Regulation Zone, and that such value "can increase to account for additional operational uncertainty."[63] As noted above, under the proposed changes in Phase 1, PJM proposes Regulation market enhancements and design changes, including offer structure, price formation, lost opportunity cost, and performance scoring, but does not include the introduction of the two RegUp and RegDown products.[64]

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[59] Proposed "Regulation Requirement" is defined as the "required megawatts of performance-adjusted Regulation capability to be maintained in a Regulation Zone," and is "a set megawatt value by commitment interval" which "can increase to account for additional operational uncertainty." *See* Phase 1 proposed PJM, Intra-PJM Tariffs, OATT Definitions – R - S, § (36.0.0).

[60] *See* Phase 1 proposed PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 3.2, OA Schedule 1 Sec 3.2 - Market Buyers (61.0.0), § 3.2.2 Regulation (abbreviated as Phase 1 proposed Operating Agreement, Schedule 1, section 3.2); *id.*, OA Schedule 1 Sec 1.10, OA Schedule 1 Sec 1.10 - Scheduling (47.0.0), § 1.10.1A Day-ahead and Real-time Energy Market Scheduling (abbreviated as Phase 1 proposed Operating Agreement, Schedule 1, section 1.10). PJM states that for convenience and ease of understanding, in its transmittal letter, PJM cites only to the energy market rules in the Operating Agreement and does not include citations to the parallel rules (or proposed rules) in Tariff, Attachment K-Appendix. PJM Transmittal at 4 n.6.

[61] PJM Transmittal at 21.

[62] *Id.*

[63] *Id.* at 21-22.

[64] *Id.* at 16.

a. Offer Structure

i. Filing

31. PJM proposes a series of additional enhancements and updates to the Regulation offer rules.[65] First, PJM proposes to revise the Operating Agreement, section 1.10.1A(e) to clarify that offers are submitted for each "30 minute Regulation clearing interval."[66] PJM explains that market sellers that wish to offer Regulation service may still vary their offers hourly but can also update their availability to provide Regulation service in each 30-minute interval, up to 35 minutes before the applicable 30-minute interval, which is a change from the current 65 minutes before each hour-long commitment period.[67] PJM states that market sellers that have not opted out of intraday hourly offers will continue to be able to update their Regulation offers hourly 35 minutes before the top of the hour. In addition, PJM proposes that "[o]nly Regulation-only resources may include all variable operation and maintenance expenses in the mileage offer, as defined in the PJM Manuals."[68] PJM states that this change is reasonable because most generation resources include variable operation and maintenance expenses in their energy market offers, and therefore, they exclude the same costs in their Regulation offers to avoid double recovery.[69]

32. Second, PJM proposes to rename the "performance offer" as the "mileage offer" to allow the mileage offer to better reflect the service that is actually being offered—the MW range of Regulation being offered at the $/ΔMW.[70] In addition, PJM proposes two

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[65] *Id.* at 27.

[66] *Id.* at 20. *See* Phase 1 proposed Operating Agreement, Schedule 1, section 1.10, § 1.10.1A(e).

[67] PJM Transmittal at 30; *see also* Phase 1 proposed Operating Agreement, Schedule 1, section 1.10, § 1.10.1A(e).

[68] PJM Transmittal at 30; *see also* Phase 1 proposed Operating Agreement, Schedule 1 section 1.10, § 1.10.1A(e)(ii)(a). According to PJM, a "Regulation-only" resource is a resource that participates *only* in the Regulation market, and does not participate in the energy market, or have any available energy market schedules from which PJM may commit or dispatch the resource. *See* PJM Transmittal at 30, n.53.

[69] PJM Transmittal at 30-31.

[70] *Id.* at 27. PJM states that the mileage offer provides the incremental cost per MW to provide Regulation movement. *Id.* (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(c)).

substantive changes to define how it will adjust a resource's submitted mileage offer.[71] The first change requires PJM to clarify that it will no longer adjust the mileage offer by a unit-specific benefits factor, but will retain the adjustment by the resource's "historical performance score," which is based on a 100-clock hour rolling average of the resource's actual performance score, as described below.[72] The second change will allow PJM to adjust each offer in each 5-minute settlement interval by the same 30-day rolling average of PJM's Regulation signal movement, i.e., "the amount of historically dispatched Regulation (mileage) calculated by [PJM]."[73] PJM states that, in sum, PJM will adjust a resource's mileage offer consistent with (1) how well PJM can reasonably expect the resource to follow the Regulation signal based on its historical performance, and (2) how much Regulation signal movement PJM can reasonably expect for the commitment level based on PJM's historical Regulation mileage needs.[74]

33. Third, PJM proposes to remove the requirement to adjust the capability offer[75] by the "unit-specific benefits factor," as it is no longer appropriate with the elimination of the RegA and RegD signals. However, PJM states that it does not propose to change how it calculates the Regulation market capability-clearing price for each 5-minute settlement interval.[76]

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[71] PJM states that, formulaically it considers a resource's mileage offer as:

$$\text{Adjusted mileage offer} = \frac{(\text{mileage offer (\$/}\Delta\text{MW)} * \text{historic mileage (}\Delta\text{MW/MW))}}{\text{Resource's historic performance score.}}$$ *Id.* at 28.

[72] *Id.* at 27. *See* Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(g).

[73] *See* Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(g). PJM states that the determination of the historical average mileage will be in accordance with the approach PJM will include in the PJM Manuals. PJM Transmittal at 28 n.45.

[74] PJM Transmittal at 28.

[75] *Id.* at 29. The adjusted capability offer = (capability offer ($/MW)) / Resource's historical performance score.

[76] *Id.*; Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(h).

ii. Comments and Protest

34. Dominion supports the Regulation Proposal as a necessary reform, which will position PJM to address the changing resource fleet and to correct a number of inefficiencies identified in the current Regulation market, while adhering to the principles of Order No. 755.[77]

35. The IMM argues that PJM's current Regulation market design is flawed and neither efficient nor competitive and that most of its problems would be resolved with the move to a one product, one signal, one price, one market design.[78] In addition, the IMM states that it supports the proposal to reduce the market period for regulation from 60 to 30 minutes.[79] The IMM also states that it agrees in part and disagrees in part with other components of Phase 1 that are described below. Therefore, the IMM argues that PJM should be encouraged to refile Phase I of its proposal, with modifications, as the end state Regulation market design.

36. Regarding the offer structure, the IMM agrees with PJM's proposal to eliminate variable operation and maintenance expenses from cost-based Regulation offers for resources with energy offers, and further believes that variable operation and maintenance expenses should be eliminated from all Regulation offers, regardless of whether or not the Regulation resource has an energy offer, because variable operation and maintenance expenses cannot be attributed to any specific incremental provision of Regulation or energy output.[80]

iii. PJM's Answer

37. PJM states that the IMM's comments on Phase 1 and concerns regarding Phase 2 do not undermine the fact that PJM's proposal is just and reasonable, and the IMM's preference for certain alternative approaches cannot prevent the Commission from accepting PJM's proposal under section 205 of the FPA.[81] Regarding the IMM's argument that resources providing only Regulation service should not be allowed to include variable operation and maintenance expenses in their Regulation offers, PJM states that resources are not permitted to include these expenses in their capacity offers to

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[77] Dominion Comments at 3.

[78] IMM Protest at 11.

[79] *Id.* at 9.

[80] *Id.* at 10, 17.

[81] *Id.* at 2.

provide capacity, and its energy market rules provide that a cost-based offer to provide energy may include a maintenance adder "to account for variable operation and maintenance expenses."[82] PJM notes that the Commission found this allocation of cost recovery between the two markets to be just and reasonable.[83] PJM states that to the extent a resource does not participate in the energy market and only participates in the Regulation market, it is just and reasonable to allow such a resource to recover variable operation and maintenance expenses through the Regulation market.[84]

iv. IMM's Answer

38. The IMM argues that its Protest is not a matter of preferences.[85] The IMM argues that PJM's arguments about Phase 1 issues do not support or justify the PJM Regulation Proposal, which asks that the Commission accept a design that has not been tested or adequately reviewed.[86] The IMM states that PJM misstates the level of regulation MW offered and cleared under the current and Phase 1 rules.[87]

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[82] PJM Answer at 20, n.84 (citing PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 2 (15.0.0), § 1.1 Permissible Components of Cost-based Offers of Energy (allowing Maintenance Adders to be included in cost-based offers in the energy market); PJM, Intra-PJM Tariffs, Operating Agreement, M-N OA Definitions M-N (22.0.0) ("Maintenance Adder" is "an adder that may be included to account for variable operation and maintenance expenses in a Market Seller's Fuel Cost Policy. The Maintenance Adder is calculated in accordance with the applicable provisions of PJM Manual 15, and may only include expenses incurred as a result of electric production.")).

[83] *Id.* at 20 (citing *PJM Interconnection, L.L.C.*, 158 FERC ¶ 61,133 at P 125 ("We accept PJM's proposal and find reasonable PJM's clarification that its proposal explicitly provides that Schedule 2((j)(iv)) of the PJM Operating Agreement prohibits market participants from including Maintenance Adders as part of any costs that are included in the generation resource's ACR [Avoided Cost Rate].")).

[84] *Id.* at 21.

[85] IMM Answer at 2.

[86] *Id.*

[87] The IMM states that PJM provides an example, which shows that a resource that provides 10 MW of bidirectional regulation, can provide 20 MW of Regulation service. According to the IMM, under the current and Phase 1 rules, the resource in the PJM's example cannot clear for 20 MW of regulation up, cannot clear for 20 MW of regulation down, and cannot clear for both 20 MW up and 20 MW down. The IMM adds that a resource that is only capable of providing 10 MW of bidirectional regulation service

v. Commission Determination

39. We accept as just and reasonable PJM's proposed tariff revisions to: (1) allow market sellers to update their availability to provide Regulation service for each 30-minute interval; and (2) provide that "[o]nly Regulation-only resources may include all variable operation and maintenance expenses in the mileage offer, as defined in the PJM Manuals."[88] We find that a 30-minute interval will better mitigate the disparity between the estimated opportunity cost in the clearing and commitment process and the Regulation market clearing price (and thus actual opportunity costs) observed in real time prices. Enabling PJM to estimate opportunity costs that are calculated both in shorter intervals and closer to the real-time interval will increase the relative accuracy of the opportunity cost calculations. We also find that the proposal provides PJM more timely information about the availability of a market seller's resource, better aligning PJM's 30-minute look-ahead and lost opportunity cost calculations with real-time system conditions.

40. Additionally, as PJM acknowledges, because most generation resources include variable operation and maintenance expenses in their energy market offers, it is reasonable to exclude these expenses from Regulation offers to avoid double cost recovery, with the exception of Regulation offers for Regulation-only resources, which do not have the opportunity to recover these costs through participation in the energy market.[89]

41. We find that PJM's proposed design changes in Phase 1 are just and reasonable because they will give resources stronger incentives to follow PJM's dispatch signals to keep the PJM system in balance. We also find that implementing the Phase 1 changes before the software and other changes necessary to implement the RegUp and RegDown products are in place is reasonable because it will give PJM time to provide adequate implementation experience to market participants to become familiar with the new signal and performance requirements.[90] Further, contrary to the IMM's arguments, we find it just and reasonable to allow Regulation-only resources to include variable operation and maintenance expenses in their Regulation offers. Currently, PJM's tariff allows a maintenance adder to be included in cost-based energy offers to account for variable

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cannot move from 40 to 60 MW in a 5-minute period, or 60 to 40 in a 5-minute period. *Id.* at 4 (citing PJM Transmittal at 6).

[88] *See* Phase 1 proposed Operating Agreement, Schedule 1, section 1.10.1A(e)(ii)(a).

[89] PJM Transmittal at 30.

[90] IMM Answer at 16.

operation and maintenance expenses in a market seller's Fuel Cost Policy.[91] Consistent with the Commission's acceptance of market rules allowing market sellers in PJM to include variable operation and maintenance expenses in their cost-based offers for energy,[92] we find that allowing Regulation-only resources to include all variable operation and maintenance expenses in their mileage offers is reasonable because the Regulation-only resource incurs these expenses and, as PJM explains, a Regulation-only resource "does not participate in the energy market, or have any available energy market schedules from which PJM may commit or dispatch the resource."[93] As such, Regulation-only resources do not have the opportunity to recover these costs through participation in the energy market, in contrast to non-Regulation-only resources.

b. Price Formation

i. Filing

(a) Clearing of Regulation Market

42. PJM explains that its Regulation market uses an hour-ahead market clearing engine to clear the optimal set of resources to provide Regulation, based on what is known at that time, including load, generation, and constraints (i.e., dispatch profile). PJM states that the clearing engine forecasts locational marginal prices (LMPs) to select the set of resources to provide Regulation at least cost.[94] PJM asserts that using the dispatch profile and forecasted LMPs, it determines an estimated opportunity cost for each eligible resource offering into the Regulation market for the hour.[95] PJM explains that the estimated lost opportunity cost is then added to the resource Regulation offers,

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[91] *See* PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 2 (15.0.0), § 1.1. Also, PJM Manuals require Regulation-only resources to include their variable operation and maintenance expenses in their Regulation cost offers. For example, PJM Manual 15 provides that "Energy storage units that participate only in regulation Service shall include all their VOM [variable operation and maintenance] cost increase in VOM adder in Regulation cost offers." *See* PJM Interconnection, L.L.C., *PJM Manual 15: Cost Development Guidelines (Rev. 44)*, § 2.8 (August 1, 2023), https://www.pjm.com/-/media/documents/manuals/m15.ashx.

[92] *See PJM Interconnection L.L.C.*, 183 FERC ¶ 61,024, at P 24 (2023).

[93] PJM Transmittal at 30 n.53.

[94] *Id.* at 25 (citing PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 1.11 – Real-time Dispatch (10.0.0), § 1.11.4(b)).

[95] *Id.*

and the resulting Regulation resource offers are then ordered by ascending total cost. PJM then selects and commits the lowest cost set of resources necessary to provide the Regulation requirement.[96]

43. PJM states that the hour-out forecasting of LMPs to estimate a lost opportunity cost does not represent the dynamic real-time system conditions or LMPs.[97] Consequently, PJM asserts that there is a tradeoff under the current approach of selecting resources to provide Regulation an hour in advance of the real-time operating hour for which the resources are to provide Regulation.[98] Therefore, PJM proposes to switch to a 30-minute look-ahead commitment interval to mitigate the disparity in the resource opportunity cost estimated in the clearing and commitment process.[99] Specifically, PJM proposes to modify Operating Agreement, Schedule 1 section 3.2.2(c) to "commit resources to provide Regulation every 30 minutes, for the clock intervals of the first 30 minutes of an hour and the second 30 minutes of an hour, up to the Regulation Requirement of such Regulation Zone."[100] PJM asserts that evaluating the opportunity cost for smaller periods and closer to the real-time operation interval should increase the relative accuracy of such estimations.[101] PJM also explains that clearing the market twice as often will reduce lost opportunity cost in the Regulation pricing in real time, in addition to better capture resource and system conditions, and will minimize opportunities for out-of-market uplift payments.[102]

(b) Update to Regulation Compensation

44. Under the current Tariff, Regulation is compensated through a two-part payment structure: (1) a capability payment; and (2) a performance payment.[103] PJM explains that

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[96] *Id.*

[97] *Id.*

[98] *Id.*

[99] *Id.* at 26.

[100] *Id.* (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(c)).

[101] *Id.*

[102] *Id.* at 24-25.

[103] *See Id.* at 35. In the instant filing, PJM proposes to change the name for "performance payment" to "mileage payment" and the mileage payment is discussed

the five-minute capability payment compensates resources for making available a MW quantity of Regulation. PJM states that it is not proposing any changes to the capability payment's determination, except to reflect changing the name of "accuracy" score to "performance" score.[104]

45. In the instant filing, the proposed five-minute mileage payment compensates resources for actually providing Regulation. PJM explains that the mileage payment is the product of the resource's cleared Regulation MW multiplied by: (1) the resource's five-minute actual performance score; (2) the mileage Regulation market clearing price divided by 12; and (3) the mileage ratio.[105] PJM states that because it proposes to move the Regulation market to a two-product market construct, it sees no need for any signal conversion to measure performance, or the quantity of movement of a signal type relative to the other (RegA/RegA or RegD/RegA), as the current mileage ratio does.[106] Nonetheless, for the five minute mileage clearing price, PJM proposes to use the performance score and the mileage Regulation market clearing price in the settlement determination, but proposes to update the mileage ratio formula to compensate resources for the actual requested mileage in the commitment period. Specifically, PJM proposes a new mileage ratio that measures the resource's actual mileage in a given five-minute settlement interval against the historical requested mileage for the Regulation dispatch signal.[107] PJM adds that this ratio will account for the fact that, during real-time operations, PJM's Regulation signal may generate more or less mileage than the historical value used to determine the clearing price.[108] PJM explains that the performance payment will continue to reflect both the MW of Regulation provided (i.e., the mileage up or down or both) and how well the resource provided Regulation in the given interval (performance score).[109] Specifically, PJM proposes to define the Mileage Credit in the settlement equation as follows:

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further below.

[104] *Id.* at 35; *see* Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(h). We note that the accuracy score (formerly, performance score) is distinct from the performance payment.

[105] PJM Transmittal at 35-36.

[106] *Id.* at 36.

[107] *Id.*

[108] *Id.*

[109] *Id.* at 37.

Mileage Credit (5-minute) = Reg Assigned MW * 5-minute actual performance score * 5-minute Mileage Ratio * Mileage Clearing Price / 12

Where 5-minute Mileage Ratio = Product Signal Actual 5-minute Mileage / Product Signal Historical Mileage[110]

ii. Comments and Protest

46. The IMM states that it agrees with PJM's proposal to reduce the market period for Regulation from 60 to 30 minutes.[111] However, the IMM disagrees with PJM's proposal to use historical values for performance and mileage to set five-minute prices and then true up settlements based on actual five-minute performance and mileage. The IMM believes that the five-minute prices paid to every resource and presented to the market should reflect actual five-minute performance and mileage and settlement should adjust compensation based on unit specific actual performance.[112] The IMM argues that the objective of five-minute pricing should be to have prices that reflect the marginal offer of the marginal unit. The IMM also states that PJM's proposal to retain the current artificial break out of the components of total price into a "capability clearing price" and a "performance clearing price" should be rejected because arbitrarily breaking the total price/MW into components needlessly complicates and obfuscates the market results.[113]

iii. PJM's Answer

47. PJM states that the IMM does not object to the specific changes to the clearing price and settlement determinations, but rather, the IMM appears to object to the concept of setting clearing prices based on estimated costs of the marginal resource and then compensating resources based on actual performance (based on an adjusted price).[114] PJM argues that the Commission should reject the IMM's comments on the determination of clearing prices as beyond the scope of this proceeding. PJM states that its Regulation market pricing and settlement approach is similar to the energy market,

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[110] PJM also proposes to remove references to the "mileage ratio" in the Market Suspension rules, such that "if the regulation mileage cannot be calculated during a Market Suspension, the mileage will be set to one (1) for the Market Suspension period." *See* Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(k)(ii).

[111] IMM Protest at 10-11.

[112] *Id.* at 11.

[113] *Id.* at 19.

[114] PJM Answer at 21-22.

where LMP is based on the marginal resource's offer to provide energy, and resources are compensated ex post based on how much energy they provide. PJM argues that the IMM provides no reasoning that the current approach is unjust and unreasonable.[115] Further, PJM adds that the IMM's comments are contrary to Order No. 755's requirement that "all RTOs and [independent system operators] . . . institute a two-part payment for frequency [R]egulation and to account for a resource's accuracy in its compensation."[116]

iv. IMM's Answer

48. The IMM states that it agrees that the proposal to reduce the market period for Regulation from 60 to 30 minutes will tend to reduce lost opportunity costs relative to the current market design.[117] However, the IMM argues that moving from a 60-minute commitment interval to a 30-minute commitment interval is part of the Phase 1 proposal and does not require Phase 2.

v. Commission Determination

49. We accept as just and reasonable PJM's proposal to switch to a 30-minute look-ahead commitment interval and the proposed five-minute mileage payment to compensate resources for providing Regulation. As PJM explains, the performance payment will continue to reflect both the MW of Regulation provided (i.e., the mileage up or down or both) and how well the resource provided Regulation in the given interval (performance score).[118] In the Commission Shortage Pricing Order, the Commission found that a five-minute clearing price for Regulation resources is consistent with price setting for PJM's real-time energy and reserves operations.[119] The Commission also found that that PJM's establishment of five-minute optimization of energy and reserves will help reduce after-the-fact compensation, in the form of uplift, to Regulation resources, and enhance price signals that will provide incentives for new innovative resources and technologies to meet PJM's frequency Regulation needs.[120] We also find that PJM's proposed change to use a 30-minute look-ahead would help to mitigate the

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[115] *Id.* at 22.

[116] *Id.* at 22-23 (citing Order No. 755, 137 FERC ¶ 61,064 at P 77).

[117] IMM Answer at 10-11.

[118] PJM Transmittal at 37.

[119] *PJM Interconnection, L.L.C.*, 139 FERC ¶ 61,057, at P 193 (2012) (Shortage Pricing Order).

[120] *See PJM Interconnection, L.L.C.*, 139 FERC ¶ 61,130, at P 58 (2012).

disparity between the opportunity cost estimated in the clearing and commitment process and opportunity cost actually observed in real-time. We further accept as just and reasonable PJM's proposals to remove the benefits factor and to retain a modified mileage ratio in the settlement determination to compensate resources for the actual requested mileage in the commitment period.

50. The IMM argues that PJM's proposed five-minute pricing is unjust and unreasonable because it fails to use actual five-minute performance of the marginal unit and the actual mileage of the Regulation signal to determine prices every five minutes. However, PJM does not propose to change the existing structure of determining prices before actual performance, and then compensating resources after-the-fact based on actual performance, and the IMM's preferred alternative is not required to render PJM's proposal just and reasonable.[121] Moreover, Regulation market pricing is designed to reflect the dispatch signals that Regulation market resources receive. PJM's commitment and dispatch instructions involve a look-ahead element whereby PJM does not know future actual LMP. Thus, the IMM's preferred approach would necessitate a divergence in the price signals being sent to resources at the time of dispatch and the prices used in settlement. Further, the IMM argues that PJM's proposal to retain its existing Regulation compensation payment structure is unjust and unreasonable because it needlessly complicates and obfuscates the market results. Yet, PJM has not revised its compensation payment structure and the IMM has not shown that changes in PJM's proposal renders the existing payment-structure unjust and unreasonable. As PJM notes, these payments mirror its offer structure, a capability payment and a performance payment.[122] Accordingly, the IMM's concerns are outside the scope of this proceeding.

c. Lost Opportunity Cost Calculation

i. Filing

51. PJM states that a primary goal in designing reserve markets (like the Regulation market) is to ensure that resources are indifferent to providing energy or reserves.[123] Thus, PJM asserts that to ensure such indifference, Regulation clearing prices should account for the foregone above-cost revenue (i.e., profit) or increase in costs relative to the energy market associated with providing Regulation and not energy.[124] PJM states

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[121] The changes proposed herein "need not be the only reasonable methodology, or even the most accurate." *See Oxy USA, Inc. v. FERC*, 64 F.3d 679, 692 (D.C. Cir. 1995).

[122] *See* PJM Transmittal at 35.

[123] *Id.* at 37.

[124] In other words, resources should be compensated for their lost opportunity

that the current market rules provide that when PJM dispatches a resource off its current energy assignment so that it can provide Regulation, the resource will follow dispatch and be capable of providing the Regulation needed.[125] PJM asserts that a resource's opportunity cost to provide Regulation "is based generally on the amount of money the resource would have earned in the energy market and what the resource may earn in the Regulation market."[126] However, PJM states that it determined that its current opportunity cost calculation in the Regulation market clearing prices incorporates certain assumptions that tend to result in opportunity costs that differ from what the resource would otherwise earn in the energy market.[127] To ensure resources are properly compensated for providing Regulation instead of energy and have the proper incentive to participate in the Regulation market, PJM proposes several reforms to the lost opportunity cost determinations. Specifically, PJM proposes to: (1) update the resource's energy schedule used to determine lost opportunity costs for online resources; (2) modify the desired MW (also known as "expected output level if had been dispatched in economic merit order") input value to the lost opportunity cost calculation; (3) modify the equation for lost opportunity cost; and (4) adjust the commitment shoulder periods used in the opportunity cost determination for units coming into Regulation or going out of Regulation.[128]

(a) Update to Energy Schedule

52. PJM explains that currently it calculates lost opportunity costs for online and offline resources using the lesser of the available market-based offer (sometimes referred to as a "price-based" offer) or the highest cost-based energy offer from the resource.[129] However, PJM states that for online resources, "when the energy schedule used for the estimated lost opportunity cost evaluation and lost opportunity cost calculation for determining the [five]-minute Regulation clearing prices differs from the energy schedule on which the resource is running to provide energy, the resulting lost opportunity cost

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costs when being committed to provide Regulation. *Id.*

[125] *See* PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1, Sec 3.2 – Market Buyers (60.0.0), § 3.2.2(d).

[126] PJM Transmittal at 38.

[127] *Id.*

[128] *Id.* at 38-39.

[129] *Id.* at 39; *see* PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 3.2 – Market Buyers (60.0.0), §§ 3.2.2(d) and (e).

value will be over- or under-stated."[130] To address this issue, PJM proposes to use the schedule on which the resource is running for energy (i.e., the resource's "Final Offer") to determine an online resource's lost opportunity cost calculation for determining the five-minute Regulation clearing prices.[131] For offline resources that need to be brought online to provide Regulation, PJM states that it will continue to use the lesser of the price-based or cost-based available energy schedule to calculate the estimated lost opportunity costs.[132] PJM asserts that it is reasonable to maintain the current "lesser of" approach as the resource is offline and not currently running on any schedule.[133]

(b) Tracking Ramp-Rate Limited Desired MW at LMP

53. PJM states that a resource's opportunity cost must consider the resource's ability to follow the energy market price signal. The current Regulation market rules consider a "resource's expected output level if it had been dispatched in economic merit order."[134] However, PJM asserts that this approach overstates a resource's lost opportunity cost and does not consider the resource's "ramp rate," (i.e., the speed at which the resource produces additional energy), or whether the resource follows PJM's energy dispatch signal.[135] Thus, to better account for the extent to which a resource foregoes revenues to provide Regulation, PJM proposes to increase the granularity of the "resource's expected output level if it had been dispatched in economic merit order."[136] In other words, PJM proposes to evaluate the resource along its offer curve based on the resource's ramp rate and use the last energy dispatched MW, as determined by PJM's security-constrained

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[130] PJM Transmittal at 39.

[131] *Id.* at 39-40.

[132] PJM states that it intends to detail in Manual 11 the process for determining which schedule PJM will use for determining the lost opportunity cost for offline resources. *Id.* at 40.

[133] PJM states that these offline resources will subsequently be online during the real-time commitment periods and will be priced and settled using the lost opportunity cost calculation methods for online resources. *Id.*

[134] *Id.* at 43; *see* PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 3.2 – Market Buyers (60.0.0), §§ 3.2.2(d) and (e).

[135] PJM Transmittal at 43.

[136] *Id.* (citing PJM. Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 3.2 – Market Buyers (60.0.0), §§ 3.2.2(d) and (e)).

economic dispatch, rather than the resource's actual energy output. Therefore, for resource-specific opportunity costs, PJM proposes to consider a resource's tracking ramp-rate limited expected output level if it had been dispatched for energy in economic merit order.[137]

(c) Applicable LMP and Regulation Set Point

54. In addition to the resource's Final Offer and its tracking ramp-rate limited expected output level, PJM proposes to retain two data points from the current calculation of lost opportunity cost: (1) the LMP "at the generation bus for the regulating resource," and (2) the resource's "Regulation set point."[138] However, given that PJM proposes to use the resource's current energy schedule, PJM proposes that the Regulation set point be determined as "the resource's regulation set point on the energy schedule curve on which the resource is running in the PJM Interchange Energy Market."[139] PJM explains that under the current construct, lost opportunity cost in the Regulation market is the product of two values[140] that do not best convey lost opportunity cost. Therefore, PJM proposes that resource-specific opportunity costs "shall be equal to the area bounded by (i) Locational Marginal Price at the generation bus for the regulating resource, (ii) the resource's Final Offer, (iii) the resource's tracking ramp-rate limited expected output level if it had been dispatched for energy in economic merit order, as further described in the PJM Manuals, and (iv) the resource's regulation set point on the energy schedule curve on which the resource is running in the PJM Interchange Energy Market."[141]

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[137] *Id.* at 43-44; Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, §§ 3.2.2(d) and (e).

[138] PJM Transmittal at 44 (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, §§ 3.2.2(d) and (e)).

[139] *Id.* (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2. § 3.2.2(d)).

[140] These two values include the deviation of the set point of the generation resource and the absolute value of the difference between the expected LMP at the generation bus and the lesser of the available market-based or highest available cost-based energy offer from the generation resource. *See* PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 3.2 – Market Buyers (60.0.0), § 3.2.2(d).

[141] PJM Transmittal at 44-45; Phase 1 proposed Operating Agreement, Schedule 1, section 3.2. §§ 3.2.2(d) and (e).

(d) Resource-Specific Lost Opportunity Cost Credit

55. PJM explains that the current rules credit Regulation resources for lost opportunity costs for "the foregone revenue and increased costs incurred when a resource deviates from its economic output level in preparation for providing regulation service."[142] PJM states that current rules provide that an opportunity cost be determined based on the three five-minute Real-time Settlement Intervals preceding the Regulation commitment and the three five-minute Real-time Settlement Intervals following the commitment.[143] However, PJM explains that "the current 15-minute shoulder periods are a vestige of PJM's prior 'real-time security-constrained economic dispatch software program [which began] sending signals to Regulation resources 15 minutes before the resource [was] scheduled to perform.'"[144] PJM states that since then, it has updated its security-constrained economic dispatch software to use a 10-minute look ahead and begin sending signals to Regulation resources 10 minutes ahead of their commitments. PJM asserts that a 10-minute period for determining lost opportunity cost should be more in line with a Regulation resource's behavior.

56. Further, consistent with the general changes to the lost opportunity cost determination, PJM proposes revisions to Phase 1, section 3.2.2(e) of Schedule 1 of the Operating Agreement to revise the lost opportunity cost calculation for the two Real-time Settlement Intervals before and after its "regulation commitment" to use the resource's "tracking expected ramp-rate limited output" and the resource's "Final Offer, at the megawatt level of the Regulation set point for the resource."[145] As a result, PJM also removes the reference to the "lesser of" the resource's available market-based offer or highest cost based offer.[146]

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[142] PJM Transmittal at 47 (citing *PJM Interconnection, L.L.C.*, 148 FERC ¶ 61,217, at P 2 (2014)).

[143] *Id.*

[144] *Id.* (citing *PJM Interconnection, L.L.C.*, Order No. 825 Compliance Filing of PJM Interconnection, L.L.C., Docket No. ER17-775-000, at 23 (Jan. 11, 2017)).

[145] *Id.* at 47-48.

[146] *Id.* at 48; Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(e).

(e) Regulation Only and Regulation Signal Bias in Settlements

57. PJM states that there are a number of resources that provide Regulation, but do not participate in the energy market (e.g., battery storage resources).[147] PJM adds that because lost opportunity costs are based on the energy market revenues a resource foregoes to follow the Regulation signal, a resource that does not participate in the energy market does not incur any of those lost opportunity costs to provide Regulation. Accordingly, PJM proposes to update the Regulation market rules to state that the opportunity costs of "regulation only resources to provide Regulation are zero."[148] PJM states that this change is for inter-temporal lost opportunity cost and for the settlements lost opportunity cost.[149]

58. PJM states that with the introduction of the Regulation-Up and Regulation-Down signals, a resource providing Regulation in a single direction may provide more or less energy over a given interval than accounted for in the Regulation set point. PJM refers to this discrepancy as "Regulation signal bias."[150] PJM explains that when signal bias occurs, the foregoing lost opportunity cost determination will need to be adjusted to recognize the Regulation signal's operational request for any further adjustments to the resource's energy output compared to where the resource would have been operating economically, absent a Regulation commitment.[151] To adjust lost opportunity cost for signal bias, PJM proposes for settlements in Phase 2 to adjust the fourth data point described above (i.e., the Regulation set point) and the resource's performance.[152]

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[147] PJM Transmittal at 48.

[148] *Id.* (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, §§ 3.2.2(d) and (e)).

[149] *Id.* (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, §§ 3.2.2(d) and (e)).

[150] *Id.* at 49-50. PJM states that its current bidirectional Regulation market was designed to assume PJM's ACE would be zero or close to zero over each hour-long Regulation commitment period, which would result in a Regulation signal bias of zero or close to zero. *Id.*

[151] *Id.* at 50.

[152] *Id.* at 50-51; Phase 2 proposed PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 3.2 – Market Buyers (62.0.0), § 3.2.2(e) (abbreviated as Phase 2 proposed Operating Agreement, Schedule 1, section 3.2).

ii. Comments and Protest

59. The IMM states that it supports PJM's proposal to use the energy schedule on which a resource is dispatched for energy to calculate lost opportunity costs and to reduce the current 15 minute shoulder[153] lost opportunity cost calculation to 10 minutes.[154] The IMM agrees that the ramp rate limited desired MW output should be used in the Regulation uplift calculation (i.e., to calculate lost opportunity costs), to reflect the physical limits of the unit's ability to ramp and to eliminate overpayment for opportunity costs when the payment uses an unachievable MW. However, the IMM believes that lost opportunity cost should be based on differences in desired LMP based MW (ramp limited based on a "shadow dispatch") and the actual output of the unit (not the Regulation set point).[155] The IMM believes that the lost opportunity cost used in the commitment period should be based on the commitment optimization engine's LMP assumed for the whole commitment period with cumulative ramp assumed within that period. The IMM also believes that the shadow dispatch should be used to determine the desired MW over time within the commitment period and reset desired MW equal to Regulation set point at the beginning of every commitment period.[156]

60. The IMM also states that PJM's argument that under Phase 2, the lost opportunity cost will be lower is incorrect because this assumes that if the economic desired MW of the unit is equal to the Regulation set point of a unit providing bilateral regulation service (both up and down Regulation), the lost opportunity cost will be zero.[157]

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[153] The shoulder is the time period in which PJM's real-time security-constrained economic dispatch software program begins sending signals to Regulation resources before the resource is scheduled to perform. PJM Transmittal at 47.

[154] IMM Protest at 9-10.

[155] *Id.*at 16.

[156] The IMM explains that lost opportunity cost calculation should account for discontinuities in the ramp profile of the resource. If the unit could not move past a mill point (ramp discontinuity) during a regulation assignment, it should not be paid a lost opportunity cost based on MW that ignore this reality. The IMM believes that ramp profiles should be included in any shadow dispatch based lost opportunity cost calculation for a resource. *Id.* at 16-17 (citing PJM Transmittal at 58).

[157] *Id.* at 6.

iii. PJM's Answer

61. PJM states that the IMM supports a different approach of tracking ramp rate limited lost opportunity cost determination, but does not allege that PJM's proposed approach is not just and reasonable.[158] PJM states that as discussed in its stakeholder process, under the PJM Regulation Proposal, lost opportunity cost would account for discontinuities in a resource's ramp profile (e.g., steps) and a resource's ramp profile would be an input into its ramp rate limited lost opportunity cost determination.[159] Further, PJM adds that under its proposed approach, it would continuously track a resource's ramp rate limited lost opportunity cost such that it would "incorporate consecutive market conditions to create the profile that units should have achieved if they had been following each dispatch signal based on their ramp rates."[160] PJM believes that this approach will encourage a resource to follow energy dispatch signals so that the resource is not over- or undervalued in PJM's Regulation commitment process and is properly compensated for providing Regulation.[161]

iv. Commission Determination

62. We accept as just and reasonable PJM's proposed changes to the lost opportunity cost calculation for Regulation resources. PJM's proposal revises certain components related to lost opportunity cost used in the calculation of Regulation clearing prices to ensure that resources are properly compensated for providing Regulation service. These provisions add a significant degree of granularity when PJM goes to determine the lost opportunity cost. First, we agree with PJM that reducing the look-ahead window for forecasting LMPs to estimate lost opportunity cost to 30 minutes before the commitment interval should result in more accurate opportunity cost evaluations because it forecasts LMPs over shorter periods and closer to the real-time operation interval.[162] We find that using the schedule on which an online resource is committed to provide energy for the lost opportunity cost calculation will allow PJM to properly reflect the real-time

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[158] PJM Answer at 17.

[159] *Id.* at 17-18 (citing PJM Interconnection, L.L.C., Real-Time Market Operations, *PJM Proposed Package*, at 21 (Apr. 18, 2023), https://www.pjm.com/-/media/committees-groups/task-forces/rmdstf/2023/20230418/20230418-item-04---pjm-proposed-package-summary.ashx ("April 2023 Presentation")).

[160] *Id.* at 18 (quoting April 2023 Presentation at 22).

[161] *Id.* at 19.

[162] PJM Transmittal at 26; proposed Operating Agreement, Schedule 1 section 3.2.2(c).

opportunity cost of providing Regulation and will align the incremental costs of Regulation and energy to ensure a least-cost solution.[163] Further, when PJM calculates the opportunity cost associated with providing Regulation, PJM will consider the energy market MW the Regulation resource would have produced if it had been economically dispatched based on (1) its ramp rate and (2) the last MW cleared and dispatched in the energy market, as determined by PJM's security-constrained economic dispatch. We find that this proposal accounts for a Regulation resource's foregone revenues to provide Regulation and will ensure that the determination of opportunity cost incorporates the resource's ability to follow the energy market signal (i.e., the ramp rate). Otherwise, and without a means of accounting for the resource's ramp rate, a resource's lost opportunity cost could be overstated.[164] Additionally, we find reasonable PJM's proposal that each resource's opportunity cost equal the area bounded by four data points including the Regulation set point determined as "the resource's regulation set point on the energy schedule curve on which the resource is running in the PJM Interchange Energy Market."[165] We find that these revisions are just and reasonable; PJM's proposed changes to the lost opportunity cost calculation will more accurately reflect a resource's lost opportunity cost[166] and will help to encourage units to follow PJM's dispatch signal.

63. The IMM does not contend that PJM's proposal is unjust and unreasonable because it uses the regulation set point of the resource. Instead, the IMM argues that lost opportunity cost should be based on the differences in desired LMP based MW and the actual output of the unit (rather than the regulation set point).[167] We find that PJM's use of the set point is just and reasonable. While the IMM suggests an alternative approach, PJM need only demonstrate that its proposed revisions are just and reasonable, not that its proposal is superior to other proposals or the most just and reasonable approach.[168]

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[163] *See* PJM Transmittal at 42.

[164] *See* Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, §§ 3.2.2(d) and (e).

[165] *See id.*, § 3.2.2(d).

[166] As PJM explains, the two values that it currently uses to calculate lost opportunity cost do not reflect the true lost opportunity cost.

[167] IMM Protest at 16.

[168] *See Cities of Bethany v. FERC*, 727 F.2d 1131, 1136 (D.C. Cir. 1984) (when determining whether a rate was just and reasonable, the Commission properly did not consider "whether a proposed rate schedule is more or less reasonable than alternative rate designs"); *Midcontinent Indep. Sys. Operator, Inc.*, 180 FERC ¶ 61,141, at P 79 (2022) (RTO bears the burden of showing that proposal under FPA section 205 is a just

d. Performance Scoring Enhancement

i. Filing

64. PJM explains that it relies on a resource's historic performance score to determine that resource's adjusted offer, whether to clear that resource, and how much Regulation PJM can reasonably rely on that resource to provide, and PJM determines an interval-specific performance score to determine that resource's compensation for providing Regulation.[169] PJM states that it calculates the performance score as the "average of a delay score, correlation score, and energy score for each ten second interval,"[170] PJM also states that its stakeholders, including the IMM, reviewed and analyzed this current formula and found that it did not accurately reflect resource performance.[171] Specifically, they found that the current calculation can inflate a resource's performance score, which would indicate that a resource is providing more system benefit than the PJM Region is actually receiving.[172] PJM's analysis of a resource's responsive change to the PJM dispatch shows that the correlation and delay components cause the performance score's inflation. Specifically, PJM provided an example that shows that under the current Tariff, a specific resource's accuracy and delay scores were calculated to be over 90%, while the resource's poor performance in following the signal resulted in an energy score of less than 20%.[173] PJM states that the analysis also finds that the energy score more

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and reasonable proposal, but not that is the best or most just and reasonable option); *Petal Gas Storage, LLC v. FERC*, 496 F.3d 695, 703 (D.C. Cir. 2007) ("[The Commission] is not required to choose the best solution, only a reasonable one.").

[169] PJM Transmittal at 51.

[170] PJM explains that the delay score measures the delay in time between PJM sending the Regulation signal and the resource's responsive change in output; the correlation score measures how closely the resource's response correlates to what was requested via the Regulation dispatch signal; and the energy score measures the difference between the energy requested by PJM via the Regulation signal and the energy provided by the resource "while scaling for the number of samples." *Id.* at 51-52 (citing PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 3.2 (60.0.0), § 3.2.2(k)).

[171] *Id.* at 52 (citing PJM Interconnection, L.L.C., *Performance Score Overview*, PJM Interconnection, L.L.C (Sept. 20, 2022), https://pjm.com/-/media/committees-groups/task-forces/rmdstf/2022/20220920/item-04---performance-score-overview.ashx.)

[172] *Id.*

[173] *Id.* at 52-53.

accurately reflects the resource's actual performance and value the resource brings to the system. Accordingly, to evaluate a resource's performance, PJM proposes to drop the accuracy and delay components of the scoring and instead use the energy score.[174]

65. PJM explains that the energy score measures the difference between what the Regulation signal asked of the resource and what the resource actually provided, i.e., the "error" in the resource's performance.[175] PJM adds that under the current formula, the error is determined as "the average of the absolute value of the error for each 10-second sample in the settlement interval, which is determined as the [absolute value of the difference between the resource's response and the signal] divided by the hourly average Regulation signal."[176] PJM asserts that to allow the energy score to better reflect the resource's performance over the interval, it proposes to modify the denominator to also include the Regulation assigned during the interval. According to PJM, "[t]he denominator will equal [the sum of the (half of the interval average Regulation signal) and (half of the assigned Regulation signal for the interval, which is referred to in the market rules as "AREG")]."[177] PJM asserts that the interval average Regulation signal and the assigned Regulation signal will be equally weighted in the performance evaluation and as such, the modified formula will better reflect resource performance independent of the magnitude of the Regulation assignment, and provide a more accurate measure of a resource's Regulation performance.[178]

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[174] *Id.* at 53-54.

[175] *Id.* at 54.

[176] *Id.* at 54; *see* PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 3.2 (60.0.0), § 3.2.2(j).

[177] PJM Transmittal at 54. The proposed performance score is as follows:

$$\text{Performance Score} = 1 - \frac{1}{n}\sum Abs(Error);$$

$$\text{Error} = \text{Avg of abs}\left(\frac{Abs(Response - Regulation\ Signal)}{(0.5 * Interval\ Average\ Regulation\ Signal + 0.5 * AREG)}\right); \text{ and}$$

n = the number of samples in the interval; AREG = assigned Regulation megawatt.

See id.; Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(j).

[178] PJM proposes to make all these changes effective in Phase 1. In the Phase 2 set of changes, PJM proposes to specify that performance scores will be separately determined for "Regulation-Down Service and Regulation-Up Service." PJM

66. In addition, PJM states that because Regulation provides a reliability benefit of keeping the system in balance, it is important that PJM procures Regulation from resources that it can rely upon to provide it.[179] Therefore, PJM avers that it includes a historical performance score in its evaluation of Regulation offers.[180] PJM proposes to codify in its Tariff certain practices that are currently provided in its Manuals. Specifically, PJM proposes to base Regulation resources' historical accuracy performance score on a 100 clock-hour rolling average of providing Regulation service as defined in the PJM Manuals.[181] PJM also proposes a minimum historical performance score requirement of 40%, and resources with historical scores below that level will be ineligible to provide Regulation "until they are able to requalify, as defined in the PJM Manuals."[182] Further, PJM proposes that Regulation resources "that have a Real-time Settlement Interval performance score below 25% will be ineligible for Regulation credits for that Real-time Settlement Interval."[183] PJM asserts that this 25% threshold is a longstanding practice in PJM's Regulation market that was implemented with the design reforms for Order No. 755 and currently provided in the PJM Manuals.[184]

Transmittal at 56 (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(j); Phase 2 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(j))).

[179] PJM Transmittal at 57.

[180] *Id.*

[181] *Id.* at 57, n.110 (citing PJM Manual 12, § 4.4.5 "[f]or new resources without 100 hours of operating history, PJM uses the resource's qualification test scores as a proxy for historical performance").

[182] *Id.* at 57 & n.111 (citing PJM Interconnection, L.L.C., *PJM Manual 12: Balancing Operations (Rev. 51)*, PJM Interconnection, L.L.C., § 4.4.5 (Dec. 20, 2023), https://www.pjm.com/-/media/documents/manuals/m12.ashx ("When the historical performance score falls below 40 percent by signal type, PJM will notify the resource owner and the resource will no longer be eligible to offer into the regulation market for the applicable signal type.")).

[183] *Id.* at 58 (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(j)).

[184] *Id.* at 58 (citing PJM Manual 11 at section 3.2.10 ("A resource whose performance score for the Real-time Settlement Interval that is below 25% will forfeit regulation credit and lost opportunity for that interval.")).

ii. Comments and Protest

67. In its supporting comments, Dominion states that the current approach to performance scoring may not accurately reflect the resource's actual performance and may reflect that the resource is providing more system benefit than it is. Dominion adds that the new market design proposes to remove the delay and correlation score and just use the energy score to determine resource performance, which will provide a more accurate and straightforward means to measure unit performance.[185]

68. The IMM agrees with PJM that the current performance score needs to be modified, but disagrees with PJM's proposed solution to the problem.[186] The IMM argues that PJM's proposed change to the performance score (based on the average regulation signal MW during the entire clearing interval) would unnecessarily alter the precision score of a resource based on the clearing interval behavior of the regulation signal and, as a result, would not reflect the actual regulation provided by the resource.[187] The IMM states that the delay and correlation components of the performance score do not accurately reflect how well a resource is responding to the regulation signal and that, for example, during Winter Storm Elliott, several resources were not able to maintain their response to the regulation signal.[188] To address this issue, the IMM proposes to evaluate regulation performance using a precision based performance score that depends on the difference between the regulation signal and the resource's response to that signal.[189] The IMM states that it presented this recommendation to the PJM regulation market senior task force. Under the IMM proposed solution, the total performance score for the clearing interval is the average of each 10 second performance score.[190]

69. The IMM states that PJM's proposed solution evaluates the 10 second error in a unit's output based on the average regulation signal MW during the entire clearing interval.[191] According to the IMM, this solution has the effect of scaling each 10 second

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[185] Dominion Comments at 3.

[186] IMM Protest at 12.

[187] *Id.*

[188] *Id.* at 13.

[189] The IMM proposes the following formula for the precision based performance score: Performance $Score_{10sec}$ = 1- ABS (RegOutputMW – SignalMW / AReg). *Id.*

[190] *Id.*

[191] *Id.* at 12.

performance score based on the clearing interval average of the overall regulation signal. The IMM recommends that PJM's current performance score calculations be changed to only include PJM's current calculation of the precision score,[192] and that PJM's proposal to change the precision score should be rejected.[193]

70. Additionally, the IMM agrees with PJM's proposal that resources "'that have a Real-time Settlement Interval performance score below 25% will be ineligible for Regulation credits for that Real-time Settlement Interval,'" but believes that resources that score lower than 25% should be ineligible to set five-minute regulation prices, which the IMM states is only relevant if actual, rather than historical, performance scores are used to set price.[194] The IMM also recommends that to prevent gaming, a penalty should be enforced in the regulation market by either reducing the resource's "performance score and/or revenues should be forfeited when resource owners elect to deassign assigned regulation resources within the hour."[195]

iii. PJM's Answer

71. PJM responds that while the IMM objects to using the magnitude of Regulation assigned in the denominator of performance score equation, the IMM fails to articulate how PJM's proposed changes to calculate the performance score are not just and reasonable—as would be necessary for the Commission to reject PJM's filing.[196] PJM adds that while the IMM's argument that PJM's "calculation would lead to different results, based solely on the overall clearing interval average of the regulation signal; identical unit performance would yield different performance score results"[197] is true, the IMM overlooks that, by including the Regulation assigned during the interval in the denominator, the performance score will better reflect the resource's performance over the interval—and the relative value of that performance to the system. PJM explains that its proposal to include both the signal requested and the magnitude (in MW) of the

[192] The IMM states that the current Regulation clearing interval is one hour. PJM's proposed change is to move to a 30-minute clearing interval.

[193] *Id.* at 15.

[194] *Id.* (citing PJM Transmittal at 58).

[195] IMM Protest at 15-16.

[196] PJM Answer at 16.

[197] *Id.* (citing IMM Protest at 12-14).

Regulation the resource is assigned in the denominator will allow the performance score to provide a more accurate measure of a resource's Regulation performance.[198]

iv. Commission Determination

72. We find PJM's proposed method to evaluate a resource's performance to be just and reasonable. We find that the proposal will allow PJM to reflect in Regulation offers the amount of Regulation MW that PJM can reasonably rely on that resource to provide. We further find that PJM's proposal will allow PJM to more accurately compensate resources for providing Regulation service. As PJM explains, its analysis demonstrates that the energy score accurately reflects the resource's actual performance and value to the system.[199] As such, we find that PJM's proposal to eliminate the correlation and delay components of a resource's historical performance score and rely solely on a resource's energy score is just and reasonable. We also find just and reasonable the proposed revisions under which Regulation resources "that have a Real-time Settlement Interval performance score below 25% will be ineligible for Regulation credits for that Real-time Settlement Interval"[200] because such resources have not followed the Regulation signal with sufficient accuracy to merit compensation for that interval.[201]

73. The IMM argues that the proposed change to the performance score calculation would not reflect the actual regulation provided by the resource. As PJM explains, however, under its current Regulation market construct, it calculates the performance score as the "average of a delay score, correlation score, and energy score for each ten second interval."[202] Additionally, PJM proposes to modify the denominator of the performance equation to also include the Regulation assigned during the interval.[203] We find that by including both the Regulation signal requested MW and the Regulation MW

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[198] *Id.*

[199] PJM Transmittal at 53-54.

[200] *See* Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(j).

[201] PJM notes that this 25% threshold performance score is a longstanding practice in PJM's Regulation market that was implemented via Business Practice Manual with the design reforms for Order No. 755. PJM Transmittal at 58 (citing Manual 11 at section 3.2.10 ("A resource whose performance score for the Real-time Settlement Interval that is below 25% will forfeit regulation credit and lost opportunity for that interval.")).

[202] PJM Transmittal at 51-52 (citing PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1, Sec 3.2 (60.0.0), § 3.2.2(k)).

[203] PJM Transmittal at 54.

assigned during the interval in the denominator, the performance score will better reflect the resource's performance over the interval.

74. We also find PJM's proposed modifications to the current energy score formula to be just and reasonable. Specifically, we find that the changes to the energy score formula will better measure the instantaneous error between the Regulation signal and the resource's response. As PJM asserts, the modified formula will better reflect resource performance independent of the magnitude of the Regulation assignment and provide a more accurate measure of a resource's Regulation performance.[204] Moreover, while the IMM contends that alternative approaches to the calculation of performance score and Real-time Settlement Interval performance score will result in a more accurate performance score, PJM only need propose a just and reasonable approach, and the IMM has not shown that PJM's Regulation Proposal is unjust and unreasonable.[205]

75. Regarding the IMM's contention that resources with performance scores below 25% should also be ineligible to set Regulation prices, we note that PJM has not proposed to change its rules for eligibility to set Regulation prices. Similarly, PJM has not proposed to enforce a penalty in the Regulation market, as the IMM argues that PJM should do. We find that such further revisions to the PJM's Regulation Proposal are beyond the scope of the proposed revisions.

[204] PJM proposes to make all these changes effective in Phase 1. In the Phase 2 set of changes, PJM proposes to specify that performance scores will be separately determined for "Regulation-Down Service and Regulation-Up Service." *Id.* at 56 (citing Phase 1 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(j); Phase 2 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(j))).

[205] While there are different methods for calculating performance score, we find that PJM's approach is not unjust and unreasonable. *See Entergy Ark., LLC v. FERC*, 40 F.4th 689, 701 (D.C. Cir. 2022) ("Rather, at bottom, Petitioners simply argue that, in its view, a better method exists. 'But FERC is not required to choose the best solution, only a reasonable one.'") (quoting *Petal Gas Storage, LLC v. FERC*, 496 F.3d 695, 703 (D.C. Cir. 2007).

2. Tariff Changes Proposed in Phase 2

a. Filing

76. Under Phase 2,[206] PJM proposes to bifurcate the single Regulation product into the Regulation-Up and Regulation-Down products to provide additional operational flexibility and allow PJM dispatch to define the up-ramping and down-ramping needs of the bulk power system.[207] PJM asserts that it will use both up-ramping and down-ramping Regulation products simultaneously to maintain and balance frequency.[208] PJM asserts that these products will allow it to procure the resources needed to increase or decrease generation and balance the PJM system.[209] PJM explains that the Regulation Proposal allows operational flexibility in different requirements for Regulation-Up and Regulation-Down to better align with system needs through the energy transition. For example, PJM states that the system may need more Regulation ramping capability in one direction (e.g., Regulation-Down). In this instance, the Regulation market will be able to procure that capability without having to also (over) procure the capability in the other direction (e.g., Regulation-Up).[210]

77. PJM proposes separate definitions for a Regulation-Up Requirement and a Regulation-Down Requirement.[211] PJM proposes to replace the new defined term "Regulation Requirement" (that was added in Phase 1) with "Regulation-Up

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[206] *See* Phase 2 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2; *id.*, OA Schedule 1 Sec 1.10, OA Schedule 1 Sec 1.10 - Scheduling (48.0.0), § 1.10.1A Day-ahead and Real-time Energy Market Scheduling (abbreviated as Phase 2 proposed Operating Agreement, Schedule 1, section 1.10).

[207] PJM Transmittal at 17.

[208] Specifically, PJM explains that up-ramping Regulation will address short-term reliability scenarios such as increased load, slow moving generation, fluctuation of intermittent resources (e.g., cloud cover or decreased wind) and fast response to system contingencies. Down-ramping Regulation will manage such events as increased intermittent output (increased wind or solar), decreases in load, or increased generation. *Id.* 17-18.

[209] *Id.* at 18.

[210] *Id.* at 21.

[211] *Id.*

Requirement"[212] and "Regulation-Down Requirement."[213] PJM also adds definitions for the new Regulation-Up Service[214] and Regulation-Down Service.[215] PJM explains that these services require a resource to either increase or decrease its output at a specified set point. PJM defines a Regulation set point as "the MW point at which the resource is operating for the energy market (or current load point for a demand resource) and is the focal MW value for defining a resource's 'Regulation range.'"[216] Thus, PJM explains that when a resource increases output from the set point, it provides Regulation in the "upward" portion of its Regulation range, and when it decreases output from the set point, it provides Regulation in the "downward" portion.[217]

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[212] Proposed "Regulation-Up Requirement" is defined as the "required megawatts of performance-adjusted Regulation-Up Service capability to be maintained in a Regulation Zone," and is "a set megawatt value by hour in accordance with the PJM Manuals," which "can increase to account for additional operational uncertainty." *See* Phase 2 Proposed PJM, Intra-PJM Tariffs, OATT Definitions – R - S, § (37.0.0) (Regulation-Up Requirement).

[213] Proposed "Regulation-Down Requirement" is defined as "the required megawatts of performance-adjusted Regulation-Down Service capability to be maintained in a Regulation Zone" and is "a set megawatt value by hour in accordance with the PJM Manuals," which "can increase to account for additional operational uncertainty." *See* Phase 2 Proposed PJM, Intra-PJM Tariffs, Operating Agreement, Q-R, OA Definitions Q-R (19.0.0) (Regulation-Down Requirement).

[214] Specifically, PJM proposes to define Regulation-Up Service as "the capability of a specific generation resource or Demand Resource with appropriate telecommunications and response capability to increase and decrease its output in the upward range from a set point or adjust load in response to a regulating-up control signal, in accordance with the specification in the PJM Manuals." PJM Transmittal at 22 (citing Phase 2 Proposed PJM, Intra-PJM Tariffs, OATT Definitions – R - S (37.0.0) (Regulation-Up Service)).

[215] PJM states that the definition of "Regulation-Down Service" is similar but requires the resource to "increase and decrease its output in the *downward* range from a set point or adjust load in response to a regulating-down control signal." *Id.* (citing Phase 2 proposed PJM, Intra-PJM Tariffs, Operating Agreement, OA Q-R, Definitions Q-R (19.0.0) (Regulation-Down Service) (emphasis added)).

[216] *Id.*

[217] *Id.*

78. PJM also proposes revisions to the market rules governing the submission of offers in Operating Agreement, Schedule 1, sections 3.2.2 (a), (c), (e), (g), (h), and (j) to transition to the Regulation-Down Service and Regulation-Up Service in PJM's existing market rules for Regulation service.[218] PJM also proposes revisions to the offer price caps in Operating Agreement, Schedule 1, section 3.2.2A.1(a) to clarify that "[t]he Regulation three-pivotal supplier test will be conducted separately for Regulation-Down Service and Regulation-Up Service in the same Regulation market clearing interval."[219]

79. In addition, PJM proposes to update the Operating Agreement, section 1.10.1A(e) to distinguish between the two types of Regulation services and offers.[220] Under the current Regulation market rules, a participant-submitted offer to provide Regulation cannot exceed $100/MW-hour.[221] PJM explains that considering the unidirectional nature of RegUp and RegDown and that each generally represents half of a bidirectional offer, PJM proposes to halve the offer cap to $50/MW-hour and clarify the language that the cap applies to the "applicable Regulation service" offer, whether RegUp or RegDown, "independently."[222]

80. PJM also proposes to clarify that both RegUp and RegDown services may include: (1) in the mileage offer component consisting of "costs associated with movement of the Regulation resource incurred from the provision"[223] and (2) a cost adder of $6/MW of Regulation that can be added to the capability offer.[224] PJM states that the $6/MW cost

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[218] *Id.*

[219] *Id.*; Phase 2 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2A.1(a).

[220] PJM Transmittal at 31; *see* Phase 2 proposed Operating Agreement, Schedule 1, section 1.10, § 1.10.1A(e).

[221] PJM Transmittal at 31 (citing PJM, Intra-PJM Tariffs, Operating Agreement, OA Schedule 1 Sec 1.10 – Scheduling (46.0.0),§ 1.10.1A(e) ("The total of the performance offer multiplied by the historical average mileage used in the market clearing plus the capability offer shall not exceed $100/megawatt-hour.")).

[222] *Id.* at 31; Phase 2 proposed Operating Agreement, Schedule 1, section 1.10, § 1.10.1A(e).

[223] Phase 2 proposed Operating Agreement, Schedule 1, section 1.10, § 1.10.1A(e)(ii).

[224] *Id.*, § 1.10.1A(e)(iii).

adder is half of the currently permitted $12/MW cost adder, and that such halving reflects the change from a single bidirectional service to two unidirectional services.[225]

81. Under Schedule 3 of the current Tariff, the Regulation range for any resource committed to provide Regulation is at least twice the amount of Regulation assigned.[226] PJM states that under this requirement, if a resource's Regulation range is 100 MW (i.e., the difference between the resource's Regulation high limit and low limit), its Regulation assignment may range between zero and offered MW but will be capped at 50 MW.[227] PJM states that because it proposes to switch the Regulation market to two unidirectional products, the requirement that the Regulation range of a resource be double the amount assigned is not needed. PJM, therefore, proposes to revise Tariff, Schedule 3 to provide that the "Regulation megawatt range to a resource providing Regulation-Up Service shall be less than or equal to, and within the Regulation range specified."[228] PJM asserts that such change provides additional flexibility for resources to have available Regulation capability and to increase the number of units available to bid which helps both maintain reliability and can increase competition and lower costs to customers.[229] For Regulation-Down Services, PJM proposes that the amount assigned must be "less than or equal to, and within the Regulation range specified" in the market participant's offer.[230]

82. In addition, PJM proposes to update the cost-based offer rules to specify that "the fuel cost increase due to the steady-state heat rate increase resulting from operating the

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[225] PJM Transmittal at 32.

[226] *Id.* PJM explains that under the current Tariff, Schedule 3, for any resource committed to provide Regulation, "[t]he Regulation range of a resource [i.e., the operating band specified by the resource owner where a resource can reliably provide Regulation service, and limits the amount of Regulation MW a resource can be assigned] shall be at least twice the amount of Regulation assigned." *Id.*; PJM, Intra-PJM Tariffs, OATT Schedule 3 (5.0.0), § (c).

[227] PJM Transmittal at 32-33.

[228] *Id.* at 33 (citing Phase 2 proposed PJM, Intra-PJM Tariffs, OATT, OATT Schedule 3 (7.0.0), § (c)).

[229] *Id.*

[230] *Id.*; Phase 2 proposed PJM, Intra-PJM Tariffs, OATT, OATT Schedule 3 (7.0.0), § 3(c).

unit at lower megawatt output incurred from the provision of Regulation" only may be included in offers for RegDown service.[231]

b. Comments and Protest

83. Dominion supports the proposal, asserting that consolidating the market to provide a single Regulation signal will eliminate many of the inefficiencies in the current design.[232] Dominion also states that moving to a two product Regulation market will better incent and procure the type of Regulation service needed. Dominion adds that by creating separate RegUp and RegDown products, the new Regulation market design will provide PJM with more accuracy over the type of service it procures and allow more technologies to participate since they can focus more on one product or the other depending on what their design favors. For example, renewable resources will have the opportunity to participate in the new market design since they can offer to curtail their resource to provide the RegDown product, which will minimize "intermittent, out of market renewable curtailment for system balance."[233]

84. The IMM argues that the Commission should reject PJM's proposal because Phase 2 is premature and PJM has not shown that its proposed Phase 2 market design is just and reasonable. The IMM states that important details of how the Phase 2 approach would operate are missing (e.g., PJM's optimization and lost opportunity cost calculations), and, therefore, it is impossible to fully evaluate the proposal.[234] The IMM argues that PJM provides only speculative assertions of benefits, but has not explained how dual offers would be handled in the clearing engine and if and how coupled offers would be allowed (since a unit must clear both RegUp and RegDown), and how they will be dealt with in the clearing process.[235]

85. The IMM argues that contrary to PJM's assertion, a separate RegUp and RegDown signal based market does not increase the regulation efficiency or the amount

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[231] PJM Transmittal at 31-32; Phase 2 proposed Operating Agreement, Schedule 1, section 1.10, § 1.10.1A(e)(i). According to PJM, such limitation is reasonable as the cost is directly associated with unit-specific heat rate degradation, which increases per MW fuel expenses, from operating at lower MW—i.e., moving to a lesser MW associated with the RegDown service. *See* PJM Transmittal at 32.

[232] Dominion Comments at 2-3.

[233] *Id.* at 3.

[234] IMM Protest at 1-2.

[235] *Id.* at 3.

of regulation MW that a regulation resource can provide. The IMM explains that under the Phase 2 market design, a regulation resource can clear and provide RegUp and RegDown service in the same market interval (30-minute market period) and when clearing for both services, the signal that the resource will follow, and the MW of regulation provided, will match what would be provided under the Phase 1 market design.[236]

86. The IMM also argues that there is no basis for PJM to assume that Phase 2 will allow renewable resources to participate in the Regulation market. The IMM states that if renewable resources are not dispatchable in a controlled and predictable way, they cannot provide reliable regulation service.[237]

87. The IMM also questions whether fuel costs associated with operating at a point below economic maximum output is not included in the heat rate curve. The IMM states that if fuel expenses are supposed to capture heat loss for running at anything less than economic maximum then they should be included in the energy offer at any point below economic maximum, not in the regulation offer. The IMM requests that the Commission eliminate "fuel cost increase due to the steady state heat rate increase resulting from operating the unit at lower megawatt output" as a component of regulation cost offers because it should already be part of the energy cost-based offer of a resource.[238] The IMM argues that allowing this cost in the regulation offer constitutes double counting.[239]

c. PJM's Answer

88. PJM answers that, contrary to the IMM's arguments, PJM has supported Phase 2 of the Regulation Proposal as just and reasonable. PJM states that the proposal was vetted through the stakeholder process (in which the IMM actively participated) over a period of 18 months and the Regulation Proposal explains how the Phase 2 market will function with two products.[240] PJM argues that, contrary to the IMM's contentions that PJM's proposal is premature and does not explain how dual offers would be handled, the

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[236] In this instance, a unit that can provide 10 MW of bilateral signal Regulation can provide 10 MW of Regulation up only service, 10 MW of regulation only down service or 10 MW of Regulation up and Regulation down service—not the 20 MW shown in PJM's example at Figure 2, at page 20 of its Transmittal. *Id.* at 3-4.

[237] *Id.* at 7.

[238] *Id.* at 9.

[239] *Id.* at 8-9.

[240] PJM Answer at 4.

lack of software coding is irrelevant to whether the proposed market design is just and reasonable and does not preclude the Commission from evaluating the proposed market rule changes. PJM adds that the Commission often accepts market rule changes well in advance of the software coding needed for implementation.[241] PJM asserts that contrary to the IMM's allegations, its proposal is supported by logic and economic theory, on which the Commission is permitted to rely.[242] PJM also states that two-product regulation market designs have been in place in the SPP, California, and Texas markets for years and these markets have a high proportion of renewables operating and providing regulation to maintain system balance.[243] PJM adds that under Phase 2, resources will only need to have sufficient capability in the direction of the Regulation product they offer to provide in order to participate in the Regulation market.[244]

89. In response to the IMM's contention that the Regulation set point for most resources in Phase 2 will not be their economic minimum or economic maximum,[245] PJM states that regardless of the set point of a Regulation resource, PJM's Regulation proposal will reduce the lost opportunity costs incurred by resources providing Regulation, and in turn, reduce the cost of the Regulation market. PJM reiterates that switching to a 30-minute commitment interval and using a 30-minute look-ahead in committing resources for Regulation would result in a more accurate lost opportunity cost calculation that will increase market efficiencies and reduce cost.[246] Further, PJM finds the IMM's objection to the steady-state heat rate cost increases from Regulation offers beyond the scope of

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[241] *Id.* at 4 (citing *PJM Interconnection, L.L.C.*, 173 FERC ¶ 61,134, at P 225 (2020) (setting the effective date of tariff revisions two years in advance because "the revisions are complex and extensive, requiring software coding and extensive testing and quality assurance performance"); *N.Y. Indep. Sys. Operator, Inc*., 108 FERC ¶ 61,188, at PP 20, 27 (2004) (accepting an extension to tariff revision implementation to account for the "extensive software coding and testing requirements")).

[242] *Id.* at 9 (citing *ISO New England Inc*., 173 FERC ¶ 61,161, at P 78 (2020) ("The Commission regularly accepts filings based on economic theory, assumptions, and projections[.]"); *Sacramento Mun. Util. Dist*., 616 F.3d 520, 531 (D.C. Circ. 2010) (Commission may make findings "based on generic factual predictions derived from economic theory" (citation omitted))).

[243] *Id.*

[244] *Id.* at 13-14.

[245] IMM Protest at 5.

[246] PJM Answer at 9.

this proceeding. PJM states that steady-state heat rate increase is a legitimate cost of providing Regulation service downward from the resource's set point.[247]

d. IMM's Answer

90. The IMM argues that PJM cannot reasonably claim both that Phase 2 will have lower prices and lower compensation for Regulation service than Phase 1 and that there will be more opportunities and incentives for resources that generally cannot provide Regulation bidirectionally to participate in the regulation market under Phase 2.[248] The IMM states that providing Regulation service requires a resource to be able to be dispatched bidirectionally in response to a signal and that a resource that can provide RegUp or RegDown can provide bidirectional Regulation service.[249] The IMM argues that, accordingly, Phase 2 does not create more opportunities or ability for renewable resources to provide Regulation. Additionally, the IMM contends that PJM has not provided an analysis to support its conclusion that its two-product Regulation market designs are similar to those in SPP, CAISO, and ERCOT.[250] The IMM also argues that PJM has not supported its assertions about Phase 2 results by testing or evidence.[251] The IMM contends that Phase 2 will not result in either lower energy or Regulation costs.[252] The IMM argues that PJM cannot assume that resources at economic minimum that are providing RegUp service will not incur a lost opportunity cost.[253] The IMM states that PJM uses "Regulation Signal Bias" to adjust a resource's regulation set point during the commitment period in its proposal to recognize that RegUp services will incur lost opportunity cost. The IMM argues that the actual lost opportunity cost is based on the

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[247] According to PJM, the cost is associated with increased fuel cost from operating at a less efficient point along the resource's energy offer curve then would coincide with LMP and Regulation set point. *Id.* at 12-13.

[248] IMM Answer at 5, 8-9, 11.

[249] *Id.* at 11.

[250] *Id.* at 11-12.

[251] *Id.* at 8.

[252] The IMM reiterates its argument that PJM's assertion of reduced costs for Regulation and reduced energy costs under Phase 2 compared to Phase 1 is based on the unsupported and incorrect assumption of zero lost opportunity cost for resources providing RegUp and RegDown service while at economic minimum and economic maximum. *Id.* at 5, 8-9.

[253] *Id.* at 5-6.

actual output of the unit relative to the economic desired MW of the unit as it provides regulation, not the initial regulation set point used in the market clearing of the Regulation resource.[254] The IMM also reiterates its arguments that Phase 2 is premature.[255]

e. Commission Determination

91. We accept as just and reasonable PJM's Phase 2 proposal to bifurcate the single Regulation product into separate RegUp and RegDown products. We agree with PJM that procuring RegUp and RegDown separately should enhance operational flexibility because it will allow PJM to differentiate certain requirements. Specifically, as PJM describes, PJM's operational need for Regulation-Up capability and Regulation-Down capability may not be the same at all times. PJM's proposal will allow PJM to differentiate such requirements and procure RegUp and RegDown capabilities that are tailored to meet its actual needs, which could reduce the costs of meeting PJM's Regulation needs. Moreover, as described further below, we also find that separate RegUp and RegDown products will allow PJM to realize market efficiencies by allowing resources that may be better suited to only provide either Regulation-Up or Regulation-Down capability to only provide that specific capability, or to reflect their relative costs of providing RegUp and RegDown in separate Regulation-Up and Regulation-Down offers.

92. The IMM asserts that separate RegUp and RegDown signals will not increase the efficiency of the regulation market or the amount of regulation capacity (in MW) that a regulation resource can provide.[256] While it may be true that certain Regulation market resources clear and provide both RegUp and RegDown services, we agree with PJM that not all potential Regulation market resources may be similarly situated to provide both Regulation-Up and Regulation-Down service. For example, as PJM describes, certain variable energy resources may be better suited to provide Regulation-Down service, while certain generation resources operating at economic minimum may be better able to provide Regulation-Up service.[257] Dominion presents similar arguments. We agree that separate Regulation-Up and Regulation-Down products will incent such resources to participate in the Regulation market and, in doing so, increase market efficiency and PJM's operational flexibility by expanding the set of resources that offer into the PJM

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[254] *Id.* at 6-7.

[255] *Id.* at 2-3.

[256] IMM Protest at 3-4.

[257] PJM Transmittal at 17-19.

Regulation market, which should increase competition and lower the costs PJM incurs to meet its Regulation needs.

93. The IMM argues that certain resources that PJM states will have incentives to participate in the PJM Regulation market may not be dispatchable in a controlled and predictable way, and thus cannot provide reliable regulation service.[258] We note that all resources that will be eligible to participate in Phase 2 of the PJM Regulation market (with the separate RegUp and RegDown products) will need to meet PJM's performance testing and Regulation market eligibility criterion, which PJM has not revised in this proposal, and the IMM has not shown that the changes that PJM does propose to the PJM Regulation Market render the existing eligibility criterion unjust and unreasonable. We believe that this eligibility criterion will ensure that only resources able to provide regulation service are eligible to participate.[259] Additionally, regulation market sellers would also be required to maintain a performance score of at least 40% to maintain eligibility.[260] These tests will ensure that resources can perform as expected.

94. We find the IMM's argument that PJM has not demonstrated that its proposal is just and reasonable because certain operational details are missing from the proposal to be unsupported.[261] In contrast to the IMM's concerns, we find that PJM has sufficiently explained the proposed design changes to offer structure, price formation, lost opportunity cost, performance scoring, and compensation, as well as the other corresponding changes to transition from a single Regulation product to a two-product market design. Additionally, PJM explains that both up-ramping and down-ramping Regulation products will be used simultaneously,[262] and explains that, in the Regulation commitment process, its Phase 2 market rules separately identify Regulation capacity on either side of the regulation set point.[263] While the IMM states that Phase 2 of PJM's proposal is unworkable, this conclusion may be premature. PJM based its two product Regulation market design on the design approved for and currently used in SPP and

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[258] IMM Protest at 7; IMM Answer at 11.

[259] See, for example, PJM Manual 11, Section 3.2.1 Regulation Market Eligibility.

[260] Phase 2 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(j).

[261] IMM Protest at 1-2.

[262] PJM Transmittal at 17-18. Phase 2 proposed PJM, Intra-PJM Tariffs, Operating Agreement, Q-R, OA Definitions Q-R § (19.0.0) (Regulation-Down Service and Regulation-Up Service); Phase 2 proposed Operating Agreement, Schedule 1, section 3.2, §§ 3.2.2(a), (c), (e), (g), (h), and (j).

[263] PJM Answer at 5-6.

CAISO.[264] As PJM states, each of these systems have among the highest proportion of variable energy resources and have capably managed their system using separate "regulation up" and "regulation down" products.[265] Similarly, PJM's proposed tariff is clear that resources can submit offers to sell both RegUp and RegDown service,[266] and PJM will select offers for each service in merit order to minimize cost.[267]

95. We also disagree with assertions that we should reject the proposal because PJM has only provided speculative assertions of benefits and has not provided data to show those benefits.[268] PJM need only demonstrate that its proposed revisions are just and reasonable, not that is proposal is the most just and reasonable among all possible alternatives.[269] As we find here that PJM's proposal is just and reasonable, PJM has no obligation to show that its proposal is superior to or provides benefits beyond its existing tariff.[270] Further, as described above, PJM provided arguments rooted in economic

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[264] *See* CAISO Order, 140 FERC ¶ 61,206 at PP, 7, 72; SPP Order, 147 FERC ¶ 61,211 at P 8.

[265] PJM Transmittal at 15.

[266] Phase 2 proposed Operating Agreement, Schedule 1, section 1.10, § 1.10.1A(e).

[267] Phase 2 proposed Operating Agreement, Schedule 1, section 3.2, § 3.2.2(c).

[268] IMM Protest at 3.

[269] *See, e.g.*, *OXY USA v. FERC*, 64 F.3d at 692 (finding that under the FPA, as long as the Commission finds a methodology to be just and reasonable, that methodology "need not be the only reasonable methodology, or even the most accurate one"); *Cities of Bethany v. FERC*, 727 F.2d 1131, 1136 (D.C. Cir. 1984) (when determining whether a rate was just and reasonable, the Commission properly did not consider "whether a proposed rate schedule is more or less reasonable than alternative rate designs"); *Midcontinent Indep. Sys. Operator, Inc.*, 180 FERC ¶ 61,141, at P 79 (2022) (RTO bears the burden of showing that proposal under FPA section 205 is a just and reasonable proposal, but not that is the best or most just and reasonable option); *Petal Gas Storage, LLC v. FERC*, 496 F.3d 695, 703 (D.C. Cir. 2007) ("[The Commission] is not required to choose the best solution, only a reasonable one.").

[270] *PJM Interconnection, L.L.C.*, 155 FERC ¶ 61,157, at P 30 (2016) ("[W]hile the Commission is required to consider all relevant factors and make a 'common-sense assessment' that the costs that will be incurred are consistent with the ratepayers' overall needs and interests, the Commission's finding need not be accompanied by a quantitative

theory that support the economic and operational efficiency benefits of its proposal, and it need not provide a detailed cost-benefit analysis to adequately support its proposal as just and reasonable.[271] Regarding the IMM's contention that PJM has not provided an analysis to support its conclusion that its two-product Regulation market designs are similar to those in SPP, CAISO, and ERCOT, we find PJM's proposal does not differ significantly from the other RTOs with two Regulation products.[272]

96. Finally, in response to IMM concerns about the inclusion of fuel expenses associated with operating at a point below economic maximum output in Regulation-Down Service offers,[273] we find PJM's proposal to be just and reasonable. We agree with PJM that, by providing Regulation-Down Service, resources could experience a unit-specific heat rate degradation, which would increase per MW fuel expenses. We find that heat rate degradation is a legitimate opportunity cost that resources could incur by ramping down to provide Regulation-Down Service. While the IMM argues that allowing Regulation market sellers to recover heat rate degradation in their Regulation-Down Service offers will allow for double counting, absent such resources providing Regulation-Down service, certain resources would be operating at more fuel-efficient operating levels. The less efficient output levels associated with providing Regulation-Down service necessitate additional per MW fuel expenses. Thus, in order for Regulation resources to remain indifferent between providing energy and Regulation service, we find that it is just and reasonable to allow resources that experience heat rate degradation to include such expenses in their Regulation-Down Service offers.

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cost-benefit analysis."), *aff'd sub nom. Advanced Energy Mgmt. All. v. FERC*, 860 F.3d 656, 660-61 (D.C. Cir. 2017) (citing *Process Gas Consumers Grp. v. FERC*, 866 F.2d 470, 476-77 (D.C. Cir. 1989)).

[271] *ISO New England*, 184 FERC ¶ 61,082, at P 49 ("a detailed cost-benefit analysis is not required for the Commission to find the Tariff revisions just and reasonable"), *order on reh'g*, 185 FERC ¶ 61,151, at P 24 (2023) (same). *See also S.C. Pub. Serv. Auth. v. FERC*, 762 F.3d 41, 65 (D.C. Cir. 2014) ("So long as a prediction is 'at least likely enough to be within the Commission's authority' and it is based on reasonable economic propositions, the court will uphold it.") (citing *Associated Gas Distributors v. FERC*, 824 F.2d 981, 1008 (D.C. Cir. 1987)).

[272] *See* CAISO Order, 140 FERC ¶ 61,206 at PP, 7, 72; SPP Order, 147 FERC ¶ 61,211.

[273] IMM Protest at 8-9.

The Commission orders:

PJM's filing and proposed tariff records are hereby accepted, to be effective June 16, 2024, October 1, 2025, and October 1, 2026, respectively, as requested, as discussed in the body of this order.

By the Commission.

(S E A L)

Debbie-Anne A. Reese,
Acting Secretary.

Appendix A

Tariff Records Accepted
PJM Interconnection, L.L.C.
FERC FPA Electric Tariff
Intra-PJM Tariffs

Tariff Records Accepted Effective Jun 16, 2024:

OATT ATT K APPX Sec 3, OATT ATTACHMENT K APPENDIX SECTION 3. ACCOUNTING AND BILLING (1.0.0)

Tariff Records Accepted Effective October 1, 2025:

PJM Tariff Sections:
R-S, OATT Definitions – R - S (36.0.0)
OATT SCHEDULE 3, OATT SCHEDULE 3 (6.0.0)
OATT ATT K APPX Sec 1.10, OATT Attachment K Appendix Sec 1.10 - Scheduling (48.0.0)
OATT ATT K Appx Sec 3.2, OATT Attachment K Appendix Sec 3.2 - Market Buyers (61.0.0)

PJM Operating Agreement Sections:
Q-R, OA Definitions Q - R (18.0.0)
OA Schedule 1 Sec 1.10, OA Schedule 1 Sec 1.10 - Scheduling (47.0.0)
OA Schedule 1 Sec 3.2, OA Schedule 1 Sec 3.2 - Market Buyers (61.0.0)

Tariff Records Accepted Effective October 1, 2026:

PJM Tariff Sections:
R-S, OATT Definitions – R - S (37.0.0)
OATT SCHEDULE 3, OATT SCHEDULE 3 (7.0.0)
OATT ATT K APPX Sec 1.10, OATT Attachment K Appendix Sec 1.10 - Scheduling (49.0.0)
OATT ATT K Appx Sec 3.2, OATT Attachment K Appendix Sec 3.2 - Market Buyers (62.0.0)

PJM Operating Agreement Sections:
Q-R, OA Definitions Q - R (19.0.0)
OA Schedule 1 Sec 1.10, OA Schedule 1 Sec 1.10 - Scheduling (48.0.0)
OA Schedule 1 Sec 3.2, OA Schedule 1 Sec 3.2 - Market Buyers (62.0.0)

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