Monitoring Analytics, LLC
2621 Van Buren Avenue, Suite 160
Valley Forge Corporate Center
Eagleville, PA 19403
Phone: 610-271-8050
Fax: 610-271-8057

Monitoring Analytics

DATE: **July 24, 2025**
TO: **PJM ELCCSTF**
FROM: **IMM**
SUBJECT: **IMM Response to PJM's Memo**

PJM posted a memo to "document PJM's concerns" with the Independent Market Monitor's (IMM) proposal at ELCCSTF to remove the generator performance data during the 2014 Polar Vortex (PV1) and 2023 Winter Storm Elliot (WSE) from the PJM's resource adequacy models.

This memo is the IMM's preliminary response.

PJM Continues to Model Bad Performance Despite Expected Improved Performance

PJM recognizes that PJM's practice of conservatively scheduling and dispatching resources since WSE has improved generator performance during cold weather events, but PJM states that "it is impossible to know the exact effect." PJM concludes that poor generator performance during PV1 and WSE should continue to be included in the resource adequacy models as representative of expected performance whenever the historical temperatures are in the identified temperature bin, which is now significantly larger than previously. To do otherwise would be, in PJM's words, "dangerously optimistic."

PJM studied the deficiencies in their operational practices during the WSE.[1] The subsequent changes that PJM adopted were designed to prevent a repeat of the generator performance issues observed during WSE that resulted from PJM's scheduling and commitment practices. PJM's going forward approach, as implemented in its first phase during Polar Vortex 2025 (PV25), included PJM committing resources in advance of the day-ahead market while recognizing real world operating constraints including minimum starting temperatures and gas nomination cycles. PJM credited the improved performance of generator resources during subsequent cold weather events and during PV25, in part to the lessons learned from WSE.[2] PJM is to be commended for PJM's ongoing commitment to continually reevaluating and improving their operational practices with the goal of improved generator performance.

However, PJM wants to simply ignore the effect of PJM's improved operational practices on expected generator performance based on observed actual improved generator performance

[1] There were multiple complaints filed about PJM's commitment and scheduling practices during WSE which PJM addressed in a settlement related to the level of penalties and associated bonuses paid based on WSE.

[2] See "PJM Review: System Performed Well During Winter Storm Gerri" PJM Inside Lines << https://insidelines.pjm.com/pjm-review-system-performed-well-during-winter-storm-gerri>> January 25, 2024.

during PV25. PJM proposes to continue to calculate the reliability risk in their resource adequacy models as if nothing had changed after WSE, with all the associated consequences for estimated ELCC values and the installed reserve margin and therefore the operation and results of the capacity market.

In PJM's data, the coldest days for which PJM has generation performance records are not PV1 (January 6-8, 2014) and WSE (December 23-24, 2022). The coldest days during PJM's selected period for evaluating performance, from 2012 to the present, include January 22 and 28, 2014, Polar Vortex 2015 (February 19 and 20, 2015), and January 30 and 31, 2019, among other days. The generator performance in PJM since 2012 does not decrease linearly with temperature. The higher forced outage rates during WSE occurred with higher temperatures than the coldest days since 2012. In PJM's ELCC model, performance from the temperature performance bin that includes WSE was more frequently sampled compared to that from the other extreme temperature performance bins.

PJM's continued use of generator performance from PV1 and WSE does not reflect the reasonably expected generator performance during cold weather given the fundamental shift in PJM operational practices. Use of historical data that does not reasonably reflect expected future performance is not reasonable.

Temperature Data Does Not Support Inclusion of Generator Performance During PV1 and WSE

There is data on observed historical temperatures by day and by hour. PJM has chosen to use data on daily minimum hourly temperatures from 1994 to the present to create groupings or bins of what PJM believes are comparable temperatures. PJM uses generator performance data from 2012 to the present. In order to create a larger data set of performance, PJM needed to relate the shorter performance period to the longer weather period. To do so, PJM had to associate observed performance with observed temperatures since 2012 and then simply assume the same performance for the earlier weather data based on temperature. Rather than simply relate performance to temperature, PJM decided to group temperatures into groupings or bins. The selection of the bins has a significant impact on PJM's calculation of performance and thus ELCC values.

PJM's assertion that better generator performance during PV25 compared to WSE is due to slightly higher temperature in 2025 ignores the underlying reality that PJM operations performed fundamentally differently in 2025. However, under PJM temperature binning, cold weather days in January 2025 (Polar Vortex 2025) would also be included in the same

temperature performance bin as WSE.[3] Similarly, better performance during the 2015 polar vortex, which is colder than PV1 and WSE per PJM's temperature metric, owes more to the PJM conservative operations than to the actual observed lower temperatures.

PJM made a subjective decision to combine the lowest two temperature bins because performance did not map to temperature in the way that PJM believed that it should.[4] The bad performance during WSE does not fall in the lowest temperature bin. Rather than accept these results, PJM combined the bottom two temperature bins. One result is to increase the number of observed historical temperature days to which PJM imputes bad WSE performance.

Survey Data Does Not Prove PJM's Point

PJM claims that the conservative approach to operations does not mitigate the likelihood of forced outages while a plant is running. PJM presented data showing that approximately 42,000 MW were at risk of forced outage during the Polar Vortex 2025, of which 28,000 were at risk of forced outage while operating. This estimate was based on data that generators submitted to PJM via an eDART data request and the temperatures during PV25, which were as low as 5°F. The actual forced outages were much lower, about an additional 4,500 MW from the outage level at the beginning of the event to the maximum outage level.[5] Unlike generator operating parameters (PLS), the minimum operating temperatures cited by PJM are not parameters defined by the OATT that require review by the IMM and PJM and approval by PJM. PJM's questions resulted in subjective responses. PJM asked generation owners for the lowest temperature at which the generators can reliably start and/or operate.[6] Based on inquiries by the IMM, generators answered that question based on their own perception of what it meant

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3 In the PJM's memo, PJM claimed that the minimum temperatures observed during PV25 (6.03 F on 01/21/2025 and 5.47 F on 01/22/2025) are higher than that observed during WSE (4.99 F on 12/23/2023 and 4.73 F on 12/24/2022). However, under PJM's binning methodology, the two days in PV25 would be included within the temperature performance bin bounded by 3.75 F and 6.13 F, same as the temperature bin that includes WSE.

4 See "Continued Discussion on Accreditation Reforms – Performance Weighting", presented by PJM at ELCC Senior Task Force Meeting, February 19, 2025, << https://www.pjm.com/-/media/DotCom/committees-groups/task-forces/elccstf/2025/20250219/20250219-item-04---continued-discussion-on-accreditation-reforms---weighting-approach---pjm-presentation.pdf>>

5 See "Cold Weather Operations January 18–23, 2025" Presented by PJM at Markets & Reliability Committee, March 19, 2025, Slide 45. << https://www.pjm.com/-/media/DotCom/committees-groups/committees/mrc/2025/20250319/20250319-item-08---1-january-2025-cold-weather-update---presentation.pdf>>

6 See "2025 Polar Vortex", presented by IMM at Reserve Certainty Senior Task Force, April 9, 2025, at 10. << https://www.monitoringanalytics.com/reports/Presentations/2025/IMM_RCSTF_2025_Polar_Vortex_20250409.pdf>>

to start or operate reliably. Some answered using design documents from the time the plant was built, some answered with reports developed by third parties or internal engineering departments, some answered using historical performance, some answered using historical weather data at the location, and some answered based on their judgement. The incentives of the respondents are unclear.

A subjective assessment which can vary from one resource owner to the other cannot be used to estimate the likelihood of failure in an analysis that determines the value of capacity resources. It is true that conservative operations may not mitigate unit failures while in operation. PJM did not provide any evidence about the correlation between the failure rate of units in operation and temperature. A subjective assessment of operating forced outage rate does not support PJM's argument that PV1 and WSE performance results should be included in resource adequacy models or that performance results are a good guide to expected performance.

A comprehensive analysis would require the review of multiple factors, including the actions taken by PJM and the generation fleet during the extreme cold days, in addition to the hourly ambient conditions and data on actual performance.

Overweighting Winter Risk Also Masks Increasing Summer Risk

Including the PV1 and WSE performance in PJM's resource adequacy analysis is uncritically backwards looking. The inclusion of these performance results will, in addition to misrepresenting the risks associated with cold weather, tend to mask future risks not yet fully experienced by PJM. For example, increasing summer loads and/or increasing shoulder loads during maintenance season will not result in EUE hours because the model will continue to result in EUE hours primarily during winter days.

PJM's Proposal Requires Additional Arbitrary Adjustments

One of PJM's current proposals (the alpha proposal) requires giving arbitrarily higher weights to more recent performance events. Under this proposal, generator performance during more recent days would receive a higher weight, which would then result in drawing such days with higher likelihood in the resource adequacy simulations.[7]

However, PJM learned that this approach would result in what PJM regarded as a counterintuitive outcome because performance during the second coldest bin, where WSE is

[7] See "Accreditation Reforms: Sensitivity Analyses with Performance Weighting", presented by PJM at ELCC Senior Task Force Meeting, May 30, 2025. <https://www.pjm.com/-/media/DotCom/committees-groups/task-forces/elccstf/2025/20250530/20250530-item-02---sensitivity-analyses-of-weighting-approach---pjm-presentation.pdf>>.

located, had worse generator performance than the coldest bin, where PV1 is located. PJM's suggested solution to avoid this outcome is to merge the two coldest bins.[8] PJM's choice is a subjective judgment which ignores the actual performance and the reasons for the actual performance.

The assertedly counterintuitive result indicates that it is an oversimplification to simply link all forced outage rates to temperature as the single explanatory variable in the binning approach. Generator performance of the generators is a function of temperature and of other variables including PJM operational practices and PJM's forecasting accuracy.

Table 1 shows the temperature performance bins where PV1 and WSE are located. Under Winter Pre Merged Bins, PV1 is included within the temperature performance bin bounded by -3.41 F and -1.03 F, and WSE is included within the temperature performance bin bounded by 3.75 F and 6.13 F. Under Winter Post Merged Bins, PV1 is included within the coldest bin bounded by -10.57 F and 3.75 F and WSE is included within the second coldest bin bounded by 3.75 F and 6.13 F. Under PJM's most recent proposal both PV1 and WSE would be included within the merged coldest bin with temperature between -10.57 F and 6.13 F. The relevant temperature for PV25 is 6.03 which would place PV25 in the same bin as WSE.

Table 1 Lower and Upper Bounds of Temperature Performance Bins where PV1 and WSE are located in the PJM's 2026/2027 ELCC Simulation

Winter Pre Merged				Winter Post Merged				PJM's Proposal			
Lower Bound	Upper Bound	PV1	WSE	Lower Bound	Upper Bound	PV1	WSE	Lower Bound	Upper Bound	PV1	WSE
-10.57	-8.18										
-5.80	-3.41										
-3.41	-1.03	X		-10.57	3.75			-10.57	6.13	X	X
-1.03	1.36										
1.36	3.75					X					
3.75	6.13		X				X				

Table 2 shows the frequency of observations for each temperature bin in the 2026/2027 ELCC simulation. There was only one day since June 1, 1993, in the ELCC simulation where the minimum temperature of the day was below -8.18 F.

[8] See "Continued Discussion on Accreditation Reforms – Performance Weighting", presented by PJM at ELCC Senior Task Force Meeting, February 19, 2025, << https://www.pjm.com/-/media/DotCom/committees-groups/task-forces/elccstf/2025/20250219/20250219-item-04---continued-discussion-on-accreditation-reforms---weighting-approach---pjm-presentation.pdf>>

Table 2 Frequency of days within each bin in the PJM's 2026/2027 ELCC Simulation

Lower Bound	Upper Bound	Frequency (Days) Winter Pre Merged	Winter Post Merged	PJM's Proposal
-10.57	-8.18	1		
-5.80	-3.41	1		
-3.41	-1.03	2	18	38
-1.03	1.36	7		
1.36	3.75	7		
3.75	6.13	20	20	

By combining bins, PJM increases the weighting of the poor performance during PV1 and WSE in the model results. The combined bins mean that any historical temperature between -10.57 and 6.13 will include the performance during PV1 and WSE. Rather than appropriately recognizing that PJM's operational practices have made PV1 and WSE irrelevant, PJM's approach results in an even large weight given to those periods.

Looking Forward

The PJM Capacity Market design went through a complete overhaul after PV1. After the events of PV1, PJM determined that it needed a more reliable Capacity Resource one that "has made, or can and will make, the necessary investment to ensure the Capacity Resource has the capability for the entire relevant Delivery Year to provide energy at any time when called upon by the Office of the Interconnection."[9] PJM removed the PV1 data from its Reserve Requirement Study (RRS) at the time because PJM believed that the Capacity Performance incentives would make the PV1 performance data irrelevant for future performance expectations.

After WSE, PJM actions implicitly recognized that relying solely on the CP incentives to perform (PAI penalties) would not be enough to ensure reliable performance. PJM's appropriate goal is to prevent another event like WSE in which a significant number of generators had mechanical failures and an additional significant number had issues procuring natural gas when called by PJM.

PJM's history indicates that PJM understands that changing rules and incentives changes expected generator performance. Just as PJM recognized a change following PV1 and left that data out of the history, PJM should exclude both PV1 and WSE data from the modeling because PJM's own changed behavior has changed the reasonable expectation of generator performance.

[9] PJM CP Filing 205 P23