



# Winter Storm Elliott Frequently Asked Questions

Updated April 12, 2023

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## What Is in This FAQ Document?

The questions below reflect frequently asked questions received from stakeholders and others regarding Winter Storm Elliott and the events impacting the PJM footprint from Dec. 23–25. PJM will be providing a comprehensive event analysis to be published in July, which will address additional items. The answers here are drafted based upon the best information available at the time of publication, and may be amended or updated.

In addition, this document will be updated as new questions come in, with the most recent questions added to the top of the relevant section.

**UPDATED: April 12, 2023**

## Operations Dec. 23–25

### 1. *What were the operating days like on Friday, Dec. 23, and Saturday, Dec. 24?*

At the start of the day on Dec. 23, PJM had approximately 12,000 MW of forced (or non-planned) outages among its generation fleet. To account for the uncertainty of the weather conditions, PJM set up the operating day by committing approximately 133 GW of energy in the Day-Ahead Market and an additional 9 GW of available 30-minute reserves. In addition, approximately 13 GW of short-lead units were reported as available based on the operating parameters submitted to PJM, for a total of 155,750 MW of available generation that Friday. This well exceeded the PJM load forecast peak of about 127,000 MW for the day.

The weather on Dec. 23 was unprecedented for that time of year, given the severe temperature drop and resulting spike in load. The record-breaking plunge of 29 degrees over 12 hours on Dec. 23 surpassed the previous PJM record of a 22-degree drop during the 2014 Polar Vortex.

As cold weather gripped the PJM region and power needs spiked, PJM began seeing high levels of forced generation outages. PJM implemented emergency procedures, including calls for synchronized reserves, an RTO-wide Maximum Generation Emergency Action and a call on demand response.

*The purpose of the Maximum Generation Emergency Action is to increase the PJM RTO generation above the maximum economic level.*

As temperatures fell, power demand rose to a peak of about 135,000 MW Friday evening. Around the same time, forced outages reached as high as 34,500 MW. Shortly before midnight Friday, PJM issued a Call for Conservation for the entire footprint, asking consumers to cut back on their energy use where possible between the hours of 4 a.m. on Dec. 24 through 10 a.m. on Dec. 25.

The demand continued after the peak on Dec. 23 and into Dec. 24. Even the valley, or low-point of demand, on Dec. 24 was significantly greater than any other peak, or high-point of demand, for that date in a decade.

Generation outages further expanded to an estimated level of nearly 46,000 MW by Saturday morning (this figure was [updated](#) to approximately 47,000 MW at the Feb. 9 Operating Committee). Factoring in a number of reserve generators that missed scheduled start times Saturday morning or operated at less than capacity, combined with PJM's inability to replenish pumped storage based on the lack of availability of generators overnight, PJM was missing approximately 57,000 MW of its generation fleet by the morning peak of Dec. 24, the coldest day of the

holiday weekend.

**2. *What happened at the evening peak on Saturday (Dec. 24) through Sunday morning peak (Dec. 25)?***

Heading into the peak for Saturday evening, there was still uncertainty about resource performance. Some resources informed PJM that they would come offline at 6 p.m. because of emissions limits. With these factors in mind, PJM submitted a petition to the U.S. Department of Energy (DOE) Saturday afternoon. At 5:30 p.m. the DOE issued an emergency order, under Section 202(c) of the Federal Power Act, determining that an electric reliability emergency existed within the PJM region that required intervention by the secretary of the DOE to keep the power flowing.

The Emergency Order posted was effective Dec. 24, 2022, through noon Eastern Standard Time on Dec. 26, 2022. The order authorized all electric generating units serving the PJM footprint to operate up to their maximum generation output levels under limited, prescribed circumstances, even if doing so exceeded their air quality or other permit limitations.

Two generating units that fell under the DOE order ran at levels that exceeded their environmental permitting limits. The Department of Energy requires PJM to identify those generators, which were Bethlehem Energy in Bethlehem, Lehigh County, Pennsylvania, and York Energy 1 in Peach Bottom Township, York County, Pennsylvania.

Altogether, calls for conservation, a Maximum Generation Action and demand response are believed to have eased operating conditions through the Dec. 24 morning peak of about 129,000 MW and the evening peak that day of about 126,000 MW.

PJM was able to come out of its Maximum Generation Emergency at 10 p.m. on Saturday night, meet the morning peak on Dec. 25 and end all emergency procedures at 10 p.m. Sunday.

**3. *Did you consider step 7, Deploy All Resources?***

Yes, the step was discussed in the Control Room; PJM ultimately decided not to implement.

**4. *How is it determined what is curtailed for exports?***

This process is detailed in these published [PJM procedures](#).

**5. *Were there transmission outages?***

In general, the transmission system performed very well. There were several areas on the system where there were constraints. The greatest challenge was not transmission constraints but keeping up with the load. Perhaps the most challenging constraint was the AEP-DOM interface on the morning of Dec. 24, given the high load, transfers and exports to *PJM's neighbors*.

**6. *How close was PJM to shedding load? In megawatts?***

This question will be addressed in the Winter Storm Elliott Event Analysis.

**7. *What criteria are considered to cancel emergency procedures, specifically the Maximum Generation Emergency Action and the Emergency Load Management Reduction Action on Dec. 24?***

PJM operators have triggers for entering and exiting emergency procedures, and they are documented in detail in Manual 13. Between the two peaks on Dec. 24, we continued to have uncertainty about resource performance, which led us to the decision to keep demand response resources deployed through the Saturday evening peak.

**8. *Did PJM take additional precautions going into Dec. 24?***

Prior to the operating day of Dec. 24, PJM issued a Cold Weather Advisory on Dec. 20 for the period of Dec. 23–26. PJM then issued a Cold Weather Alert for the entire RTO at 07:10am on Dec. 23, effective for Dec. 24. These messages are issued to all Members via the All-Call system and are posted to the PJM Emergency Procedures website (<https://emergencyprocedures.pjm.com/ep/pages/dashboard.jsf>).

In addition, PJM operators knew that there was going to be uncertainty in the load forecast for Dec. 24 as a result of the extreme weather. Based upon this, the decision was made to operate very conservatively in terms of reserves. PJM had sufficient energy and reserves scheduled in the Day-Ahead Market and the initial RAC run to account for this uncertainty. However, as generation began to fail over the evening peak, PJM performed additional RAC runs and made additional unit commitments to units being reported to PJM as available to schedule. Operators also looked at long-lead-time resources that were beyond the window for calling on, which was about 3,000 MW going into the weekend. Maintenance outages that were recallable totaled about 1,692 MW; however, these are only recallable with 72 hours' notice.

***What is the RAC run?*** After the Day-Ahead Market is cleared and the re-bid period closes, PJM performs a second resource commitment known as the Reliability Assessment and Commitment (RAC) run, which includes the updated offers, updated resource availability information, and updated PJM load forecast information and load forecast deviation. The focus of this commitment is reliability.

## Load Forecast

**9. *Why was the load forecast lower than the actual load on Dec. 23?***

The weather conditions, while extreme, were within the outer limits of the range PJM had planned for prior to the start of the winter. The PJM models under-forecast the peak load by about approximately 8% on Dec. 23, and 9% on Dec. 24, but Control Room operators had scheduled day-ahead what should have been more than enough generation for contingencies. NOTE: The original estimate was that load was under-forecast by 10%; totals were revised once all information on demand response performance was available.

The load forecast is determined by algorithm, and the model had never seen the conditions that occurred on Dec. 23, with the confluence of unprecedented cold temperature drops, the holiday and the weekend. In some areas of the region, the difference between the high and low temperature on Friday the 23rd was one of the greatest in recorded history. Operators therefore knew there was a lot of uncertainty in the load forecast because of the fast onset of frigid weather and, as a result, operated very conservatively, making a conscious decision to carry a large amount of additional capacity.

**10. *How do you forecast what is available?***

After the Day-Ahead Market runs, PJM has its own reports in the Control Room that come in from generators about their availability to make sure that adequate generation is scheduled. This availability is based on the unit

parameters that the resource owners are required to keep up to date. Looking at the overall fleet, PJM ended up with a maximum about 46,000 MW being on forced outage at any one time.

**11. Will PJM look at its load forecast procedures?**

PJM will analyze load forecasting procedures to determine how Operations can better account for the type of in-day extreme weather shifts and challenges presented by Winter Storm Elliott.

PJM weather forecasts are generally accurate. During this event there were conditions that have not been seen historically. The holiday effect and the nature of not having any historical comparison for the temperatures were two things that impacted PJM's model. PJM is looking at enhancements.

The actual load for this storm and the associated cold weather was significant but not historic. In addition, generator/plant issues appear to be larger than anticipated. The broader event analysis will look more closely at the reasons for generator outages.

**12. What does peak for Winter Storm Elliott look like compared to other historically challenging peaks?**

Our all-time winter peak is around 143,000 MW (Feb. 20, 2015). The 2014 Polar Vortex (Jan. 7, 2014) was about 140,500 MW. Preliminary numbers show the Dec. 23 load at about 140,000 MW (demand response brought it down to about 135,000 MW); the final numbers will be part of PJM's comprehensive report on the event.

## Generator Performance

**13. Can you break down the generator performance by fuel type?**

Measured by megawatt-hours, which indicates the availability over the course of the three days Dec. 23 – Dec. 25, natural gas plants had the most outages. This includes both gas and gas/diesel dual-fuel plants. About 63% of all outages were natural gas, 28% coal, 4% oil, 2% nuclear, 1% hydro, and about 1% other.

**14. How did wind and solar perform during Winter Storm Elliott?**

During Winter Storm Elliott, the wind and solar resources performed as the near-term forecasts projected, based upon wind speed and solar irradiance throughout the RTO. The hourly output of wind, solar and other resources can be found on Data Miner 2 at [https://dataminer2.pjm.com/feed/gen\\_by\\_fuel/definition](https://dataminer2.pjm.com/feed/gen_by_fuel/definition).

**15. Can PJM break out the volume of outage megawatts from units with capacity commitments vs. energy only for Dec. 23 and Dec. 24?**

Throughout the event, 95–96% of units that experienced unplanned outages were from resources with capacity commitments. The peak outage volume of megawatts from “energy-only” units was 1,518 MW the morning of Dec. 24.

**16. Were these generators expected to be called upon given the load forecast?**

PJM recognized that there was significant uncertainty in the load forecast given the anticipated weather conditions and the holiday weekend, and expected that sufficient generation capability could be called upon if needed based on the data submitted to PJM by the generation owners.



The PJM load forecast is not an input into the PJM Day-Ahead Market. The Day-Ahead Market clears based on bid-in demand. For Dec. 23, the Day-Ahead Market committed 133,000 MW of generation for energy, with an additional 9,000 MW of available 30-minute reserve.

For Dec. 24, the Day-Ahead Market committed 135,000 MW of generation for energy, with an additional 8,000 MW of available 30-minute reserves. Utilizing these commitments, as well as the generator parameters of units that did not have Day-Ahead commitments but were reporting to PJM as available with short notice, PJM anticipated that approximately 156,000 MW of generation should have been available.

While many generators performed well, the overall outage rate was unacceptably high. PJM had as many as 46,000 MW of units on forced outages during the hours when they were most needed. While a cross section of generation was impacted by the cold weather, gas plants and dual-fuel gas plants made up the majority of outages.

Capacity resources are required to offer into the Day-Ahead and Real-Time markets with accurate reporting as to their availability and unit parameters, which include but are not limited to start time, ramp rate, minimum output and maximum output.

In addition, resources can and do update their offers in both of these markets to reflect their actual fuel and operating costs.

PJM uses this information in its scheduling of both energy and reserves, and will call upon these available units when needed to serve customer demand and to maintain the reliability of the system. This includes scheduling additional resources during the operating day that were not given a day-ahead commitment.

**17. *What is the correlation between the load forecast and the generation that wasn't available in PJM? How, if at all, did the under-forecast impact the generation fleet that performed poorly?***

Some of the PJM resource owners have expressed concern about the correlation between the load forecast and unplanned generation outages. If a day-ahead load forecast is too low, this may result in longer lead generation (i.e., 24-hour time to start) not being scheduled in the RAC run with advanced notice. The amount of long lead (unscheduled) generation was approximately 3,000 MW. However, unless there was also an equipment failure or fuel supply issue, these unscheduled units would not be reflected in the 46,000 MW of forced unit outages. In addition, approximately 7,000 MW of generation were called but were not available in time for the Saturday morning peak.

PJM operators knew there was uncertainty in our load forecast for Dec. 23 because of the fast onset of frigid weather. PJM therefore operated very conservatively, making a conscious decision to carry a large amount of additional capacity in addition to the generation that was committed in the Day-Ahead Market; this should have been more than adequate to meet the actual observed load. However, PJM did not expect the extremely high rate of generation forced outages. The forecasting and the poor generation performance are not directly related; the load forecast did not make the generators perform poorly.

**18. *Why does PJM issue cold weather advisories and alerts?***

The Cold Weather Advisory and Alert are designed to get a generator to take a number of actions to prepare for the event so that they are able to either update their availability parameters or operate when called upon.



**19. Was there an issue with natural gas supply, either from pipeline problems or issues at the wellheads?**

The storm and the rapid onset of cold temperatures heavily impacted natural gas production, particularly in the Marcellus and Utica basins, which are the predominant source of the natural gas procured by gas generation in the PJM footprint. This led to significant loss of gas supply for all downstream gas consumers, particularly larger, more-efficient gas-fired power generation units that require nominated supply and higher pipeline pressures to operate.

- Supplies from the Appalachian Basin shrank 27% from usual levels, according to reports by Bloomberg.
- Well freeze-offs sent production plunging by more than 20% in Pennsylvania, while output more than halved in Ohio, constraining supplies into the Northeast and the Tennessee Valley.
- There were also losses of pipeline compression that occurred in Ohio and Pennsylvania, which tended to exacerbate gas delivery issues.

Based on preliminary information, the greatest cause of outages appears to be failure of plant equipment, along with failure to start, units tripping offline and temperature-related failures. Part of PJM's task over the coming weeks will be to determine exactly why those and other resources didn't perform.

**20. Were there coal units that couldn't start with low natural gas pressure?**

This question will be addressed in the Winter Storm Elliott Event Analysis.

**21. Is PJM going to release information about which plants/generators failed?**

PJM will release resource performance to the extent permitted under the Operating Agreement provisions for data confidentiality.

**22. Explain the relationship between all-call and the units that may have requested planned maintenance?**

In a Cold Weather Alert, there are units on approved planned and approved maintenance outages – those categories don't have to do all those steps here; there were about 4,293 MW of planned outages and 1,692 MW of maintenance outages at the evening peak on Dec. 23.

**23. On Dec. 21, were generators contacting PJM with respect to unavailability of gas?**

As part of the cold weather alert, PJM requires generators to update their availability and operating parameters (notification time, start time, unit cost, etc.) in the Markets Gateway and eDART tools. In 92% of cases where generators failed to perform, PJM either had little or no notice, and very few resources provided updated parameters to reflect known fuel supply constraints or other unit issues.

Throughout the event PJM was in contact with both generation owners and natural gas pipeline operators regarding natural gas supply and pressure concerns to maintain situational awareness, but improvements need to be made in this area. This is continuing to be discussed at the Electric Gas Coordination Senior Task Force.

As part of the Winter Storm Elliott Event Analysis, PJM will look at all the weather and capacity emergency steps, timing, actions taken and other factors.

**24. Did CTs interact with PJM?**

Approximately 11,000 MW of CTs were committed in the Day-Ahead Market for the Dec. 23 operating day, and close to 13,000 MW were committed in the Day-Ahead Market for the Dec. 24. Resources were notified of their commitments via Markets Gateway per normal procedures. Based on the Day-Ahead Market clearing results, PJM

did not anticipate the need to run a significant amount of additional CTs on Dec. 23 or Dec. 24. However, as more and more generating resources started to report their unavailability to PJM during the evening peak on Dec. 23 and through the early morning hours of Dec. 24, PJM dispatch then began verbally scheduling additional CTs to come on-line.

**25. What actions are taken when a Cold Weather Advisory is issued?**

PJM Manual 13, Section 3.3 describes actions required prior to the operating day identified in the advisory:

- Prepare to take freeze protection actions such as erecting temporary windbreaks or shelters, positioning heaters, verifying heat trace systems or draining equipment prone to freezing.
- Review weather forecast, determine any forecasted operational changes, and notify PJM of any changes.
- Update Markets Gateway by entering unit specific operation limitations associated with cold weather preparedness. Operating limitations include:
  - Generator capability and availability
  - Fuel supply and inventory concerns
  - Fuel switching capabilities
  - Environmental constraints
  - Generating unit minimums (design temperature, historical operating temperature or current cold weather performance temperature as determined by an engineering analysis)

**26. Does PJM rely upon information communicated to it by generators?**

If a generator reports to PJM through their offer parameters and generator availability status in Markets Gateway that they are available to run, PJM expects that unit is available and can run if needed.

**27. How are causes of outages reported to PJM? Does PJM independently verify causes of outages?**

Generation resources are required to report outages in advance of the operating day (when known) and in real time through the eDART application. This reporting is required to include the cause of the outage as indicated in PJM Manual 14D. Furthermore, PJM also requires more detailed after-the-fact reporting of all outages in the eGADS system by the 20th of the following month. Additional information on this reporting can be found on the PJM [eGADS web page](#) and the eGADS User Guide.

PJM doesn't validate data on causes of outages. If a unit is out, it will get a penalty. The outage is reported to PJM and NERC. The Independent Market Monitor also stated that they will be looking at every single outage of every unit.

**28. Can generation owners retroactively make changes to a unit's eDART ticket?**

Generation owners may augment previous eDART submissions to reflect additional forced outages, but retroactive eDART changes to remove or reduce previously-submitted forced outages is not allowed. If a Market Participant needs to remove or minimize a forced outage status previously submitted in eDART; such a revision must be submitted via eGADS and not eDART.

Note: PAI settlements use eDART data; any revisions submitted to eGADS will not be considered in PAI settlements. If a unit was online and generating during an interval when a forced outage was also reported, the unit's reported output via Power Meter is credited toward its actual performance megawatts, regardless of any eDART

outage. In addition, the scheduled megawatts for bonus and penalty utilize data reported in Markets Gateway during the PAI and are not influenced by eDART outages.

## Electric/Gas Coordination

### **29. *Could you describe interactions between PJM and the gas pipelines and when they may have occurred?***

PJM conducts weekly operational calls with the interstate pipelines throughout the winter period to review load forecasts and operating conditions to establish where risks may be present. Those discussions with the pipelines ramped up beginning on the morning of Dec. 23, 2022. At that point, all of the interstate pipelines had various restrictions in place including Daily Balancing Operational Flow Orders (OFOs), Ratable Take Requirements (uniform hourly gas flow), storage and transportation contract limitations as well as reductions to interruptible services.

As conditions began to deteriorate that afternoon, additional conversations were ongoing to gauge real-time operations on both the gas and electric sides and assess mutual areas of concern, largely around the significant loss of upstream gas supply due to gas production failures. These supply failures were resulting in reductions of pressure in portions of the pipeline and limiting or preventing certain generation from operating due to those supply and pressure drops.

PJM was also informed by one of the major pipelines of three separate compressor station failures that resulted in the issuance of Force Majeure declarations between Dec. 23 and Dec. 24. PJM in turn conducted conversations with the generators downstream of those failures to review any potential loss of output as a result.

### **30. *Are there ongoing discussions about modifying the process for Real-Time commitment of gas generation?***

The larger natural gas issue is something PJM will consider. It appears that the expectations related to the then new Cold Weather Advisory PJM instituted in 2022 caught some stakeholders by surprise. There may be more actions that PJM and generators can take within the three to five days between the Cold Weather Advisory and the identified operating day. PJM relies on its stakeholders to provide the status of the units and their operating parameters, either through markets gateway or eDART, in any kind of weather or on a day-to-day basis. That is how PJM makes decisions. PJM and stakeholders will continue to discuss some of these issues in the Electric Gas Coordination Senior Task Force.

### **31. *Can you provide a status on regulatory developments relating to winterization in the natural gas industry?***

PJM and other RTOs have asked FERC and NERC to adopt stricter weatherization standards for generators, which they have thus far not approved. PJM hopes those regulatory agencies will revisit that issue and take note of the filing in December by all RTOs, including PJM, MISO, NYISO, ISO-NE, SPP, ERCOT, CAISO and Canadian grid operators.

Part of PJM's task over the coming weeks will be to determine exactly why those and other resources didn't perform. PJM will conduct an analysis and report those results along with our recommendations and actions. In addition, stronger winterization standards for the natural gas industry are also needed, and is something state and federal government should seriously consider, though PJM does not have any jurisdiction in area of natural gas production.

## Markets/Credit

### **32. *Is the penalty structure strong enough incentive to perform?***

That is a question that PJM will be looking at closely. PJM has never had a system-wide Performance Assessment Interval since the implementation of the current penalty structure, and many generators will be reviewed for performance and may be implicated as a result of this event. On the whole, the generator performance was not where it needs to be.

PJM and other RTOs have asked FERC and NERC to adopt stricter weatherization standards for generators, which they have thus far declined to do. PJM hopes those regulatory agencies will revisit that issue and take note of the filing in December by all RTOs, including PJM, MISO, NYISO, ISO-NE, SPP, ERCOT, CAISO and Canadian grid operators.

### **33. *How much of LMP during higher-than-normal prices is being paid by penalties from capacity resources that did not perform vs. ratepayers?***

None of the collected penalties go to paying energy costs (i.e., LMPs). Collected penalties are paid to over-performing resources as bonus for providing energy in excess of their required levels during emergency conditions.

Those details, including penalties and bonuses, are being worked out under a prescribed schedule.

### **34. *Did transmission constraint penalty factors influence prices, and if so, at which interfaces did this occur?***

Individual transmission constraints in the Real-Time Market and their marginal values are available in [Data Miner](#). This data shows which constraints were binding at the Transmission Constraint Penalty Factor and for which five-minute interval. More details are available in the [Jan. 11 slide presentation](#) at the Market Implementation Committee.

### **35. *When will data come out?***

PJM plans to publish preliminary reports on resource penalties and bonuses during the first full week of February. PJM expects to produce a full report on the event in mid-July (see March 22 update under Post-Event Analysis, Data and Report on page 19). PJM will continue to make data available on the [PJM Winter Storm Elliott Info web page](#).

### **36. *Will PJM delay the pre-auction activities for the 2025/2026 Capacity Auction?***

It is something PJM is considering given issues that are outstanding. PJM is sticking to the timeline at this point. As things change, PJM will need to look at whether the June auction needs to be delayed.

### **37. *What about making units whole if they proactively purchase gas without a Day-Ahead commitment and then are not allowed to operate in real time?***

Units need to be prepared to operate; there are no provisions in the PJM Tariff for making generators whole for fuel that they don't burn.

## PAI Settlements

### **38. *Energy and reserve market prices, particularly in certain areas of the PJM region, did not seem to indicate the need for emergency procedures and/or demand response during the latter part of the event on Saturday,***

***Dec. 24. Does PJM intend to remove the PAI designation for any intervals in any locations in the PJM region for any period during the event?***

No. PAIs are driven by the emergency procedures' steps initiated by PJM. PJM implemented the emergency procedures' steps that were determined to be necessary given the operating conditions and uncertainties faced by the system operators, and it is not possible to undo those declarations once the event is concluded. Units that were available and either operating or not called by PJM will be subject to the Security Constrained Economic Dispatch evaluation required by the Tariff and described in this document: <https://www.pjm.com/-/media/markets-ops/rpm/performance-assessment-settlement-summary.ashx>.

***39. Will PJM take into account the actual cost of gas when conducting the Security Constrained Economic Dispatch analysis?***

PJM will use the available offer schedules that were in Markets Gateway as of the PAIs in conducting the evaluation.

***40. If a unit was on a forced outage but would not have been economic based on the LMPs at the unit's bus in a given interval, is the unit excused from a performance penalty for that interval?***

No. Units on forced outages during a PAI are not excused from performance penalties.

***41. If a unit was called by PJM during a time period during which the Market Seller could not nominate natural gas transportation, is the unit excused from performance penalties until such time as a natural gas transportation nomination could be submitted?***

No. Inability to procure fuel or schedule natural gas transportation in the absence of a catastrophic force majeure is not an excuse from performance penalties in a PAI.

***42. If a unit was called by PJM and was unable to procure sufficient fuel to operate at its expected performance for the duration of the event, is the unit excused from performance penalties, especially if the Market Seller worked with PJM to manage its output so as to remain in operation for the duration of the event, albeit at a reduced output level?***

No. Inability to procure sufficient fuel is not an excuse from performance penalties during a PAI, and such penalties would be based upon the difference between actual performance and expected performance for each PAI.

***43. If a unit had its natural gas supply or transportation curtailed by either its natural gas supplier or natural gas pipeline, is it excused from PAI performance penalties?***

No, inability to procure fuel supply or transportation is not an excuse from PAI performance penalties.

***44. If a pumped storage hydro unit was directed by PJM operations to pump during a PAI, is the unit excused from performance penalties?***

Yes. Pumped storage units that followed PJM direction to either reduce output or pump during PAIs will be excused from performance penalties because such resources were scheduled down by PJM operations. However, storage

resources that had insufficient run hours available to produce energy up to their expected performance level, regardless of the reason, are otherwise not excused from performance penalties during PAIs.

**45. *Certain units with long lead times were never called by PJM to operate during the event. Are such units excused from performance penalties because they were never called on by PJM?***

No. If the sole reason why PJM operations did not call on such units was the lead-time parameter, then those units are not excused from performance penalties.

**46. *Is a unit excused from PAI performance penalties if the plant indicates it needs to conserve non-fuel consumables and PJM authorizes a reduction?***

No. Inability of a unit to operate due to a limitation other than fuel (non-fuel consumables, emissions, etc.) is not an excuse from performance penalties during a PAI.

**47. *How many generators are affected by penalties? (Updated April 12, 2023)***

Roughly 200 Market Participants are expected to be assessed a Performance Assessment Interval penalty based on the underperformance of roughly 750 capacity resources. PJM is reaching out to many of these Participants based on PJM's internal credit assessment to discuss their exposure, liquidity and ability to pay.

**48. *How much will generators be charged in penalties, and who is responsible for these payments? (Updated April 12, 2023)***

In general, those resources that underperformed relative to their committed capacity obligation will be penalized, and those that over-performed will receive bonuses. The total Non-Performance Charges assessed for underperformance during this event are approximately \$1.8 billion. Bonus performance payments ultimately depend on total collected Non-Performance Charges, so those credits are subject to change based on actual collections. Collection of these charges cannot be guaranteed because of factors such as litigation outcomes, bankruptcy discharge or other financial constraints affecting collectability. As such, the bonus credits are subject to change. See this [spreadsheet](#) (XLS) for additional details and how the charges will be assessed over the nine-month billing period.

**49. *When will the final numbers be known? (Updated April 12, 2023)***

Invoices were issued on April 7. The total Non-Performance Charges assessed for underperformance during this event are approximately \$1.8 billion. Bonus performance payments ultimately depend on total collected Non-Performance Charges so those credits are subject to change based on actual collections. Collection of these charges cannot be guaranteed on account of factors such as litigation outcomes, bankruptcy discharge or other financial constraints affecting collectability. As such, the bonus credits are subject to change.

**50. *What are the criteria to exit PAI and emergency procedures? (Updated April 12, 2023)***

Manual 13 describes the steps and triggers for declaring certain emergency procedures. It is ultimately at the discretion of the PJM Control Room to determine when system conditions are appropriate to end the emergency procedures reliably. As this is a dynamic system that is constantly changing, Operations will evaluate not only current system conditions but also future forecasted system conditions in making this decision. PJM operators were still facing an unknown evening peak and load performance and exercised caution with the use of demand response



resources. These considerations were factors in PJM operators' decision to exit emergency procedures in a prudent manner on Dec. 24.

**51. How do I find out if my generator was penalized? (Updated April 12, 2023)**

Final non-performance assessment reports representing the amounts to be billed in March were published in the Market Settlements Reporting System (MSRS) on April 5, 2023.

**52. Where do I submit questions regarding penalty and bonus calculations once they are available? (Updated April 12, 2023)**

Once the penalties and bonuses have been billed, questions may be directed to PJM Market Settlements at [mrkt\\_settlement\\_ops@pjm.com](mailto:mrkt_settlement_ops@pjm.com) or [custsvc@pjm.com](mailto:custsvc@pjm.com).

**53. Are PAI-related disputes appropriate for PJM's Alternate Dispute Resolution (ADR) process? (Updated March 30, 2023)**

No. PAI-related disputes are not appropriate for PJM's ADR process. Under Tariff, section 12.1, ADR is only applicable in the context of "any dispute between a Transmission Customer or New Service Customer, an affected Transmission Owner, or the Transmission Provider involving transmission or interconnection service under the Tariff."

Pursuant to Operating Agreement, Schedule 5, section 2.1, PAI disputes are also precluded from the ADR process, as the underlying penalties do not "aris[e] under the Related PJM Agreements," as set forth in Operating Agreement, Schedule 5, section 1.2. Additionally, FERC Order 578 provides guidance on identifying matters in which the use of ADR would not be appropriate. For these reasons, PJM's ADR process is not available for PAI-related disputes.

PJM will provide an informational update on this subject at the April 12 meeting of the [Market Implementation Committee](#).

**54. How much will this cost (for the penalties)? How much will I get (for the bonuses)? (Updated April 12, 2023)**

Total payment of bonuses will equal the total collection of penalties, although the megawatt-hour quantities of penalized resources and those receiving bonuses will not be the same, so the per-megawatt-hour rates will be different. The penalty rates by LDA are available at <https://www.pjm.com/-/media/markets-ops/rpm/2022-2023-pai-charge-rates-by-lda.ashx>. Market participant-specific penalty charges and bonus credits are available in the Non-Performance Assessment Billing Month Summary report in MSRS. Bonus performance payments ultimately depend on total collected Non-Performance Charges so those credits are subject to change based on actual collections. Collection of these charges cannot be guaranteed on account of factors such as litigation outcomes, bankruptcy discharge or other financial constraints affecting collectability. As such, the bonus credits are subject to change.

**55. What do you mean on Slide 31 of [the presentation at the Market Implementation Committee](#) when you say, "PJM is currently working through the billing timeline to account for any nonpayment risk and liquidity concerns"? (Updated April 12, 2023)**

The slide in question has to do more with PJM's liquidity than with Members. Bonus credits are equal to the total non-performance penalties actually collected by PJM. PJM's prior practice has been to bill penalties and bonuses in the same month. PJM previously assumed that 100% of penalties would be collected and therefore remitted 100% of bonus credits. However, due to the amount of the penalties for this event, it is reasonable to expect that there may be some nonpayment of penalties. If PJM were to remit bonuses equal to 100% of penalties under the



assumption of full collection, PJM may not have the liquidity to cover the bonuses if there are failures to pay a portion of the penalties.

On April 3, 2023, FERC accepted PJM's proposal to extend the payment period for non-performance penalties to help mitigate the risk of Member defaults and provide additional opportunities to collect penalty payments due. In addition, PJM [presented information](#) on the implementation of a bonus holdback at the March Risk Management Committee to account for differences between total penalties billed and total penalties collected.

**56. *Why does PJM propose extending the payment period for non-performance penalties into the next delivery year?***

PJM is seeking to mitigate the risk of Member defaults and provide additional opportunities to collect penalty payments due. This ultimately decreases the reliability risk that would otherwise arise if resources defaulted and could no longer be relied upon as capacity for the remainder of the delivery year. It correspondingly helps increase the pool of bonus payments available for resources that over-performed during the event.

**57. *Will penalty payers pay interest if they opt into the extended payment window of nine months? (Updated April 12, 2023)***

For future events that occur subsequent to the approval of the pending Tariff language, PJM believes it is reasonable to extend the billing schedule, where needed, without interest payments given potential extension of the billing time frame will already be accounted for in market expectations. In its April 3, 2023, ruling, FERC agreed.

Charging interest for the carrying cost of extending the Non-Performance Charge undermines the underlying goal of maximizing the collection of Non-Performance Charges and minimizing the risk of Member defaults.

However, in the limited instance where the Performance Assessment Interval already occurred and resource performance was conducted in accordance with expectations under the existing Tariff billing schedule, as is the case with this event, payment of interest is reasonable given that extension of the payment window may disrupt market expectations. For this event only, PJM proposes to assess the FERC interest rate at the time of the election of this option for months four through nine of the extended, proposed payback period. Interest would be allocated to Market Participants receiving bonus payments.

**58. *What is the likelihood that Market Participants will default? (Updated April 12, 2023)***

It is likely, based on the size of the penalties, that some PAI penalties may not be collected. The goal is to maximize how much is collected. PJM seeks to mitigate the risk of default through our credit and collateral efforts, as well as through PJM's amended billing timeline filing accepted by FERC on April 3, 2023.

**59. *Why not collect interest on payments in months one through three?***

The issue of interest payable during the delivery year in which the event occurs has already been considered and rejected by FERC in prior filings. The Commission found the practice of not charging interest appropriate because "not assessing interest reduces the liquidity risk for resources that may be subject to Non-Performance Charges and increases the probability of full recovery of Performance Bonus Payments by the over-performer."<sup>1</sup>

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<sup>1</sup> PJM Interconnection, L.L.C., 151 FERC ¶ 61,208 (2015) at P 184.

**60. What happens to penalties if a PAI is disputed by the Member?**

PAI penalties were included in the April 7 invoices. PJM has made determinations on the excusals submitted. Market Participants are required to pay their invoices notwithstanding any disagreement with PJM's determinations.

**61. When will generators entitled to bonuses learn what they can expect?**

Bonus estimates will be included in the preliminary reports targeted to be released by Feb. 10. These preliminary estimates will assume 100% collection of non-performance penalties. The total amount of non-performance penalties billed, and therefore bonus credits available, is subject to change based on additional data review and reconciliation. Further, the bonus credits actually remitted to Participants may vary as PJM only pays out the non-performance penalties that are actually collected from underperformers.

**62. Can payments be delayed pending a FERC ruling on PJM's proposal to lengthen terms? (Updated April 12, 2023)**

Market Participants are required to pay when invoices are due. PJM is invoicing based on the Tariff rules that are in effect at the time of the March billing statements, which were issued on April 7, 2023.

**63. Can PJM Members settle their amounts owed earlier than planned? (Updated April 12, 2023)**

No. If Members were allowed to pay off charges early, PJM would be required to recalculate the total bonus performance payment for all bonus recipients each time a Member paid early. Such recalculations would be administratively complex and unduly burdensome.

**64. Can PJM provide a number of megawatts that have reached the Capacity Performance penalty cap as part of this analysis?**

PJM will not have this information until after the submission of DR compliance data. PJM can include this information in the Winter Storm Elliott Event Analysis.

**65. Are excusals only granted for manual dispatch directives to lower a resource's output, or also for resources dispatched down for economics?**

An excusal can be granted for either reason. An excusal can be granted if the resource was manually dispatched down below its expected megawatt level. An excusal can also be granted if a resource is dispatched down based on economics, or LMP at the resource's location did not support operation at the expected megawatt level based on their available offer. It should be noted that resources on a forced outage do not have an available offer and are not eligible for an excusal based on economics.

**66. If a unit did not get a Day-Ahead offer, are you comparing Real-Time prices to a unit's Day-Ahead offer?**

PJM is comparing the offer available in the Real-Time Market with the Real-Time LMP for the purposes of evaluating whether a resource is excused from a CP penalty because its output was not economically required. In some cases, the Real-Time offer is the same as the Day-Ahead offer. However, units that have elected intra-day offers have the ability to update their offers in real time.

**67. When you discussed holding back some of the bonus performance payouts at the January Market Implementation Committee meeting, would that require a Tariff waiver?**

The Tariff language dictates that PJM only pay bonus credits equal to the non-performance penalties actually collected. Billing both penalty charges and bonus credits in the same month, so that Participants can benefit from

netting their bonuses with their penalties, requires PJM to make an assumption on the level of penalty that will be collected.

## **Credit, Collateral and Default**

### **68. Have there been any defaults as a result of Elliott?**

Dec. 23 and Dec. 24 billing activity was included in the Dec. 28, 2022, bill issued on Jan. 3, 2023. All monies due from the Dec. 28, 2022, bill were received, and there were no defaults.

### **69. When might any increases of collateral hit? Would that trigger a collateral call against that payment?**

PJM is developing a plan, which was [discussed](#) at the Jan. 24 Risk Management Committee, for how to proceed with collateralizing this event.

### **70. If generators default and PJM cannot collect all the PAI penalties, will that be a default that is part of the default allocation, and will PJM collect money from all Members to pay the default?**

The Tariff states that bonuses are only paid from penalties that are collected. To the extent a market Participant does not pay their PAI penalty, it reduces the amount of bonuses that will be paid. It is not treated as a socialized default subject to the default allocation procedures.

### **71. Could there be membership consequences if a resource is penalized, doesn't pay their penalties, then defaults and does not cure the default?**

Yes.

### **72. Is there a potential risk of default on penalty payments by any Market Participants?**

It is likely, based on the size of the penalties, that some might not be collected. There is not a default allocation to Members for nonpayment of these penalties. The risk of nonpayment is contained in the bonus pool.

## **System Reliability and Extreme Weather**

### **73. Is PJM participating in NERC standards reform?**

PJM is very active in winterization standards. The first set of standards goes into effect in April 2023. PJM voted against the second set because PJM did not believe it went far enough. In comments to FERC, PJM and all other North American RTOs urged FERC to approve this set because it is an improvement over the status quo, but also to develop tougher standards and quicker implementation. PJM recognizes that some of NERC standards are years down the road. PJM adopted several enhancements in our manuals to get ahead of those. Some of the winterization and data steps are stricter than the NERC requirements. PJM kept Reliability First, SERC, FERC and NERC aware of those steps.

### **74. You said in your winter assessment that you were ready; would you re-evaluate that winter assessment in hindsight?**

PJM was prepared for winter operations. For detailed information on PJM preparations, please refer to the [Operating Committee presentation](#) in November. This assessment planned an outage contingency of 16,500 MW versus the actual 46,000 MW. See also [PJM, Members Prepared To Meet Winter Electricity Demand](#) on PJM's news site, Inside Lines.

PJM had what should have been enough generation online for the weekend of Dec. 23–25. Operators scheduled conservatively, making a conscious decision to carry a large amount of additional capacity going into the Dec. 23 operating day. PJM saw an unacceptably high rate of generation failure – 92% of which came without warning. Operators deployed demand response resources and customer conservation when generators failed to perform. PJM was able to get through very difficult conditions while keeping the lights on.

Part of PJM's task over the coming weeks will be to determine exactly why resources PJM was relying upon didn't perform. PJM will conduct an analysis and report those results along with our recommendations and actions.

**75. *Is PJM seeing any patterns from the 2014 Polar Vortex, Uri and Elliott that the electricity industry needs to address?***

This question will be further addressed in the Winter Storm Elliott Event Analysis.

**76. *Were there lessons learned from Uri?***

PJM took actions as a result of Uri. The early warning provided by the Cold Weather Advisory was one of the new protocols introduced in 2022, and PJM also required generators to provide their minimum operating temperatures so that operators could understand when low temperatures would impact specific generators. Freezing issues were reported to PJM at generating plants in temperatures that, while low, were not unprecedented. These freezing issues outpaced the cold-weather impacts that PJM forecasted based on the data collected through the Cold Weather Advisory process.

In addition, all nine North American regional grid operators petitioned FERC and NERC for stronger winterization requirements.

PJM will provide additional detail in its Winter Storm Elliott Event Analysis.

**77. *With data PJM has observed to date, did units with onsite fuel perform better during this event than those without onsite fuel?***

This question will be addressed in the Winter Storm Elliott Event Analysis.

**78. *In the big picture, PJM saw high generator outages in this storm, and then you're losing additional resources due to policy and other drivers. How does this impact the long-term reliability concerns PJM has recently expressed?***

PJM remains concerned that the fleet is losing resources that provide essential reliability attributes and services, without an operationally viable replacement. At the same time, Winter Storm Elliott adds another layer, because these units that provide essential reliability services must perform when called upon.

PJM's number one priority is operating a reliable and cost-effective system for the 65 million consumers who depend on electricity in their daily lives. PJM did get through this historic event without any loss of load, but it was tighter than expected, and we don't want a repeat of it. We can and should do better.

This event and others will help PJM further understand which generators are reliable and inform PJM's ongoing work with stakeholders on the energy transition.

PJM will continue to examine all issues that have the potential to affect reliability and provide recommendations.

**79. Can PJM provide what the performance characteristics were in the rest of the Eastern Interconnection?**

The NERC/FERC report after Winter Storm Uri was comprehensive. PJM has expectations that the upcoming NERC/ FERC investigation will cover that.

## Communication

**80. Why did you issue a Call for Conservation? What was the timing driven by?**

On Friday evening of Dec. 23, as the generator outages continued to climb, PJM realized that the outage numbers would go up overnight and Control Room operators were concerned about meeting the peaks on Saturday morning and Saturday evening. The plan was to get the appeal released for it to be ready for the morning news cycle. PJM put the word out late Friday night via news release, social media and direct email to PJM Transmission Owner Communicators, and reissued the call early Saturday morning. PJM met with Transmission Owner Communicators at 8:30 a.m. Saturday and asked for their help; many Members responded by amplifying the Call for Conservation on their social channels and in the media.

More than 30 partners joined in that effort, gaining nearly 1 million impressions on Twitter alone. PJM believes their actions helped to flatten the load beginning at 7:15 a.m. Saturday, when the New Jersey Board of Public Utilities issued the first Tweet in response to PJM's call. We are grateful to all of those partners, as well as the consumers who took action during a holiday weekend to shut off some lights or appliances.

**81. At what point did PJM reach out to state officials?**

As PJM's State Government Policy team received information from Operations about the issues they were seeing on the system, PJM provided that information to state officials. PJM also ensured that state officials received PJM's Call for Conversation, and many of the states took action to publicize that request. PJM will continue to work with states so that we can reach as many end-use customers as possible when necessary.

## Post-Event Analysis, Data and Report

**82. When will PJM publish a comprehensive analysis of Winter Storm Elliott?**

We are targeting to publish a full, single report in mid-July.

**83. Why has the report date been delayed from the April time frame that was publicly discussed?**

As we got into our analysis of the event, it became clear that some of the critical data – such as GADS generator data and PAI settlement values – would not be available in a time frame to analyze and determine lessons learned by April. For the PAI piece specifically, we would need to complete the settlement process before conducting our lessons-learned approach, which may take a few weeks on its own.

In the meantime, additional requests came in from FERC that will engage the same resources that are working on the report:

- The NERC and FERC national investigation of Winter Storm Elliott grid performance involves multiple data requests to PJM that are due by the end of March. NERC/FERC will also follow up our submission with an on-site meeting at PJM in mid-April.
- FERC issued an order as part of the larger Order 2222 that requires compliance filings that also touch multiple areas of the organization attached to PJM's work on the Winter Storm Elliott post-event paper.

**84. Will there be any lessons learned available before the report is published to inform the work of the CIFP-RA on capacity market changes?**

We plan to release targeted lessons learned and recommendations regarding the capacity market in the mid-May time frame to help support discussion in that group and package development. Many of these are already in scope for that group, including:

- Rules regarding PAIs
- How we model winter risk
- How we account for correlated outages, etc.

**85. What are the focus areas of the paper?**

We are creating small “learning teams” that will hold three discussions on each of the following topics:

- Generator performance and gas availability
- Load forecasting
- Timing and criteria for emergency procedures
- Resource scheduling
- Capacity performance (execution of PAI process; where in the process can we find room for additional clarity, etc.?)
- Unit cost offer verification process

We will also be looking at event planning, market results and external communications.

## Miscellaneous

**86. Was there coordination with Duke Energy on the timing of their load shed in North Carolina?**

PJM coordinated with neighboring systems in advance and throughout the event. PJM and its neighbors always do what is possible to help one another based on system conditions. Once PJM implemented a maximum generation emergency, operators canceled most exports as authorized in PJM’s Tariff.

PJM heavily supported TVA and the Carolinas throughout the duration of this event by providing exports and stressing the PJM transmission system to its limits in the process. PJM also received interchange assistance from neighboring systems.

**87. What is the IMM’s perspective on this weather event?**

Joseph Bowling, President of PJM’s Independent Market Monitor, Monitoring Analytics, announced at the Jan. 11 MIC meeting that Monitoring Analytics would be performing its own comprehensive analysis of the Dec. 23–25 events.

**88. Will PJM continue to answer frequently asked questions received about Winter Storm Elliott?**

To the extent possible, PJM will continue to address frequently asked questions either through posted FAQs, or through the Winter Storm Elliott Event Analysis.

