Purpose

The purpose of this memo is to document PJM's concerns with Monitoring Analytics' Effective Load Carrying Capability Senior Task Force (ELCCSTF) proposal to remove the performance observations associated with Winter Storm Elliott (WSE), December 22-24, 2022, and Polar Vortex 1 (PV1), January 6-8, 2014, from the resource adequacy risk and accreditation analysis. Removal of these observations significantly reduces overall risk in the model and results in a large shift in risk from the winter to the summer which will substantially change the Forecast Pool Requirement (FPR) and Accredited UCAP (AUCAP) factors. The rationale provided in support of this proposal is the belief that the scheduling actions PJM took during the January 2025 cold weather event will mitigate most, if not all, large-scale correlated outage events in the future. However, a conservative approach to scheduling the system in anticipation of potential, extreme weather events that are forecasted far enough ahead of time, such as was the case in January 2025, is far from a new concept. The advance scheduling steps PJM took in this instance likely had some effect on resource performance as hypothesized later in this memo, but it is impossible to know the exact effect. Given the role of the risk modeling and accreditation methodology in establishing reliability metrics to support future resource adequacy, it is dangerously optimistic to believe those actions had a significant enough effect that it warrants elimination of the WSE and PV1 observations.

Recall that following PV1 the PJM system experienced similar weather conditions in Polar Vortex 2 (PV2) in February 2015 which, like January 2025, featured a conservative scheduling approach by PJM in response to a prior cold weather event and strong generator performance during extreme cold conditions. Despite the operational enhancements made by PJM and excellent generator performance in PV2, the underlying risk of large-scale correlated outage events was not fully mitigated and recurred during WSE. At this time PJM does not believe there is sufficient evidence to support that large-scale correlated outage events cannot reoccur and should therefore be removed from all risk modeling. PJM does not believe that any procedural changes it can make will result in this outcome including those made in January 2025. PJM alone does not have the ability to fully mitigate large-scale correlated outage risks. Attempting to do so would require additional direct investment in generation assets, fuel delivery systems and other infrastructure which are currently outside of PJM's control. Furthermore, eliminating those past observations of performance in the ELCC accreditation analysis and in particular the more recent WSE event is both (1) harmful to those entities that had chosen to invest and do what was necessary to have their resources perform during the periods of time that saw significant reliability risk on the system, and (2) would introduce a moral hazard concern, where generation owners would reasonably question whether it is beneficial to invest in their resource's future performance during extreme events if there's a material chance that PJM will enact some operational improvements following that event and again decide to remove the performance of such event from the history used in accreditation.

PJM believes the purpose of the resource adequacy risk modeling and accreditation processes are to put together as accurate of a model as possible to determine the resource adequacy risk profile of the PJM system and accredit resources relative to their marginal benefit in mitigating those risks. Removing risks from the model, such as the large-scale correlated outage risk being suggested here, without clearly defined actions taken to mitigate those risks with certainty, can result in inappropriately biasing the model, resulting in outcomes that are inconsistent with risks on the system and ultimately can skew the market results away from incentivizing the investments needed to drive down resource adequacy risk at least cost. Based on the analysis done by PJM to support the ELCCSTF[1], the outcome of this proposal would do exactly that. It would remove a significant amount of risk from the model by reducing the Installed Reserve Margin by about 1.6 percentage points without clear, effective mitigations, and would result in a model outcome that suggests that the majority of PJM's resource adequacy risk is in the summer. That outcome is inconsistent with recent observations in PJM and other areas across the Eastern Interconnection.

By its nature, resource adequacy risk modeling focuses on outlier detection. The objective is to determine the conditions under which the system is at risk. These, by definition, are outlier events that inform how we determine the 1-in-10 standard. Removing them or lessening their impact without clear supporting mitigations goes against the purpose of the analysis. Those clear supporting mitigations do not exist for WSE and PV1 and therefore it is PJM's position that those observations should remain as inputs into the resource adequacy risk analysis and accreditation processes.

The remainder of this memo focuses in on specific factors which reinforce PJM's position that removal of these performance observations is inappropriate.

The temperature in January 2025 was not as cold as other days where PJM experienced a significant amount of generator outages.

The table below shows the minimum RTO temperature for all days in the coldest two bins in order from coldest to warmest. The observations from the 1994 load shed event, WSE and PV1 are highlighted in yellow. The January 2025 cold weather observations are highlighted in green. As demonstrated here, there is a significant difference in temperatures between January 2025 and other cold weather observations where large-scale correlated outages were observed.

Date	Minimum RTO Temperature
1/19/1994	-10.57
1/18/1994	-5.17
1/16/1994	-2.27
2/20/2015	-1.98
1/7/2014	-0.98
1/31/2019	-0.30
1/15/1994	0.01
1/21/1994	0.53

[1] Slide 10; Sensitivity Analysis for the May 22, 2025 ELCCSTF

1/16/2009	0.56
1/20/1994	1.15
2/5/1996	1.24
2/4/1996	1.37
1/17/2009	2.63
1/28/2014	2.67
1/30/2019	2.79
1/8/2015	3.10
1/22/2014	3.51
1/19/1997	3.59
2/24/2015	3.78
2/6/2007	3.90
2/16/2015	4.00
2/19/2015	4.27
1/24/2014	4.36
12/24/2022	4.38
1/1/2018	4.39
1/6/2018	4.57
1/6/2014	4.73
2/5/2007	4.86
12/23/2022	4.99
2/15/2015	5.01
2/3/1996	5.27
1/17/1997	5.38
1/7/2018	5.40

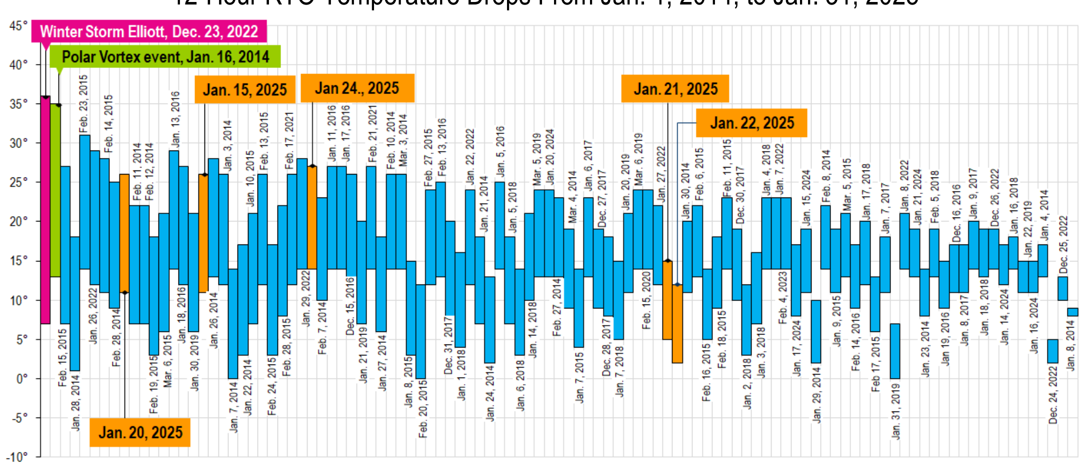
2/6/1995	5.42
1/22/2025	5.47
1/29/2014	5.55
1/27/2003	5.61
1/18/1997	5.77
1/2/2018	5.77
1/21/2025	6.03

The difference in temperatures are especially stark when comparing January 1994 temperatures to those experienced in January 2025. Today, when sampling performance profiles back to 2012, there is an implicit assumption in the model that the outage levels we would observe under a 1993/94 weather would be no worse than those observed during cold events since 2012, despite facing significantly colder temperatures under 1994 weather patterns. This is a relatively optimistic assumption in the model today that likely understates the level of expected outages observed when facing 1994 temperatures. Dismissing the cold events that saw the highest levels of correlated outages on the system since 2012 would only exacerbate this assumption and very likely overstate the performance of the fleet during a 1994 weather pattern by a significant amount.

A further factor differentiating January 2025 with WSE and PV1 is the temperature drop over time experienced in these events. The graphic below was posted originally as part of the [Cold Weather Update to the March 2025 Markets and Reliability Committee] and highlights the differences between these events. The RTO temperature dropped approximately 30 and 22 degrees over 12 hours during WSE and PV1, respectively, while only about 15 degrees in a 12-hour period in January 2025. The specific weather patterns around these events is important and this data shows that January 2025 had a materially different weather pattern than WSE or PV1.

Historical Temperature Drops Under 15°

12-Hour RTO Temperature Drops From Jan. 1, 2014, to Jan. 31, 2025



Even with PJM's conservative scheduling in January 2025, the peak forced outage rate during this period reached almost double the annual average.

The average EFORd calculated for the 3rd Incremental Auction for the 2024/2025 Delivery Year was 5.10%. The peak forced outage rate experienced during the January 2025 cold weather event was almost double that at 9.24% as shown on slides 44 and 45 of PJM's Cold Weather Update to the March 2025 Markets and Reliability Committee.

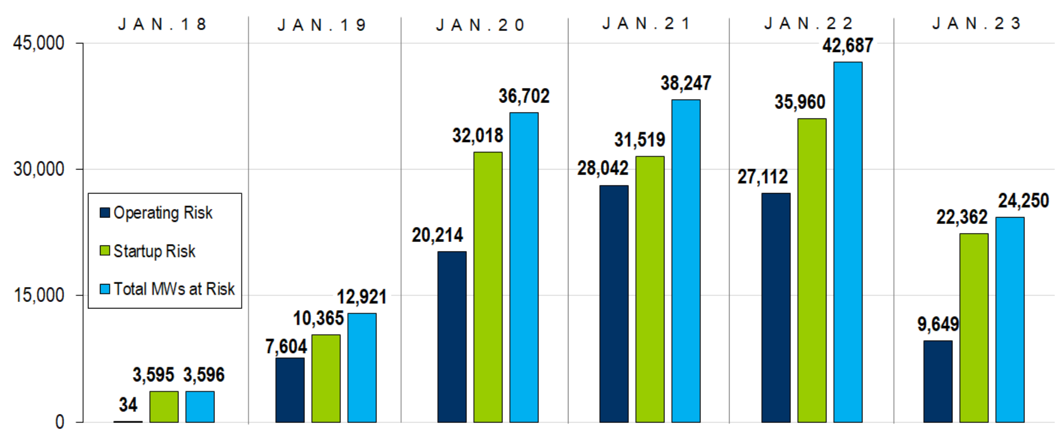
This outage level is higher in total MWs than what was experienced during Winter Storm Gerri in January 2024. During the January 2025 cold weather event, at its highest, there were approximately 17,000 MW of forced outage as compared to about 16,000 MW during Winter Storm Gerri (see Slide 14).

From this perspective it could be argued that the conservative scheduling steps taken by PJM in 2025 were less effective than hoped.

Data provided by generation owners indicates significant risk of generator failure during the operating cycle during cold temperatures.

Following WSE and in response to Recommendation 1(f) in the FERC, NERC and Regional Entity Staff Report, "Inquiry into Bulk Power System Operations December 2022 Winter Storm Elliott", PJM began surveying generation owners for their Cold Weather Operating Limits (CWOL) which were used during the cold weather operations in January 2025. The results of that survey indicate that up to 28,000 MW of generation resources are at risk during their operating cycle (dark blue) is distinguished from startup and fuel-related risks.

Generation MWs at Risk During January 2025



In PJM's view, the conservative scheduling done in January 2025 likely had some beneficial effect in two primary scenarios:

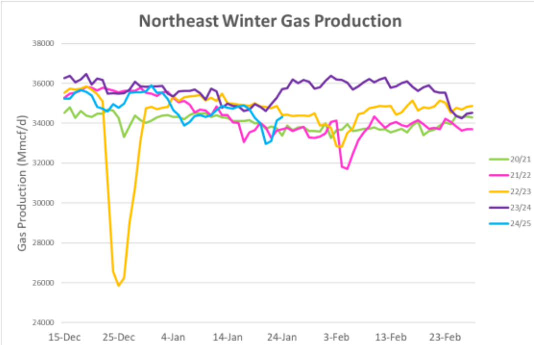
1. Resources that were able to obtain fuel only because of PJM's advanced commitment of them, and

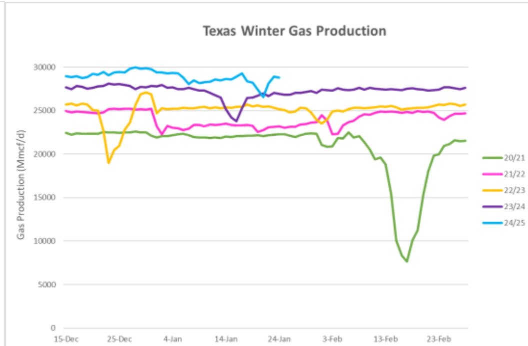
2. Resources that were able to start only because PJM called them on before temperatures reached colder levels.

As demonstrated by the CWOL report, a significant number of generators have risk of failure when they are already operating. This means they have already purchased fuel and completed the start cycle. This risk of failure falls outside the bounds of any mitigation step that PJM took in its conservative scheduling in January 2025. It is unclear to PJM how to align this information with the proposal to remove WSE and PV1 performance observations.

The PJM system experiences natural gas-related risks that are outside of its control but must be accounted for.

Slides 54-56 of the Cold Weather Update to the March 2025 Markets and Reliability Committee consistently show that there is a drop in natural gas production in the Northeast and Texas that is correlated with well-known cold weather operational events. Exactly how these events impact the availability to procure gas in PJM is not completely known at this time but the fuel availability risk associated with these events is clearly outside of PJM's control and not addressed by conservative scheduling practices. The graph below shows the significant decline in natural gas production observed during the WSE event compared to other recent winter events. The fact that more recent events did not face near the levels of reduced natural gas production as WSE, it is not at all clear how the more recent events provide sufficient evidence that more conservative operations removes the risk of experiencing fuel-related outage levels near those observed during WSE.





The resulting model outcome under these assumptions is inconsistent with recent observations and the general industry trend regarding winter risk.

As shown in slide 10 of the Sensitivity Analysis for the May 22, 2025 ELCCSTF, the outcome of the resource adequacy risk model after removing WSE and PV1 is a significant shift in risk from the winter to the summer. Class average ELCCs of certain classes change by up to 37 percentage points and the IRM drops by 1.6 percentage points due to the removal of the vast majority of winter risk. PJM does not agree that the current system is one that is largely dominated by peak load risk in the summer. This does not align with recent empirical observations and would be challenging to support analytically or qualitatively to meet the Just and Reasonable standard required by FERC.

Ultimately, it cannot be determined exactly how much correlated outage risk was mitigated by the conservative scheduling practices implemented in January 2025. Further, such practices have been utilized in the past and will continue to evolve. As such, PJM operator actions may not be exactly the same in anticipation of future events, with the potential to result in differing resource performance.

PJM is open to exploring methods to incorporate conservative scheduling actions into the resource adequacy risk modeling and accreditation processes but believes these need to be based in analysis. Further, there may be other areas that changes in scheduling practices should be included such as in reserve markets and operational practices which should also be considered.