UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

PJM Interconnection, L.L.C.	)	Docket No. ER24-99-000

PROTEST OF THE INDEPENDENT MARKET MONITOR FOR PJM

Pursuant to Rule 211 of the Commission's Rules and Regulations[1] Monitoring Analytics, LLC, acting in its capacity as the Independent Market Monitor ("Market Monitor") for PJM Interconnection, L.L.C. ("PJM"),[2] submits this protest responding to the filing submitted by PJM Interconnection, L.L.C. ("PJM") on October 13, 2023 ("October 13th Filing").

PJM's proposed radical changes to the capacity market design in this docket, and in the related Docket No. ER24-99, are not motivated by any specific market issues. There was nothing in the PJM Board's charge to PJM and its members that required or implied anything like the proposals in this filing. PJM proposes an unsupported and unprecedented paradigm change for the markets and requests expedited treatment by the Commission. The PJM proposed tariff language is unacceptably vague and would leave almost unlimited discretion to PJM to interpret that vague language. That failure to create an implementable or enforceable tariff is enough reason to reject the filings as not just and reasonable. There is no reason to create unnecessary time pressure on stakeholders or the Commission to address the dramatic changes in PJM's filing. PJM's filings should be rejected as not just and reasonable. Regardless of the Commission's treatment of the filing in Docket No. ER24-99,

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1 18 CFR § 385.211 (2023).

2 Capitalized terms used herein and not otherwise defined have the meaning used in the PJM Open Access Transmission Tariff ("OATT"), the PJM Operating Agreement ("OA") or the PJM Reliability Assurance Agreement ("RAA").

the October 13th Filing related to the definition and implementation of MSOCs would permit the exercise of market power and should be rejected because PJM has not shown that its proposed changes to the market rules are just and reasonable.

There is nothing preventing PJM from implementing changes immediately to address defined and identified issues, including improved risk modeling, recognition of winter risk, recognition of correlated outages, and hourly modeling of load and generation resources. PJM could also support the Market Monitor's Complaint filed in Docket No. EL24-12 in order to reduce risk and uncertainty.[3]

One positive result of all the attention paid to reliability is that PJM has begun to reconsider its approach to risk and reliability. PJM has made progress in recognizing that all hours matter and that risk is not confined to a few hours in the summer. PJM does not need to make a Commission filing in order to continue to improve their approach to risk analysis and continue their progress towards a full hourly approach including both load and supply.

There is no reason for PJM's hurry to have the filings approved. The lack of detailed analysis, the lack of clarity, and the unenforceability of key provisions in the filings reflect the fact that they were developed and written in haste and mean that PJM has not shown that its proposed changes to the market rules are just and reasonable. The Market Monitor's Complaint provides the Commission an option to allow more time for PJM and the stakeholders to consider any proposed changes to the capacity market design.[4]

If PJM's proposals are not rejected as deficient on their face, the proposals necessarily require a lengthy process for careful testing, review and consideration. Moving forward with the current RPM auction schedule should not be contemplated except under the current framework as proposed by the Market Monitor pending in Docket No. EL24-12.

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[3] *See* Complaint Requesting Fast Track Processing of the Independent Market Monitor for PJM, Docket No. EL24-12-000 (November 7, 2023).

[4] See *id*.

I. PROTEST

A. PJM's Filings Derive Bad Market Design from Faulty Premises.

PJM's filings (Docket No. ER24-98 and ER94-99) have a common logical structure. The filings start with mistaken premises and then derive bad market design features from those mistaken premises.

PJM assumes that high PAI penalties are essential to good market design. This is despite the overwhelming evidence from Winter Storm Elliott that this is not correct. The high PAI penalties impose risk on generators. This risk is a function of both the draconian level of the penalties and of the fact that PJM has not and cannot administer the rules governing who is liable and who is excused in a logical or supportable way. Those risks must then be reflected in capacity market offers via the risk component of avoidable costs, CPQR. (Docket No. EL24-98.) The calculations of CPQR are complicated in part because they are calculations of the cost to mitigate the risk of high impact, low probability events. PJM concludes that generators with market power have the unique ability to define the correct CPQRs, and not be subject to meaningful review by the Market Monitor, but that PJM can calculate CPQRs. PJM also concludes that CPQRs are a cost solely of being a capacity resource, unrelated to the provision of energy which is the only point of the markets, and therefore gross CPQRs, with no net revenue offset, should define offers and set capacity market prices. In summary, PJM's insistence on retaining extreme PAI penalties leads to PJM rejecting the key principles of capacity market offers and creating the opportunity to exercise market power without meaningful review. This entire exercise is unnecessary and should be rejected because it has not been shown to be just and reasonable.

PJM has created its own unique approach to capacity accreditation based on the general ELCC approach. PJM considers the ELCC derating factors to result in the equivalent of a perfect resource at the derated level. As a result of being a perfect resource, PJM penalizes solar resources for not producing energy in the middle of the night, despite the fact that this is a ludicrous requirement. Because this requirement is clearly not

reasonable, PJM exempts intermittent resources from the must offer requirement, which is a longstanding and core element of the PJM capacity market, so that such resources will not be required to be subject to the unreasonable requirement to produce solar power when the sun is not shining. Because this requirement is clearly not reasonable, PJM also proposes to create a financial market to allow solar resources to buy a hedge against having to pay penalties for not generating in the middle of the night. (See Docket No. EL24-98.) In summary, PJM's insistence on using their ELCC approach leads to PJM imposing unreasonable penalties on intermittent resources which leads PJM to reject the core must offer requirement and to create a financial market to address the unreasonable risk that PJM has created. This entire exercise is unnecessary, PJM has not shown that its proposed changes to the market rules are just and reasonable, and the filings should be rejected as not just and reasonable.

B. PJM Does Not Correct the Capacity Market Failures.

PJM's proposed capacity market reforms do not address the fundamental failures of the capacity market that have become evident during the Winter Storm Elliott.

The incentive/penalty issue is core to all the capacity market design issues considered in the CIFP process. Abstract discussions of incentives and penalties led some to the conclusion that if high prices provide incentives at times, then even higher prices or extreme penalties are even better incentives. One of the lessons of the winter storms Uri and Elliott, in very different market designs, is that extreme prices and penalties do not have the intended incentive effect and do have a destructive effect, in the energy market and in the capacity market. There is no reason to bankrupt generators or force generators into early retirement. There is no reason to bankrupt customers or impose impossible bills on customers. There is no reason to permit the exercise of market power. There is no reason to create lengthy litigation. That is not the basis for a reasonable, sustainable design consistent with investment incentives and customer confidence.

The use of capacity market penalties rather than energy market incentives creates risk. This risk is not risk that is fundamental to the operation of a wholesale power market. This is risk created by the CP design in order, in concept, to provide an incentive to produce

energy during high demand hours that is even higher than the energy market incentive. When that artificial risk is included in capacity market prices, customers pay to cover it.

The goal of incentives is to increase the likelihood that resources will be available to produce energy when called on. Paying resources only when they are available provides an important incentive to perform at all times. Paying resources only when they are available is a long term, predictable incentive for performance. This is a positive performance incentive based on the market price of capacity rather than a penalty.

If units' capacity market revenue depends on investing in making generators more reliable in every hour, the units are more likely to be available at times of high stress. Ongoing capacity market revenue is essential to the economic viability of generating resources in PJM. Linking payment of those revenues to hourly performance is a strong incentive to invest in reliability.

Appropriate and actionable incentives provide strong, consistent, repeated, and predictable incentives for performance through a combination of paying only when resources are available and stronger testing requirements. These elements create a strong incentive to invest in maximum availability, including availability during high stress hours.

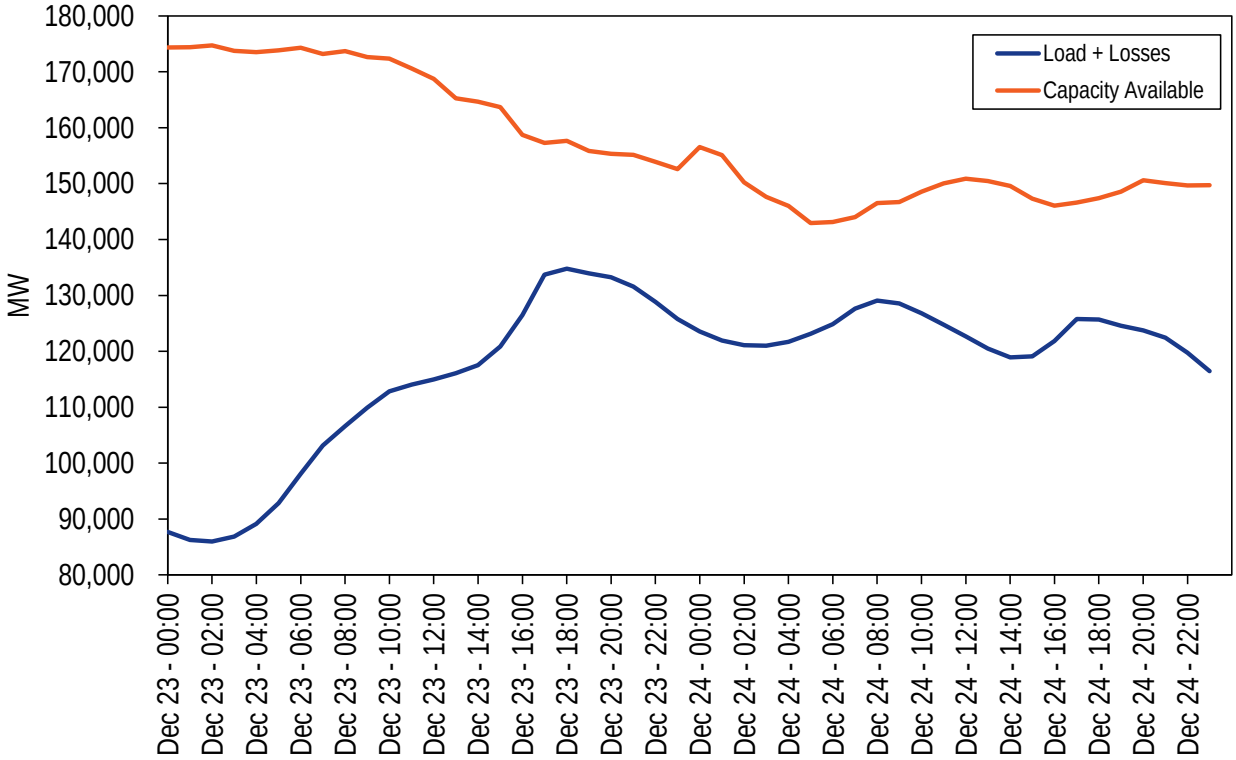
On a routine basis (in the absence of infrequent PAI), the CP model provides no incentives for performance. Units are paid their equal hourly capacity price regardless of performance. The CP approach provides no incentive to perform when markets are tight but there is no defined emergency or PAI. The failure of CP incentives to result in improved unit performance has the perverse effect of increasing the probability of PAI emergencies. The absence of regular, ongoing incentives in the CP approach means less maintenance which results in failures under extreme circumstances.

C. PJM's ELCC Analysis Is Unsupported.

Despite assertions about reliability, PJM's Reserve Reliability Study (RRS) does not actually determine loss of load expectation. That is a feature of all such studies. The RRS simulates whether there is enough capacity to meet the load. The RRS does not simulate commitment and dispatch; it assumes that any MW available are instantly available to meet the demand. The RRS determines the loss of load expectation under the assumption that

PJM operations can commit all the units that it needs to meet the demand. Events like Winter Storm Elliott are not captured by the RRS. During Winter Storm Elliott, PJM had more than enough capacity to meet the demand, but the capacity was not used to meet the demand because it was not committed in time. Figure 1 compares the capacity available as submitted by market participants and the load plus losses in PJM during Winter Storm Elliott.

Figure 1 Capacity available versus load during Winter Storm Elliott



This is not a criticism of PJM operations. PJM operations committed units based on the available information. Forecasts changed and generators failed.

PJM has made and is making significant improvements in its reliability analysis. But the related efforts to define the reliability contribution of individual units that should be paid for in the capacity market are not complete nor ready for implementation. Unlike security constrained economic dispatch (SCED), PJM's seasonal ELCC analysis has not been reviewed in detail by anyone but PJM, to the best of the Market Monitor's information. Given the identified issues, PJM has not shown that its proposed changes to the market

rules related to the capacity value of resources (PJM's ELCC analysis) are just and reasonable.

1. ELCC Based Accreditations Depend on the Accuracy of the Outage Reporting Inputs That Have Not Been Properly Reviewed and Corrected.

The results of PJM's Reserve Reliability Study (RRS) depend on the quality of the input data. For decades, PJM has relied on generator data submitted in eGADS for its reliability analysis. The data in eGADS has been sufficient to do analysis based on EFORd. However, the data in eGADS is not adequate for the hourly analysis of the type that PJM has begun to perform.

PJM's current outage reporting data quality is not sufficient to support the changes PJM proposes to make to capacity accreditation, the definition of the MW value of assets in the capacity market. After Winter Storm Elliott, the Market Monitor noticed significant discrepancies between the availability data submitted in the energy market, the outages reported in eDART and the outages reported in eGADS. On January 26, 2023, the Market Monitor posted a market notice recommending Market Participants ensure that the outages reported in Markets Gateway (i.e. availability in the energy market), in eDART and in eGADS were correct.[5] The result of this communication alone resulted in additional records and updates to existing records in eDART and eGADS:[6] Nearly 300 new tickets totaling more than 21,000 MW of reductions (spread over the period) have been added to eDART; Over 100 existing tickets totaling more than 14,000 MW of reductions (spread over the period) have been updated in eDART; Over 250 GADS event records have been added or modified.

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[5] *See* Monitoring Analytics Outage Reporting during Winter Storm Elliott market notice to PJM Market Participants on January 26, 2023. http://www.monitoringanalytics.com/reports/Market_Messages/Messages/IMM_Outage_Reporting_During_Winter_Storm_Elliot_20210126.pdf.

[6] *See* PJM's presentation "Winter Storm Elliott Generator Performance," on February 9, 2023 <https://pjm.com/-/media/committees-groups/committees/oc/2023/20230209/20230209-item-04---winter-storm-elliott-generator-performance.ashx>.

The quality of PJM's outage data, especially during the high demand periods that determine ELCC values, must be carefully analyzed for accuracy and consistency. It has not been. If the same issues found during Winter Storm Elliott, occurred also during all other emergency situations, PJM ELCC analysis will result in inaccurate accreditation. That is because the ELCC accreditation analysis is significantly affected by the outages reported during high demand periods instead of the average of the year as it is today. Without that analysis, PJM has not shown that its proposed changes to the market rules are just and reasonable.

2. ELCC Based Accreditations are Inaccurate since Summer Derates are based on Unverified Data and Winter Uprates are Omitted.

The data in eGADS does not appropriately reflect ambient derates or uprates that have a significant impact on the availability of energy on an hourly basis and that therefore should be incorporated explicitly in the ELCC analysis.

As a result of the fact that eGADS does not include ambient adjusted data, PJM had to rely on a different outage reporting tool (eDART) for data on ambient derates. Generators are not required to report ambient derates, although many do. But even when reported, the derates are only the highest expected derate for the day and are not hourly. Outages in eDART are submitted with a start and end and PJM recommends submitting the worst ambient derate for the day. Derates typically occur in the summer as a result of higher temperatures while uprates typically occur in the winter as a result of colder temperatures.

This approach was workable in an environment with only thermal resources and the highest expected derate coincided with potential shortage hours in the summer. But the purpose of an hourly analysis is to address the availability of resources in an environment with more intermittent resources. Use of the maximum derate value in that environment leads to inaccurate results. The maximum demand for thermal resources could be when the sun sets rather than the hour of the peak derate.

The opposite issue occurs in the winter. In PJM's RRS, thermal generators are only available up to their summer ICAP, regardless of season. This means that a 100 MW

summer ICAP CT cannot provide more than 100 MW in the winter. But that is incorrect. Thermal generators, especially CTs and CCs, have significant increases in capability during cold weather. Ignoring this fact grossly underestimates the amount of capacity available in the winter. For example, assuming 80,000 MW of summer ICAP from CTs and CCs, and assuming that 5 percent of that is forced out during summer peak hours, means unforced capacity of 76,000 MW. If the same fleet has a winter ICAP of 88,000 (10 percent more) but a higher outage rate during winter peak hours of 15 percent, the resulting unforced capacity in the winter is 74,800 MW. If the 10 percent increase in winter capability is not recognized, the resulting unforced capacity in the winter is 68,000 MW, or 6,800 MW less than the actual.

PJM's definition of ICAP for a thermal generation resource is a single metric that corresponds to the maximum output of a generator under peak summer ambient conditions.[7] Thermal generators tend to have higher output capacity during the winter season relative to the output capacity during the summer season. The higher output capacity offsets the higher forced outage rates observed during the winter season. Currently, PJM does not account for higher ambient uprates due to lower temperature. PJM provides the following detail regarding the treatment of ambient adjustments in the proposed RRS and ELCC based accreditation analyses.

> Ambient derates: ambient derates refer to reductions in resource output due to ambient conditions. The PJM proposal considers using historical data on ambient derates recorded in eDART starting on June 1, 2012. The ELCC/RRS model will derive ambient derate patterns following the same "sample-from-bins" approach described above for forced outages of Unlimited Resources and unavailability of Variable Resources, while also capturing the historical correlation between the ambient derates

[7] See PJM Manual 21: Rules and Procedures for Determination of Generating Capability, Revision 18 (July. 26, 2023) Section 1.2.

and the forced outages of Unlimited Resources and unavailability of Variable Resources; [8]

Ignoring ambient uprates in the RRS overestimates the reliability requirement. Ignoring ambient uprates in the ELCC based accreditation analysis further adds to the inaccuracy of the derates applied to the thermal generators. PJM presented the breakdown of summer and winter class average accreditation values for 2026/2027 during the Critical Issue Fast Path Stage 3 stakeholder meeting.[9] For example, PJM estimated the class average summer accreditation value for Gas Combined Cycle units as 97 percent and winter accreditation value as 76 percent.[10] The substantially low winter accreditation values for thermal resources reflect the omission of winter uprates in the data used by PJM. Based on EUE distribution between the seasons, PJM attributed 64 percent weight to winter accreditation values in arriving at their final annual accreditation values.[11] The substantial contribution of winter accreditation values means that annual accreditation values are also substantially understated. PJM capacity market sellers would only be allowed to offer less than they would otherwise in the capacity market simply because PJM's ELCC calculations did not account for winter uprates. As a result, PJM has not shown that its proposed changes to the market rules are just and reasonable.

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8 See October 13th Filing, Attachment E (Affidavit of Dr. Patricio Rocha-Garrido) on Behalf of PJM Interconnection, L.L.C., page at 11.

9 See "Update on Reliability Risk Modeling," PJM (July 17, 2023) < *https://pjm.com/-/media/committees-groups/cifp-ra/2023/20230717/20230717-item-03---reliability-risk-modeling---july-update-v2-copy.ashx*> at 8.

10 The accreditation values presented at the Critical Issue Fast path, Stage 3 Stakeholder meeting by PJM for 2026/2027 DY and accreditation values presented in Attachment E (Affidavit of Dr. Patricio Rocha-Garrido) for 2024/2025 DY are within two percentage points for all resources except for solar resources.

11 *See* October 13th Filing, Attachment E (Affidavit of Dr. Patricio Rocha-Garrido) at 19.

3. PJM Does Not Test Whether Auction Clearing Retains the Target Level of Reliability

PJM's Reserve Reliability Study (RRS) is built on several untested assumptions with several layers of approximations. PJM's proposed changes to the RRS add additional layers of approximations built on similar untested premises without first testing if the original approximations are reasonable.

The reliability metric used by PJM is the loss of load expectation (LOLE) or the equivalent expected unserved energy (EUE). The LOLE is a complex multivariate function of uncertain load and uncertain generation. PJM approximated this function as a simple relationship between the LOLE and the annual peak load. In this simplified mathematical representation, the reliability profile of the entire portfolio of uncertain generation expected to be in service during the delivery year is assumed to stay constant. By incrementally varying the annual peak load, PJM solves for a peak load that satisfies the LOLE criterion. This annual peak load is called the Solved Load. PJM derives the reliability requirement by first calculating the Installed Reserve Margin (IRM). The IRM is the installed capacity minus the "Solved Load" expressed as a percentage of the "Solved Load."[12] PJM calculates the reliability requirement in ICAP terms as the expected peak load multiplied by the IRM. Underlying the PJM's approach for calculating the reliability requirement is the implicit assumption that applying the same reserve margin to the expected peak load would approximately achieve the same level of targeted reliability. Historically, the expected peak load has been lower than the Solved Load. PJM never tested the validity of this assumption. PJM did not estimate the magnitude of error introduced due to this very large approximation.

The Solved Load and its derivative, reliability requirement is a function of uncertain load and also uncertain generation. To approximate the relationship between the annual

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[12] IRM = (Installed Capacity/Solved Load – 1). *See* October 13th Filing, Attachment E (Dr. Patricio Rocha-Garrido Affidavit).

peak load and LOLE, PJM considered the reliability profile of the entire installed capacity expected to be in service during the delivery year.[13] The Solved Load does vary with the resource mix. However, PJM applies the same approximated relationship between the annual peak load and the LOLE to the committed capacity in the auction, with likely a very different reliability profile compared to the reliability profile of the installed capacity used in the RRS. The likely consequence of these approximations is that the committed capacity may not achieve the target level of reliability. PJM never studied the impact of these approximations. Moreover, the proposed capacity market changes builds on this approach without first studying the validity of all the approximations. A substantial redesign of the capacity markets without adequate analysis of the impact of all the approximations introduced in the estimation of reliability requirement is not just and reasonable. As a result, PJM has not shown that its proposed changes to the market rules are just and reasonable.

D. Theoretical Foundations of the Proposed ELCC Method.

PJM does not support its ELCC proposal, particularly the mathematical complexities. ELCC maps the ICAP MW corresponding to the ELCC resource classes to the amount of load that the portfolio of resources can reliably serve at the target resource adequacy measure. The ELCC mapping is a multi dimensional function where the inputs to the function are the ICAP MW levels corresponding to the resource classes and the output is the load or ELCC MW that can be reliably served. Alternatively, consider a multi dimensional ELCC surface where the ELCC function maps the combination of resource class ICAP MW to a point on the ELCC surface. The resource class marginal contributions to the ELCC MW are determined by the shape of the surface at that particular point. If you change the resource class ICAP MW, then you move to a different point on the surface and the marginal contributions to the ELCC MW will be different. This is the fundamental

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[13] PJM proposed RRS would account for temperature dependent outages for thermal generators. It does not however adjust of ambient temperature uprates for the winter season.

problem with using ELCC to determine capacity values for use in a capacity auction. Prior to the auction PJM will determine the marginal contributions for the resource classes assuming one point on the surface. The capacity portfolio that clears the auction will be at a different point on the surface and therefore the actual marginal contributions will not be correct. PJM has not addressed these issues. As a result, PJM has not shown that its proposed changes to the market rules are just and reasonable.

ELCC was introduced as a planning tool to measure the incremental load that could be served by the addition of a generator while maintaining a specified reliability criterion.[14] [15] An important feature of the early ELCC analyses are that the generation portfolio is known and fixed, and then a series of loss of load analyses are used to determine the increase in load served for various amounts of generator additions. For example, Garver developed the ELCC function displayed in Figure 2.[16] Garver assumes the existing generation portfolio is 4,600 MW and considers the addition of generation up to 1,000 MW. The marginal contribution of the additional ICAP MW is given by the derivative of this function and the marginal contributions vary by ICAP MW level. The marginal ELCC rate at 400 ICAP MW is 0.72 and the marginal ELCC rate at 600 ICAP MW is 0.40.

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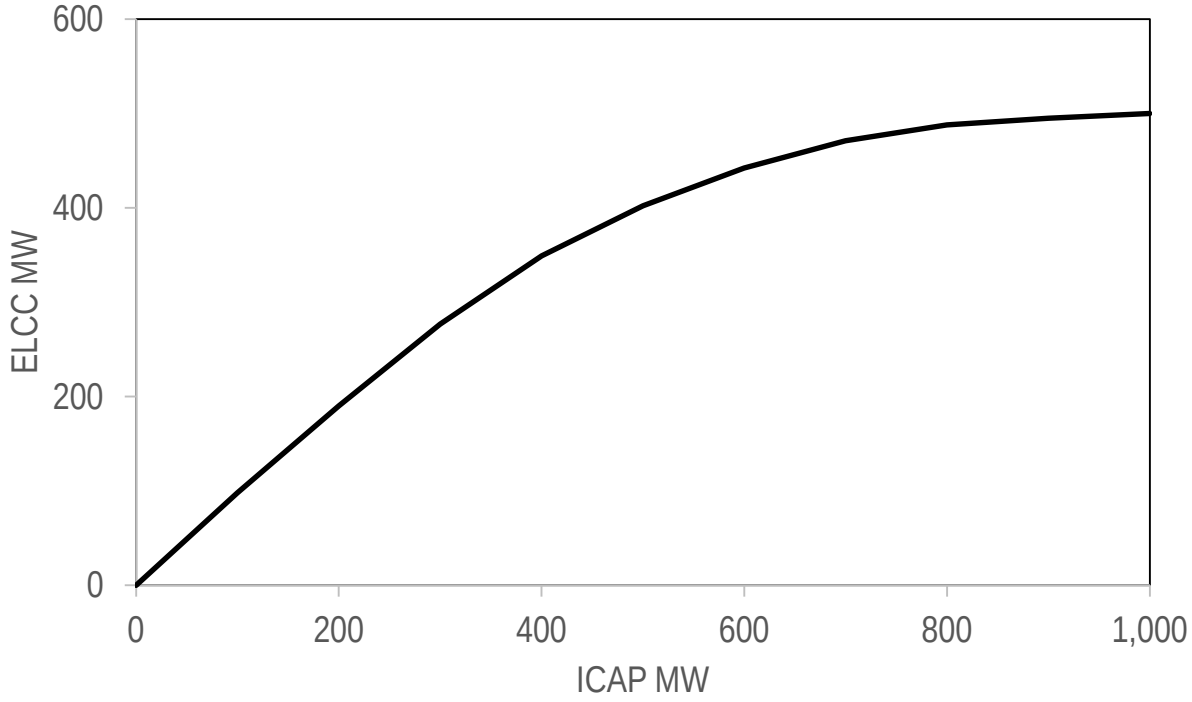
[14] *Effective Load Carrying Capability*, Garver, L. L., Transactions on Power Apparatus and Power Systems, VOL. PAS-85, NO. 8 (August 1966) at 910–919. This article is considered a seminal work in the ELCC literature.

[15] Garver provided a method for measuring the ELCC capacity value in comparison to a perfectly reliable resource. The PJM ELCC method is similar.

[16] *Id*. at 914, Figure 7.

Figure 2 ELCC function



PJM proposes to calculate the ELCC values for 25 different types of resources.[17] No analysis has been produced that examines the PJM ELCC function, called function $f(x_1, x_2, x_3, \cdots, x_{25})$ for this discussion. The inputs to the ELCC function, $x_1, x_2, x_3, \cdots, x_{25}$, represent the ICAP MW of each ELCC resource class. The value $f(x_1, x_2, x_3, \cdots, x_{25})$ is the total ELCC MW corresponding to the ICAP MW for each resource class represented by $x_1, x_2, x_3, \cdots, x_{25}$. Although PJM does not explicitly discuss the function f, there are assumptions about function f inherent in the PJM ELCC method. PJM assumes that function f is smooth, in other words continuous and differentiable. Continuity implies that small changes in any of the input variables will result in comparably small changes in the value of the function f. Differentiability is required for the existence of marginal values. That function f is smooth seems plausible, although whether this is a correct assumption at

[17] October 13th Filing, Attachment A (Redlines) Schedule 9.2 Section B. There are nine classes of unlimited resources, seven classes of variable resources, eight classes of limited duration resources and a demand resource class.

saturation levels is less clear. Other complications in understanding function f are the interaction effects among the different classes. E3 describes the interaction effects as synergistic and antagonistic, and notes that the "multiplicity of interactions and dimensions become increasingly difficult to disentangle from one another, a sign of the challenge inherent in the accreditation of ELCC values to individual resources."[18] The point being made by E3 is the capacity value of one type of resource will vary with the level of a different resource type, or in mathematical terms, the cross partial derivatives, assuming they exist, could be significant and may be positive or negative. For example, the partial derivative of the function with respect to the variable x_1, denoted by $\partial f / \partial x_1$, is the marginal ELCC value for resource class 1. The cross partial derivative gives the interaction effect, or the change in marginal ELCC value for one resource type relative a change in the level of a second resource type. For example, the cross partial derivative, $\partial^2 f / \partial x_1 \partial x_2$, is the change in the marginal ELCC value for resource class 1 that results from a change in the level of resource class 2. This is an important point because the PJM ELCC analysis is an ex ante analysis or forecast of the capacity values of the resources that clear in the auction. There will be differences between the resource portfolio used in the ELCC analysis and the resource portfolio that clears the auction. The impacts of this difference must be studied and found to be negligible in order for the proposed changes to the ELCC method to be just and reasonable. Unless and until such studies are completed, PJM cannot and has not shown that its proposed changes to the ELCC method are just and reasonable.

Let $(x_1, x_2, \cdots, x_{25})$ denote the ICAP levels for the resources classes used in the ELCC analysis and $(x_1 + \Delta_1, x_2 + \Delta_2, \cdots, x_{25} + \Delta_{25})$ represent the ICAP levels that cleared in the auction. Then Δ_1 represents the difference between the ICAP level for resource class 1 used in

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[18] Capacity and Reliability Planning in the Era of Decarbonization: A Practical Application of Effective Load Carrying Capability to Resource Adequacy, E3 Energy + Environmental Economics (August 2020) at 6.

the ELCC analysis and the ICAP level for resource class 1 that cleared the auction. The error for the marginal ELCC rate for resource class 1 is

$$E_1 = \frac{\partial f}{\partial x_1}(x_1 + \Delta_1, x_2 + \Delta_2, \cdots, x_{25} + \Delta_{25}) - \frac{\partial f}{\partial x_1}(x_1, x_2, \cdots, x_{25}).$$

The second term in the expression for E_1 is the marginal ELCC rate for resource class 1 that was determined prior to the auction and used to establish the accredited capacity values for each resource in resource class 1. The first term in the expression for E_1 is the actual marginal ELCC rate for resource class 1 based on the auction clearing results. In other words, the first term represents the marginal ELCC rate for resource class 1 that would have resulted if the portfolio of resources used in the PJM ELCC analysis matched perfectly with the capacity that cleared in the auction. The error term E_1 can be restated as

$$E_1 = \frac{\partial^2 f}{\partial x_1^2}(x_1, \cdots, x_{25}) \cdot \Delta_1 + \frac{\partial^2 f}{\partial x_1 \partial x_2}(x_1, \cdots, x_{25}) \cdot \Delta_2 + \cdots + \frac{\partial^2 f}{\partial x_1 \partial x_{25}}(x_1, \cdots, x_{25}) \cdot \Delta_{25} + R(\Delta^2).$$ [19]

The last term is called a remainder term and is given by

$$R(\Delta^2) = \sum_{i=1}^{25} \sum_{j=1}^{25} \frac{\partial^3 f(c)}{\partial x_1 \partial x_i \partial x_j} \Delta_i \Delta_j .$$ [20]

There are primary impacts and secondary impacts in the error term. The primary impacts capture the change in the marginal ELCC rate for resource class 1 caused by the change in the ICAP MW of resource class 1 (Δ_1). The secondary impacts include changes in the marginal ELCC rate for resource class 1 cause by the interaction effects and changes in the ICAP MW levels for the other classes. The first term in E_1 and the first term in $R(\Delta^2)$ capture the primary impacts,

$$Primary\ Error\ for\ Resource\ Class\ 1 = \frac{\partial^2 f}{\partial x_1^2}(x_1, \cdots, x_{25}) \cdot \Delta_1 + \frac{\partial^3 f}{\partial x_1^3}(c)\Delta_1^2.$$

The secondary error that captures the interaction effects is

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[19] The restated error term results from the application of Taylor's Theorem. *Elementary Classical Analysis*, Marsden and Hoffman, 2nd Edition (1993) at 359.

[20] The point c is a point on the line connecting the two points (x_1, …, x_{25}) and ($x_1+\Delta_1$, …, $x_{25}+\Delta_{25}$).

Secondary Error for Resource Class 1

$$= \sum_{i=2}^{25} \frac{\partial^2 f}{\partial x_1 \partial x_i}(x_1, \cdots, x_{25}) \cdot \Delta_i + \sum_{j=2}^{25} \frac{\partial^3 f(c)}{\partial x_1 \partial x_1 \partial x_j} \Delta_1 \Delta_j + \sum_{i=2}^{25} \sum_{j=1}^{25} \frac{\partial^3 f(c)}{\partial x_1 \partial x_i \partial x_j} \Delta_i \Delta_j .$$ [21]

The first term in the primary error is a multiple of the difference between the ICAP MW used for the ELCC analysis and the ICAP MW that clears the auction, or the Δ_1 term for resource class 1. The second term of the primary error is a multiple of the square of this term, or Δ_1^2. The secondary error term is dependent upon the differences in the ICAP MW, the Δ_i terms, and the product of differences in ICAP MW, the $\Delta_i \Delta_j$ terms. For the error terms to be insignificant, either the Δ terms must be very small which seems unlikely or the 2nd and 3rd partial derivatives must be very small. For example, if Δ_1 is 100 MW and the 3rd partial derivative is 10^{-6}, the primary error is approximately 0.01. In general, if the Δ term is order of magnitude n, then the 2nd partial derivative must be of order –(n+2) for the error to be less than 1 percent; and the 3rd partial derivative must be of order $-2(n+1)$ for the error to be less than 1 percent.[22]

PJM does not address the ex ante modeling issue and the errors that are certain to occur. The new RAA language says that PJM will include capacity resources "that are expected to offer in a given RPM Auction, or otherwise provide capacity, in the Delivery Year."[23] PJM provides the following details regarding the forecast of capacity offers:

> The quantity of deployed resources studied in the analysis shall be based on resource deployment forecasts and, where applicable, on available information based on Sell Offers submitted in RPM Auctions or Fixed Resource Requirement plans for the applicable Delivery Year, and, where applicable, information provided to the Office of the Interconnection regarding intent to offer in an RPM

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[21] Primary and secondary errors for resource classes 2 through 25 can be expressed in a similar manner.

[22] Since $10^n 10^{-2(n+1)} = 10^{-2}$ and $(10^n)^2 10^{-2(n+1)} = 10^{-2}$.

[23] October 13th Filing, Attachment A (Redlines), RAA Schedule 9.2, Section H.

> Auction, pursuant to the requirements in the Tariff, Attachment DD, section 5.5.[24]

The revised language also states that the set of ELCC Resources that are expected to offer "shall be scaled to meet the annual reliability criteria of the Office of the Interconnection."

Note that PJM is forecasting the expected offers in a future capacity market auction. What matters is the portfolio of resources that actually clear the auction. The argument inherent in the PJM proposal is that the forecast of capacity offers will be close enough to the cleared results and the ELCC function is smooth enough that the deviations in the marginal values are not material. This is a fundamental assumption that has not been acknowledged by PJM or supported. As a result, PJM has not shown that its proposed changes to the market rules are just and reasonable.

There have been two base residual auctions under the current ELCC rules. How did the cleared auction results compare with the resource portfolios used in the ELCC analyses? In the 2024/2025 RPM BRA, 6,437.1 ICAP MW from generators and demand resources offered and did not clear.[25] An additional 15,905.5 ICAP MW did not offer into the 2024/2025 RPM BRA, of which 3,873.4 ICAP MW was intermittent and 1,305.8 was capacity storage.[26] In the 2023/2024 RPM BRA, 8,608.0 ICAP MW from generators and demand resources offered and did not clear.[27] An additional 13,901.6 ICAP MW did not offer into the 2023/2024 RPM BRA, of which 3,722.3 ICAP MW was intermittent and 1,051.3 was capacity storage.[28]

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24 *Id*.

25 *See* Market Monitor, *Analysis of the 2024/2025 RPM Base Residual Auction* (October 30, 2023), Table 7 and Table 15.

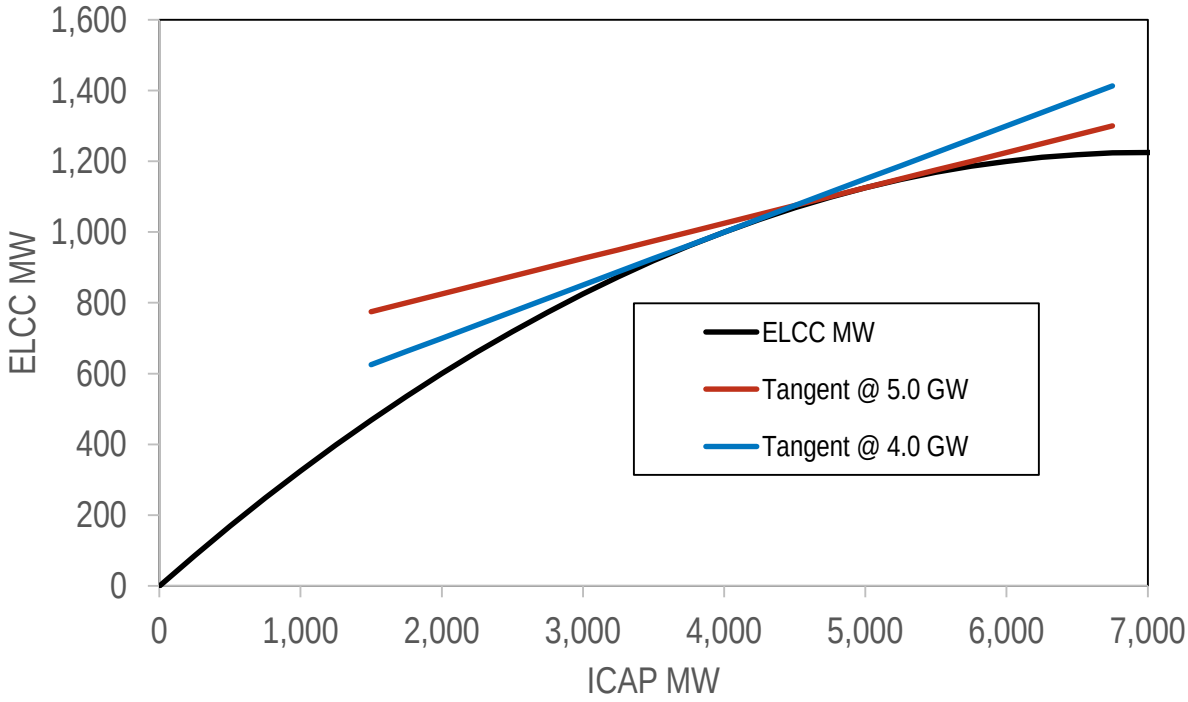
26 *Id*.

27 *See* Market Monitor, *Analysis of the 2023/2024 RPM Base Residual Auction* (October 30, 2023), Table 8 and Table 16.

28 *Id*.

Figure 3 shows what can happen if the forecast of resource offers does not line up with the cleared capacity. For this illustration, assume that PJM correctly forecast resource classes one through 24 but missed the forecast on resource class 25. In Figure 3, the ELCC MW curve represents the ELCC MW for resource class 25 with the ICAP MW of the other classes fixed at levels that cleared the auction. The ELCC marginal values are given by the slopes of the tangent lines. As the ICAP MW moves from 4,000 MW to 5,000 MW, the decrease in the corresponding marginal ELCC rates is evident from the flattening of the tangent lines. At 5,000 ICAP MW, the slope of the tangent is 0.10. At 4,000 ICAP MW, the slope of the tangent is 0.15. If the ELCC analysis assumed 5,000 ICAP MW for resource class 25 and 4,000 ICAP MW cleared the auction, then the marginal ELCC rate is understated by 0.05, or 33.3 percent.

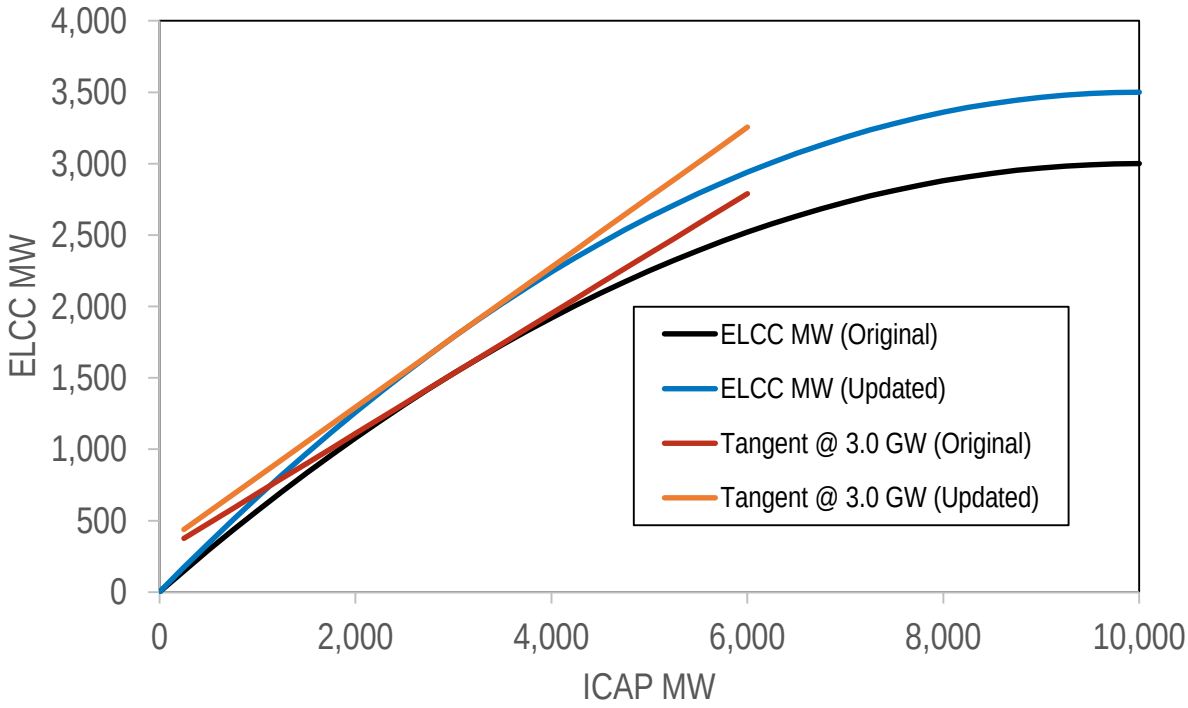
Figure 3 Impact of forecast error on marginal ELCC values (primary error)



The error illustrated in Figure 3 is the primary error (error in the marginal ELCC rate for resource class 25 attributable to the change in the ICAP MW level for resource class 25). There is no secondary error in the marginal ELCC rate for resource class 25 since it is assumed that the ICAP MW levels used in the ELCC analysis for all other resource classes

are the same as the ICAP MW levels that cleared the auction. However, there may be secondary errors for resource classes 1 through 24 due to the interaction effects. Figure 4 illustrates the impact of the forecast error of resource class 25 on one of the other resource classes. Suppose that 3,000 ICAP MW of resource class 1 was included in the ELCC analysis and 3,000 ICAP MW of resource class 1 cleared in the capacity auction. In Figure 4, the original ELCC MW curve represents ELCC MW for the resource class 1 where the ICAP MW of the other classes are fixed at levels assumed in the ex ante ELCC analysis. The updated ELCC MW curve represents the ELCC MW for resource class 1 where the ICAP MW of the other classes are fixed at the levels that cleared the auction. The tangent lines indicate that the marginal values have changed due to the updated capacity level for resource class 25. At 3,000 ICAP MW, the marginal ELCC rate corresponding to the original ELCC MW curve is 0.42. At 3,000 ICAP MW, the marginal ELCC rate corresponding to the updated ELCC MW curve is 0.49. Due to the interactive effects caused by the missed forecast for resource class 25, the marginal ELCC rate for resource class 1 is understated by 14.3 percent.

Figure 4 Impact of forecast error on marginal ELCC values (secondary error)



In order for the Commission to find the PJM ELCC method just and reasonable, it must be shown that the errors in the marginal ELCC ratings caused by the ex ante approach are negligible. The Market Monitor does not believe this can be done at all, and is certain the task cannot be accomplished in the time frame for which PJM requests a determination. PJM has not sufficiently studied the ELCC function f. This is a not condemnation of PJM's work to this point but an acknowledgement that the proposed method has not been evaluated to a sufficient degree. To the Market Monitor's knowledge, PJM has not done any error analysis related to the differences in the auction clearing results and the assumed resource portfolio used in the ELCC analysis.

There is no reason to believe that the forecast of resource offers for 25 different resource classes will come close to the predicted auction results. The BRA results noted above for 2023/2024 and 2024/2025 show that thousands of MW were offered and did not clear. Several thousand MW of intermittent resources did not offer and under the PJM proposal these resources will not be subject to a must offer requirement. Demand resources are allowed to submit sell offer plans up to 15 business days prior to an auction. Even cleared quantities of thermal resources are not easy to predict. Thermal resources are subject to a must offer requirement but offers are often segmented and the resources may not clear to their full ICAP. The only way to make accurate use of ELCC in a capacity auction is to incorporate the ELCC calculations into the auction clearing engine. This is not a feasible alternative.

E. Unsupported Claims Regarding the Benefits of ELCC Method

PJM made several unsupported claims regarding the benefits of their proposed ELCC approach. PJM claims that the ELCC based accreditation "yields a reliability-neutral exchange rate and allows for a substitutable product definition where accredited capacity can be exchanged on the margin with no expected change in reliability."[29] The

[29] *See* October 13th Filing, Attachment D (Affidavit of Dr. Walter Graf) at 6.

substitutability is only valid at the point where PJM's reliability criterion is satisfied, i.e. where the Solved Load in RRS yields one expected loss of load event on average in 10 years and for relatively small substitutions. PJM derivation of ELCC accreditations is limited to 100 MW substitutions.[30] PJM assumes that this "exchange rate" stays constant at any point on the surface of the ELCC function despite potential deviation between the reliability profile of the committed capacity and cleared capacity and despite varying annual peak load and for any size of the substitution. Under their proposed approach PJM would clear a capacity market where a 1,000 MW ICAP Gas Combined Cycle with 84 percent marginal ELCC class rating unit is replaceable by a less expensive four 1,000 ICAP MW Tracking Solar capacity resources with 20 percent ELCC class rating. PJM's distribution of expected unserved energy by month and hour shows that more than 50 percent of expected unserved energy occurs during the night time hours. No amount of solar capacity can generate energy during those hours. PJM's assertion that 1,000 ICAP MW of combined cycle power plant is perfectly equivalent to four 1,000 ICAP MW solar capacity is implausible. Under PJM's proposed approach there is no limit on the size of such substitutions.

F. Performance Adjustment Factors and ELCC

PJM proposes to calculate unit specific performance adjustment factors based on an estimate of a resource's hourly output, weighted by the probability of losing load during the hour.[31] This is yet another significant problem in the application of ELCC to a capacity auction. The ELCC analysis, as proposed by PJM, does not produce resource specific capacity values. Thus PJM has to create an allocation method to determine resource specific capacity values. PJM's chosen method bases the allocation on a small subset of the simulated hours, hours with a nonzero loss of load probability. PJM's approach is not a reasonable way to calculate unit specific capacity values. PJM's approach adds an

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30 *See* October 13th Filing, Attachment E (Affidavit of Dr. Patricio Rocha-Garrido) at 17.

31 October 13th Filing, Attachment A (Redlines), RAA Schedule 9.2, Section D(2).

unnecessary and additional layer of randomness to the final capacity value determination, and is more reason for the PJM filing to be rejected as not just and reasonable.

G. Firm Fuel Requirements

PJM (and the Market Monitor) concluded that it is not possible to define enforceable criteria for firm fuel and did not make firm fuel a requirement to be a capacity resource. But PJM effectively requires firm fuel through the ELCC process. PJM proposes two classes of combined cycle generators based on whether the generator has an onsite secondary fuel option, and two classes of combustion turbine generators based on the same criteria.[32] PJM's definitions of the dual fuel class for CCs and CTs is not clearly defined and is unenforceable. It is not clear why or how PJM decided that two 16 hour periods is the definition of reliability when emergency events can extend longer than 16 hours and extreme weather can last longer than two days. For these reasons, PJM has not shown that its proposed changes to the market rules are just and reasonable.

1. Capacity Emergency Transfer Objective (CETO) for LDAs

The accuracy of PJM's proposed Reserve Reliability Study (RRS), PJM's proposed ELCC based accreditation analysis and PJM's CETO/CETL analysis depends on accurately modelling existing and planned generation. PJM currently assumes that all the planned generation in the queue that had completed the Interconnection Service Agreement at the time of calculating auction parameters would offer in the capacity market auction. If the planned generation failed to offer in the capacity market auction, reliability requirement of the RTO and LDAs, CETO and CETL parameters would be inaccurate and clearing prices would not reflect the underlying demand and supply fundamentals. This flaw in the capacity market design was revealed in the 2024/2025 Base Residual Auction. A significant level of capacity located in the DPL South LDA that PJM had assumed would be offered in the BRA did not offer. PJM's reliability requirement for the DPL South was calculated based

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[32] October 13th Filing, Attachment A (Redlines), RAA Schedule 9.2, Section B.

on the assumption that the proposed generation capacity resources that had completed PJM's interconnection service agreement at the time of the CETO calculation would be available to satisfy the DPL South LDA's target reliability criteria of less than one loss of load event in 25 years. The inconsistency between the projected generation capacity in DPL South LDA and the actual offers resulted in an overstated CETO and reliability requirement for the DPL South LDA.[33]

The proposed capacity market design addresses this issue by requiring a binding intent to offer for all the planned generation. Only the planned generation that submits a binding intent to offer would be allowed to offer their planned capacity in the capacity market Base Residual Auction. Ironically, planned intermittent resources would have a must offer requirement while existing intermittent resources would not. The Market Monitor supports consistent binding must offer obligations for all intermittent and storage resources, and for all capacity resources.

However, the larger deficiencies of PJM's proposed Reserve Reliability Study (RRS), and PJM's proposed ELCC based accreditation analysis and PJM's CETO/CETL analysis still remain. PJM sets the import objective for an LDA based on the installed capacity and PJM does not test if the CETO value satisfies the target reliability criteria of one loss of load event in 25 years on average is achieved with the committed capacity. For example, consider an LDA where solar capacity accounts for only 20 percent of the total existing and planned generation capacity, but accounts for 50 percent of the total committed capacity. PJM's CETO value and the reliability requirement of the LDA is based on the assumption that solar capacity only accounts for 20 percent of the installed capacity. Higher reliance on

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[33] Prior to clearing the auction and posting prices, PJM requested that FERC allow PJM to correctly reflect only the actual capacity offers and the associated revised CETO and reliability requirement of the DPL South LDA for the 2024/2025 RPM Base Residual Auction. PJM also requested a tariff change to provide PJM the authority to revise the CETO and reliability requirement of any LDA in the future for similar situations. FERC approved PJM's request, and PJM posted the auction clearing results on February 27, 2023. *See* Market Monitor, *IMM Analysis of the 2024/2025 RPM Base Residual Auction* (October 30, 2023) at 122.

intermittent solar capacity during the delivery year than assumed in the CETO analysis study could very likely result in a lower level of reliability.

H. PJM Simulation Analysis.

PJM claimed that their proposed market design yields substantial reliability benefits at modest cost to consumers.[34] PJM asserted that based on simulation analysis of 2024/2025 Base Residual Auction (BRA), the reliability benefit measured in Expected Unserved Energy (EUE) improves by 25 percent and the total cost to consumers increase by only $200 million. PJM simulation analysis is oversimplified and based on several unrealistic assumptions.

1. The Simulation Analysis Underestimates the Cost by Ignoring Locational Constraints

In the 2024/2025 BRA, Rest of RTO, Dayton LDA, ComED LDA, the Rest of ATSI and ATSI Cleveland LDA were the only LDAs priced at the unconstrained RTO clearing price ($28.92 per MW-day). The unconstrained RTO accounted for only 55.1 percent of the total cleared capacity and 39.1 percent of the total resource credits. PJM's comparison between clearing the 2024/2025 BRA without locational constraints and clearing the 2024/2025 BRA under the proposed capacity market design without locational constraints has no informational value and does not capture the magnitude of the likely impact. PJM would need to recalculate the CETO and reliability requirements for all LDAs. The new CETO values using the proposed temperature correlated generation performance and the proposed ELCC based accreditations may result in the addition of new LDAs that weren't modeled in the 2024/2025 BRA and among the modeled LDAs may result in a different set of constrained LDAs. Particularly, LDAs such as ComED with significant intermittent capacity that did not price separate in the 2024/2025 BRA may price separate given the lower accreditation values assigned to the intermittent resources.

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34 *See* October 13th Filing, Attachment D (Affidavit of Dr. Walter Graf) at 8.

2. The simulation Analysis Does not inform of Likely Increase in the Cost to the PJM Customers

The PJM simulation analysis claims that the cost to the consumers increased by only $200 million from $2.2 Billion to $2.4 Billion. PJM presented additional scenarios in the Critical Issue Fast Path Stage 3 stakeholder meeting.[35] The $200 million increase corresponds to the scenario where PJM did not include CPQR in the offers of the capacity resources. For the base case without locational constraints, PJM first cleared the 2024/2025 BRA under the status quo accreditations. The clearing price was $43.33 per MW-day and clearing quantity was 139,145 UCAP MW. The total cost to the consumers was $2.2 Billion per year ($43.33 x139,145.0 x 365). In the second scenario, PJM cleared 2024/2025 BRA using the proposed ELCC accreditations without locational constraints. The reliability requirement was lowered from 132,055.7 UCAP MW to 116,418.4 UCAP MW. PJM explained that the lower reliability requirement is due to decrease in the pool wide accreditation factor from 0.9498 to 0.8245. The clearing price in the second scenario was $52.48 per MW-day and clearing quantity was 124,610 UCAP MW. The total cost to the consumers was $2.4 Billion ($52.48 x 124,610 x 365). PJM described the difference, $200 million ($2.4 Billion - $2.2 Billion) as modest. PJM presented a third scenario that was not discussed in their filings. In that scenario, PJM included a $15 per MW-day CPQR. In this third scenario, the clearing price was $67.19 and the clearing quantity was $124,280.[36] The total cost to the consumers was $3.04 Billion, an increase of $847 million compared to their base case scenario. Despite PJM selectively disclosing a lower cost scenario with omitted CPQR cost, these example scenarios do not inform the likely cost to the PJM customers of the proposed capacity market reforms. The offer behavior under the proposed ELCC based accreditation, new PAI triggers and penalties, and new rules related to the inclusion of

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[35] See "Simulation Analysis of PJM CIFP-RA Proposals," PJM (August 14, 2023) <*https://pjm.com/-/media/committees-groups/cifp-ra/2023/20230814/20230814-item-05d---2023-08-14-market-simulation-analysis.ashx*> at 9.

[36] *Id*.

CPQR cost to the incremental offer cannot be assumed to be remotely similar to the offer behavior in the 2024/2025 BRA.

The PJM simulations are not adequate to support any conclusions about the cost impact of PJM's proposals. The PJM simulations do not support the assertion PJM's proposed changes to the market rules are just and reasonable.

3. PJM Reliability Benefits Are Unsupported.

Using the results of the simulation analysis, PJM asserted that the proposed capacity market changes would result in lowering the Expected Unserved Energy (EUE) by 25 percent. In the base case scenario, where PJM cleared the 2024/2025 BRA without locational constraints, the cleared quantity was 139,810 UCAP MW. PJM claimed that this cleared quantity yields 1 in 100 LOLE or 75 MWh EUE under the status quo reliability risk analysis. However, PJM asserted that the same clearing quantity would yield 1 in 40 LOLE or 350 MWh EUE under the proposed reliability risk analysis. In the second scenario, PJM cleared the 2024/2025 BRA using the proposed ELCC accreditations, also without locational constraints. PJM claimed that the cleared quantity 139,145 yields 1 in 50 LOLE or 260 MWh EUE. PJM asserted that this represents a 25 percent improvement {(350-260)/350}. PJM claimed that this 25 percent increase in reliability costs only $200 million. Another more accurate representation of the cost is to simply divide the increase in costs by the energy that will be served, this results in $1.8 million per MWh ($200 million divided by 110 MWh). That means that for each MWh that will be served due to the higher availability, consumers would be paying $1.8 million of capacity only costs. This is not modest.

PJM did not explain how the LOLE and EUE values were derived. These improvements reflect extrapolated reliability benefit of clearing capacity beyond the reliability requirement. An increase in reliability by the way of reducing one event in 40 years LOLE to one event in 50 years LOLE, where the actual reliability standard is LOLE of one in 10 years with a corresponding substantial increase in prices and charges to consumers is not just and reasonable.

I. Proposed Changes to OATT Attachment M–Appendix Are Not Supported as Just and Reasonable.

Attachment M–Appendix to the OATT is part of the PJM Market Monitoring Plan. Attachment M–Appendix provides details on how the Market Monitor interacts with market participants to perform its role monitoring market participant behavior, including in the capacity markets. Because Attachment M–Appendix is core to the Market Monitor's role and purpose, the development of proposed changes to Attachment M–Appendix should involve the Market Monitor.

In the October 13th Filing, PJM proposes revisions to Attachment M–Appendix that would eliminate for all auctions for delivery years after the 2024/2025 Delivery Year, Section II.C.3. Section II.C concerns the RPM Must Offer Requirement, a key requirement for preventing the exercise of market power. Section II.C.3 concerns the Market Monitor's review of a sellers EFORd, which contributes to the determination of the quantity that a seller must offer. The October 13th Filing also proposes to delete from II.C.5 provision for the Market Monitor to "exercise its powers to inform Commission staff of its concerns and/or request a determination from the Commission that would require the Generation Capacity Resource to submit a new or revised Sell Offer, notwithstanding any determination to the contrary made under Tariff, Attachment DD, section 6.6" when the Market Monitor believes that a seller's "maximum EFORd … is inconsistent with the maximum level determined under section II.C.3." In other words, PJM is proposing to delete provisions specifically authorizing steps that the Market Monitor can take when it is concerned that incorrect determinations about EFORd made by PJM could permit the exercise of market power. PJM's proposed changes are contradicted in the OATT, which assigns to the Market Monitor exclusive responsibility to make determinations concerning market power.[37]

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[37] *See* OATT Attachment M § IV.B; OATT § 12A.

PJM should not be permitted to unilaterally delete rules from the PJM Market Monitoring Plan that facilitate the Market Monitor's carrying out its core responsibility to review offers to ensure that market power is not exercised in the capacity market. Determinations of EFORd directly relate to the quantity offered and potential for withholding. PJM is proposing to change/replace its EFORd concept with an analogous concept that it refers to as "Accredited UCAP Factor."[38] The proposed conceptual change does not change the fundamental need for Market Monitor review of an adjustment to the quantity that sellers must offer. The current rules in Section II.C regarding the must offer requirement and determinations about the level of any adjustment to the quantity that must be offered, whether based on EFORd or Accredited UCAP Factor, should be retained.

PJM did not discuss the proposed changes to Section II.C with stakeholders. PJM did not discuss the proposed changes with the Market Monitor separately. The October 13th Filing provides no explanation supporting the proposed changes to the PJM Market Monitor Plan. Because there is no explanation, PJM fails to show how the proposed revisions to Attachment M–Appendix are just and reasonable. The proposed revisions to Attachment M–Appendix Section II.C should be rejected.

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[38] *See* October 13th Filing at 35–36 ("PJM's proposal includes using the Accredited UCAP of an individual resource to derive a resource's Accredited UCAP Factor. The Accredited UCAP Factor represents the share of the installed capacity of a resource that is accredited as Capacity and is equal to 'the ratio of the Capacity Resource's Accredited UCAP to the Capacity Resource's installed capacity.' The Accredited UCAP Factor will replace the EFORd-based metric ...").

II. CONCLUSION

The Market Monitor respectfully requests that the Commission afford due consideration to this pleading as the Commission resolves the issues raised in this proceeding.

Respectfully submitted,

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Dated: November 9, 2023

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated at Eagleville, Pennsylvania,
this 9th day of November, 2023.

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