

Winter Storm Gerri Review

January 13 – 18, 2024

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Markets & Reliability Committee
January 24, 2024

Operations Update

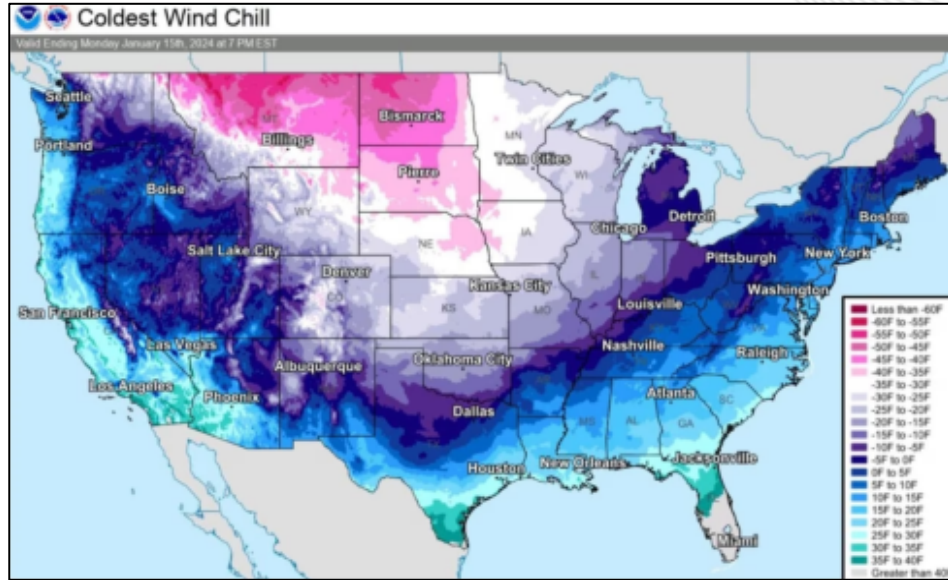
- Emergency Procedures
- Weather, Temperature and Load Forecast Accuracy
- Scheduled Interchange
- Generation Performance
- Gas Performance
- Transmission Performance

Markets Update

- System Energy Price Overview
- Congestion Impacts
- Ancillary Service Requirement Adjustments
- Ancillary Service Clearing Prices

Peak Load 134,777 MW @ 08:10

- Limited set of emergency procedures required
- Load forecast error within 3% threshold
- Significant level of exports to assist neighbors
- Strong generator performance
- Much better gas performance compared to Winter Storm Elliott
- Excellent transmission performance



On Jan. 13: Arctic air pushed into Western Region.

From Jan. 14–16: Air temperatures below zero degrees in COMED most hours



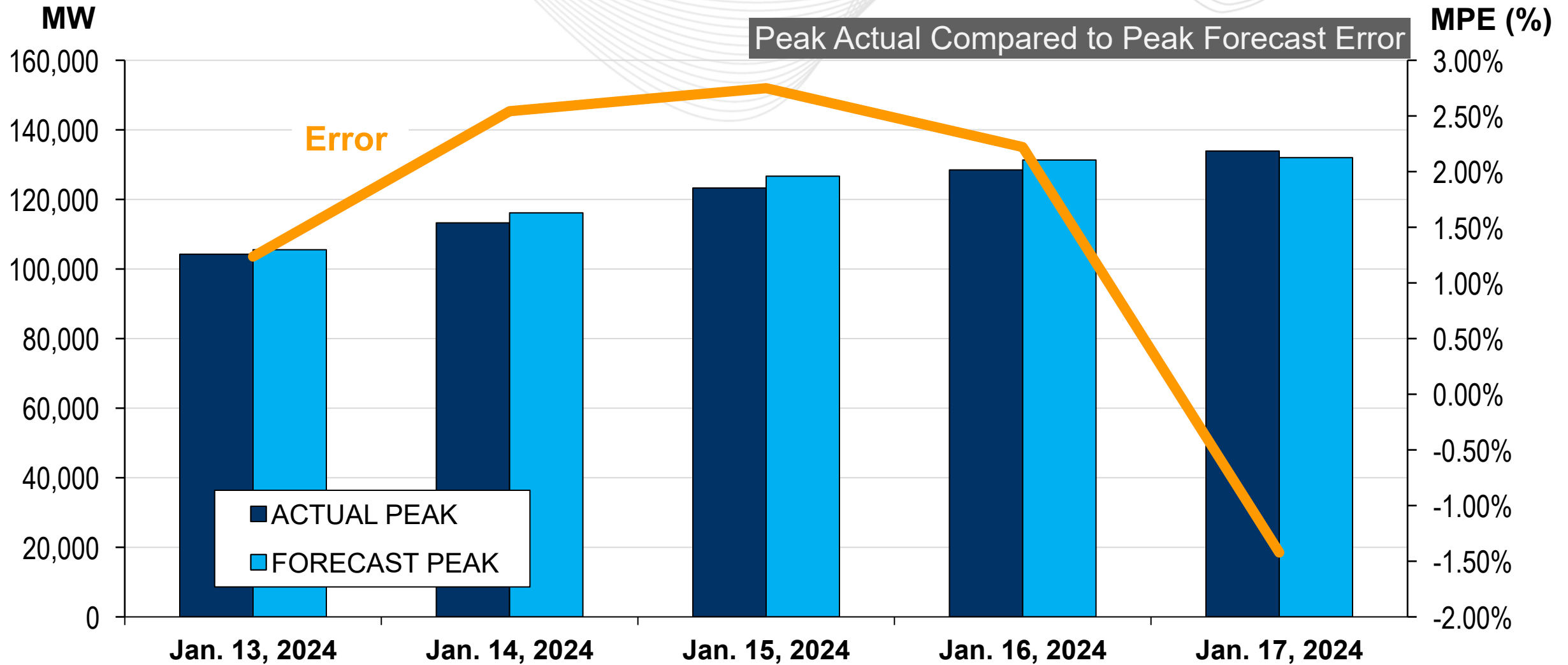
On Jan. 15: Coldest in Western Region

On Jan. 17: Coldest in Mid-Atlantic and Dominion regions

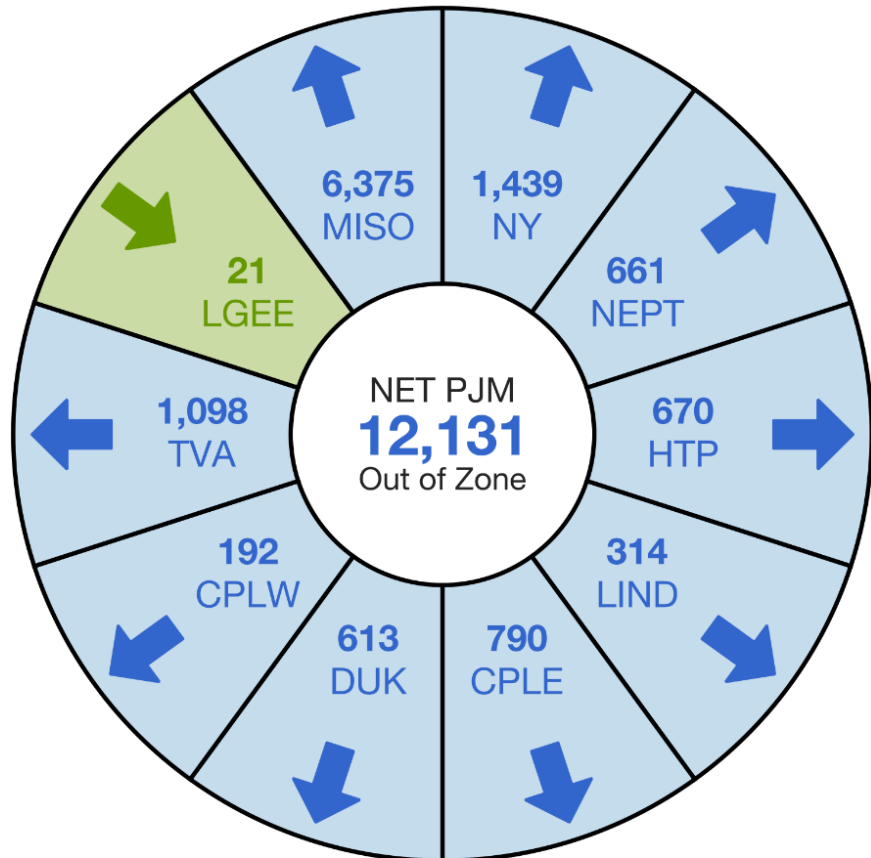
Winter Storm Elliott Dec. 23–26, 2022			January 13–18, 2024 Cold Wave	
Cities	Coldest Air Temperature	Coldest Wind Chill	Coldest Air Temperature	Coldest Wind Chill
Chicago	-8°F	-35°F	-10°F	-33°F
Columbus	-7°F	-34°F	6°F	-13°F
Louisville	-5°F	-31°F	6°F	-6°F
Philadelphia	7°F	-14°F	14°F	2°F
Richmond	8°F	-11°F	14°F	9°F

- **Cold Weather Advisory Western Zone**
 - Jan 14, 2024, 00:01 through Jan. 22, 2024, 10:00 (800 MW Regulation)
- **Cold Weather Alert Western Region**
 - Jan 14, 2024, 00:01 through Jan 17, 2024, 23:59
 - Jan. 19, 2024, 16:00 through Jan 22, 2024, 10:00
- **Conservative Operations**
 - Jan. 13, 2024, 00:01 through Jan. 17, 2024, 23:59
- **NERC Transmission Loading Relief (TLR) 1**
 - Jan. 17, 2024, 07:00 through 22:45

Forecast Error Trend for Jan. 13–17, 2024



As of Jan. 17, 2024, 9:35 a.m. EPT

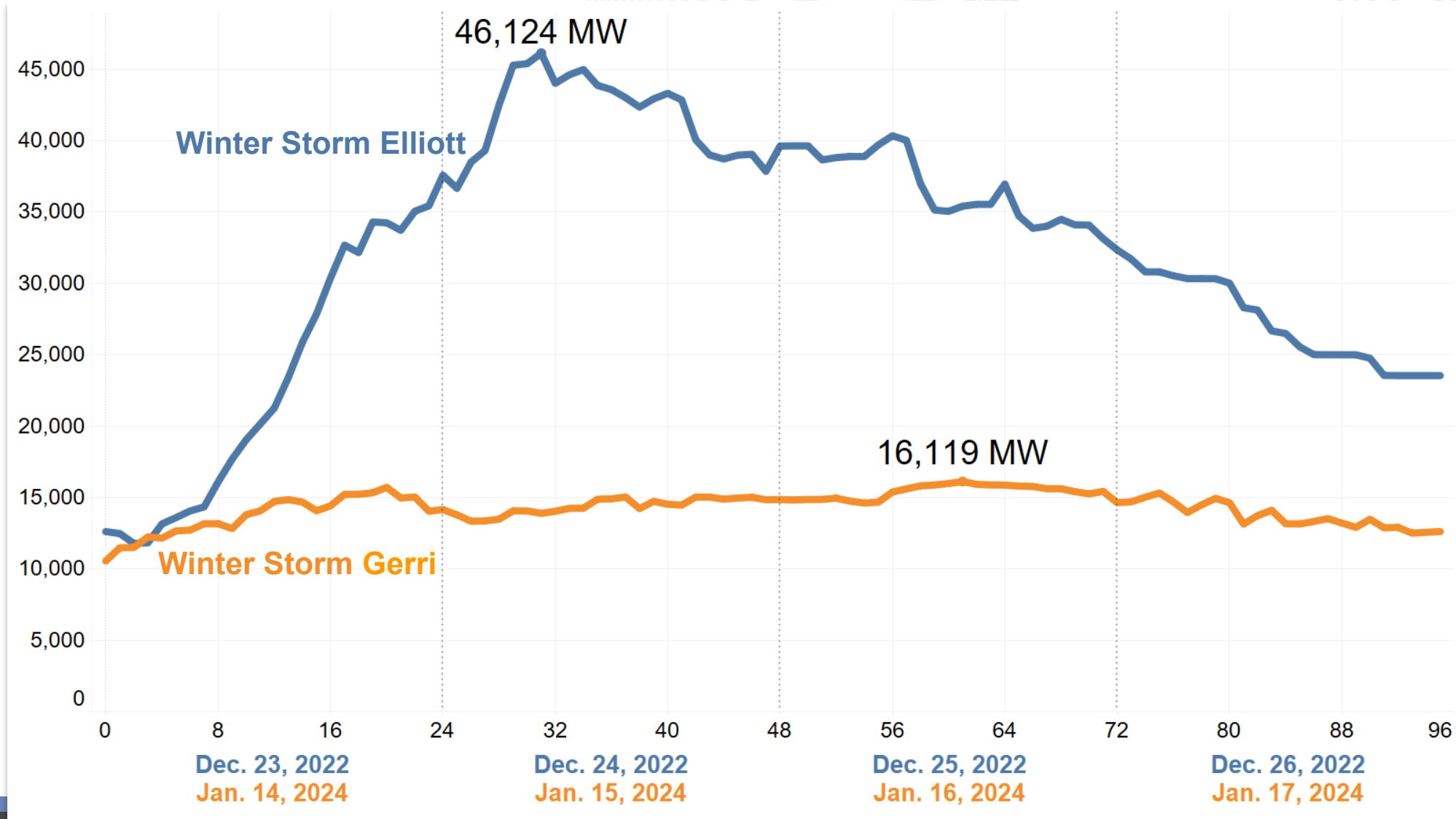


- Eastern Interconnection relies on mutual aid.
- PJM was able to aid neighbors at depth of cold snap, exporting nearly 10% of PJM's own needs.
- During 2014 Polar Vortex, roles were reversed, PJM imported power.

Actual
Imports: 21
Exports: 12,152

Scheduled
Imports: 71
Exports: 11,827

Winter Storm Forced Outage Comparison



Note: 16,653 MW discrete generator outages modeled in winter OATF analysis.

Winter Storm Gerri outage data shown is collected from eDART and considered preliminary.

- Much better performance compared to WS Elliott

- Production well freeze-off impact greatly reduced in the Northeast.

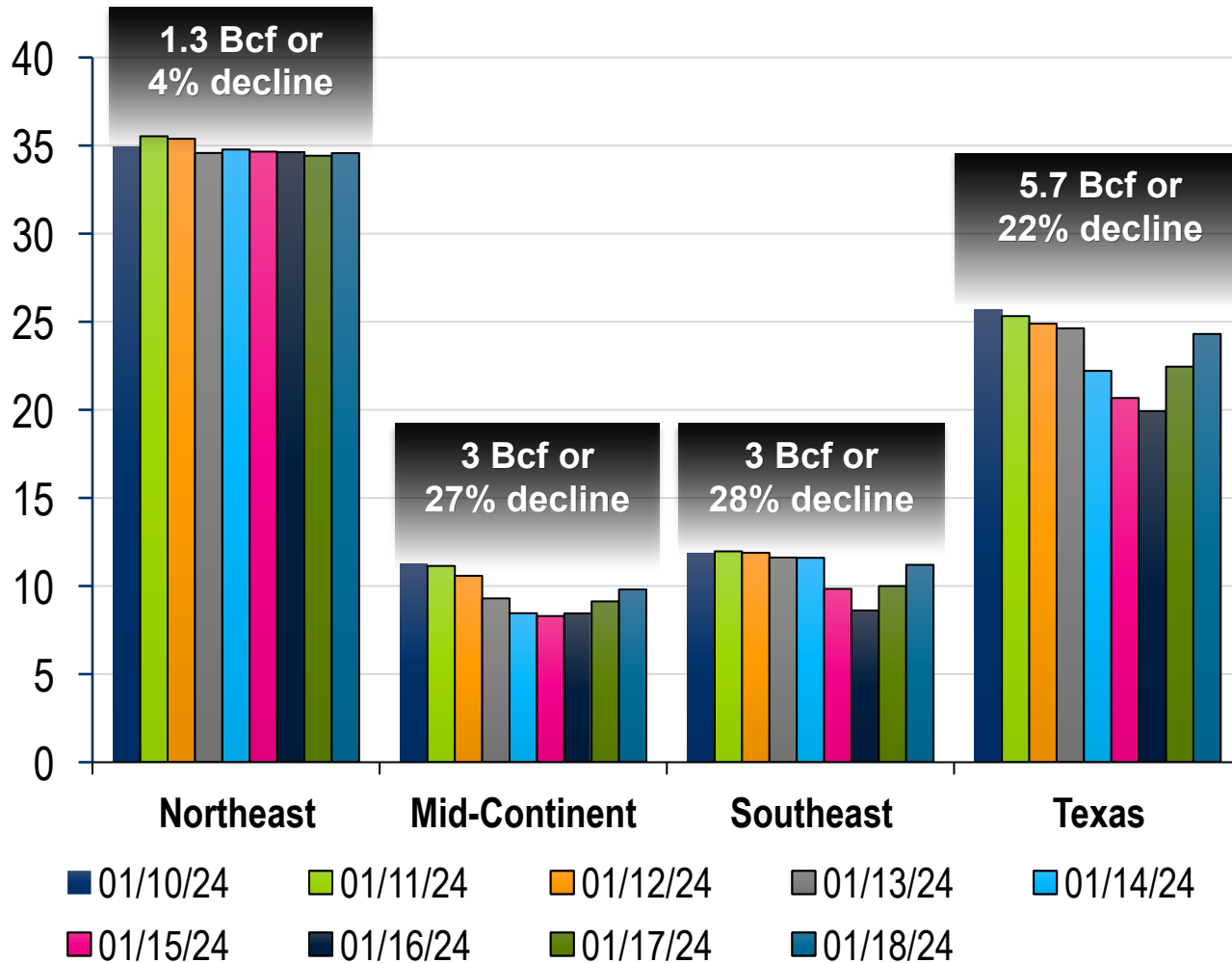
- Strong pipeline performance with minimal capacity or pressure impacts

- All pipelines were effectively “locked down” with various levels of daily and hourly capacity and contractual restrictions.
- Mechanically only a couple of minor compressor station issues that were quickly rectified within a few hours with minimal impact on generation

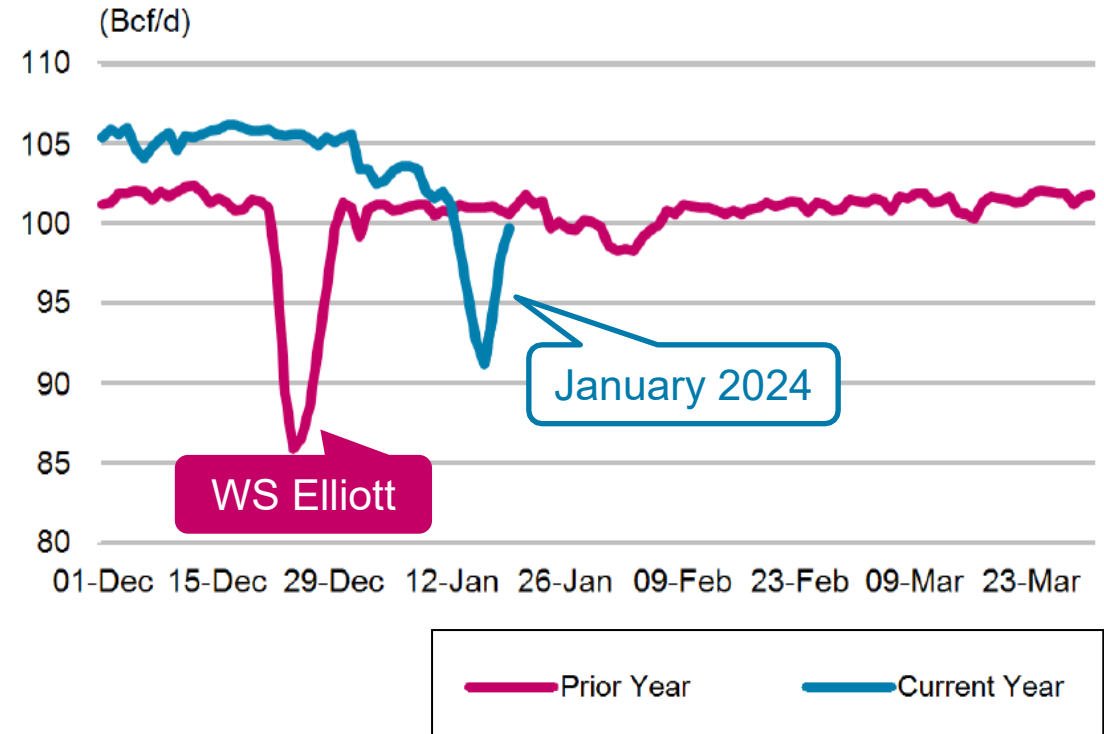
- PJM Gas-Electric Team maintained continuous communication with the pipeline control centers to monitor and share operating conditions and forecasts.

- Spot gas prices spiked up during trading on Friday, Jan. 12, 2024, for MLK holiday weekend gas (Saturday through Tuesday) but not to the levels observed during WS Elliott.

Daily Gas Production Losses Jan. 10–18, 2024 (Bcf/Day)



U.S. Dry Gas Production



PJM coordinated with:

- Transmission owners to reschedule approximately 40 scheduled maintenance transmission outages to periods of when lower loads are projected
- Transmission owner switched 765 kV reactors out of service in order to enhance transfer capability.
- Neighboring areas to place normally open EHV lines into service for more resiliency and transfer capability prior to the onset of anticipated cold weather

On Friday January 12

- Blizzard-like conditions were moving through the COMED area that caused (3) 345 kV lines to trip.
- Crews assessed damage, and no significant damage was found.
- Tripping was attributed to high winds and galloping conductors and the lines were re-energized.

Real-time pricing peaked coincident with system conditions on Jan. 16–18, driven by load, interchange and localized congestion.

SMP = \$479.87 @ Jan. 17, 07:45; \$490.39 @ Jan. 18, 06:55

Localized congestion peaked on Jan. 17.

Nineteen out of 26 active constraints in RT SCED bound at the \$2,000/MWh penalty factor.

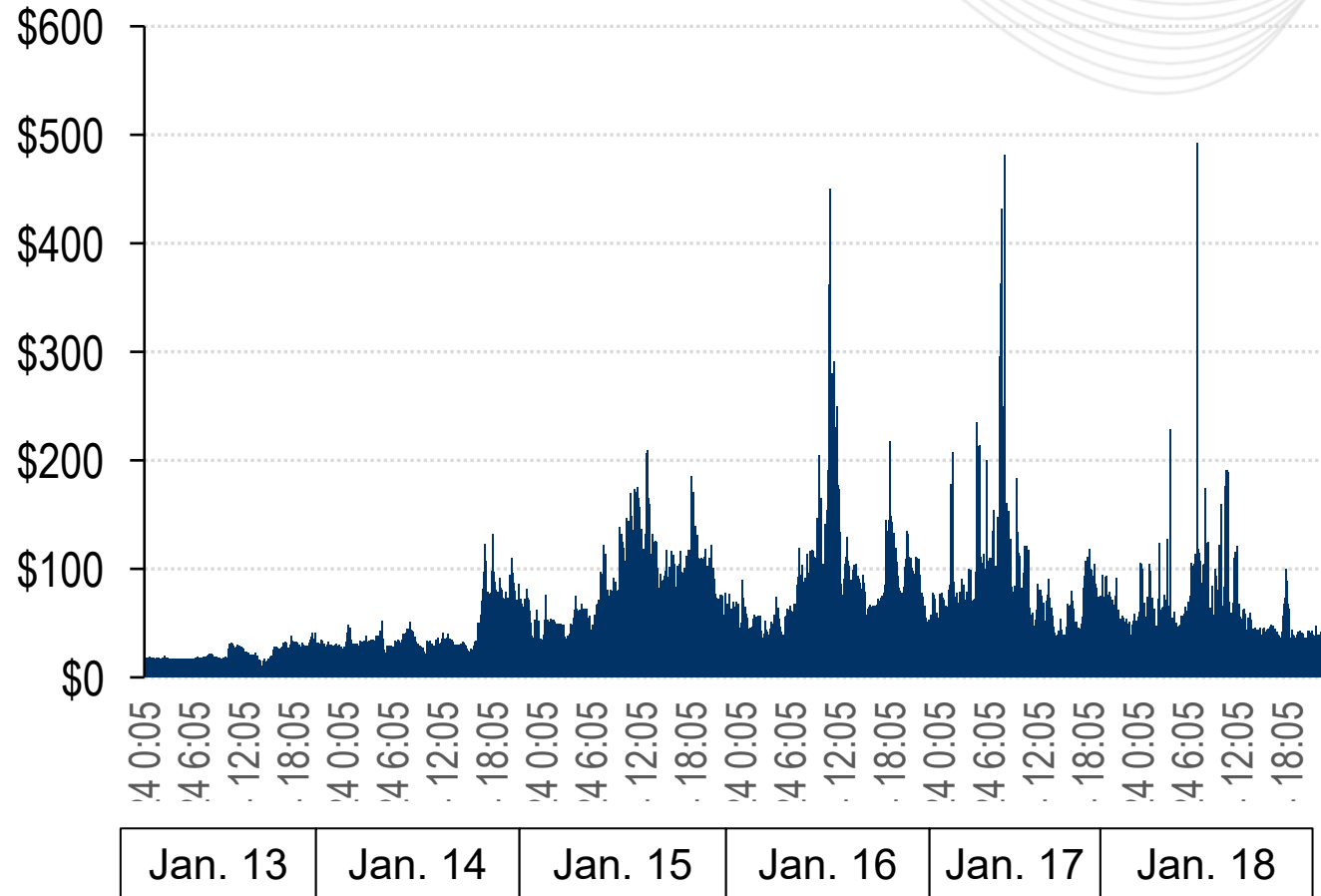
Additional reserves and regulation:

- No reserve shortage cases approved throughout event.
- One Synchronized Reserve event Jan. 13 (<10 minutes)

Date	Day - Ahead		Uplift
	Self-Scheduled Units	Committed Unit for Conservative Operations	
	<i>Sum of Eco Max</i>		
Jan. 13	80,657	< 1,000	\$3,160,956
Jan. 14	73,807	< 9,000	\$4,696,662
Jan. 15	70,596	10,140	\$20,304,835
Jan. 16	71,266	15,189	
Jan. 17	70,760	14,009	
Jan. 18	65,712	< 2,000	
Jan. 19	59,887	< 2,000	
Jan. 20		< 2,000	
Jan. 21		0	
Jan. 22		0	

Note: Uplift values reflect available settlement values.

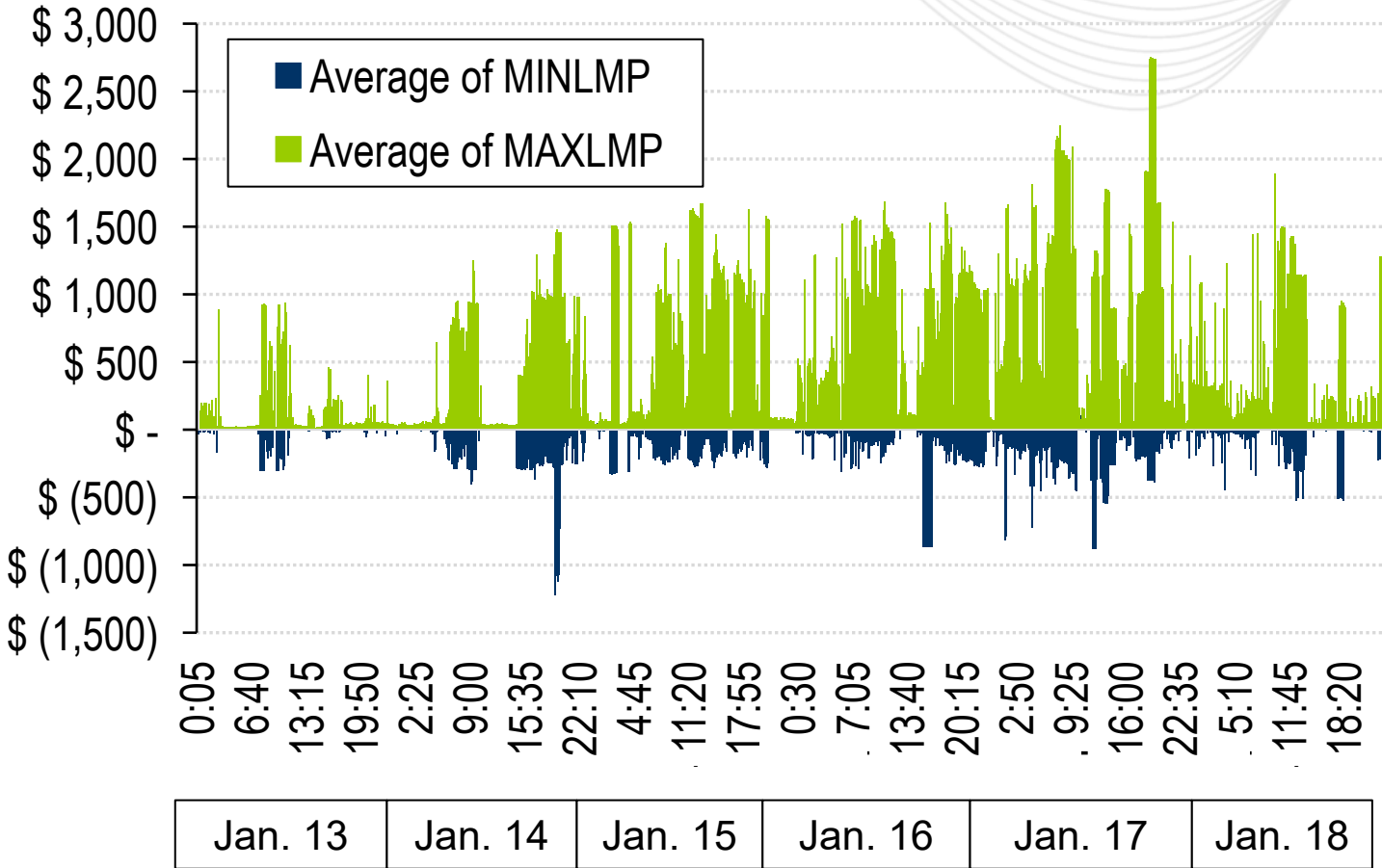
5-Minute Real-Time System Energy Price



Energy Component of LMP reflects the price of offers to supply an additional increment of energy from a generation resource or decrease an increment of energy being consumed by a Demand Resource to meet the forecasted load.

- *Energy component of LMP* is capped at the energy offer cap + 2 * Penalty Factor from first step of reserve Operating Reserve Demand Curve (ORDC).
No shortage cases were approved during WSE Gerri.
- *Total LMPs* were above \$2,000 when factoring in locational congestion and loss prices for multiple intervals.

Min./Max. 5-Minute Real-Time Total LMP



Locational aspect of load to constraints ultimately impacts pricing.

Pnode prices reached:

As high as \$2,749 As low as \$1,222
on Jan. 17 *on Jan. 14*

Zonal prices reached as high as
 \$1,122 (DOM) on Jan. 18.

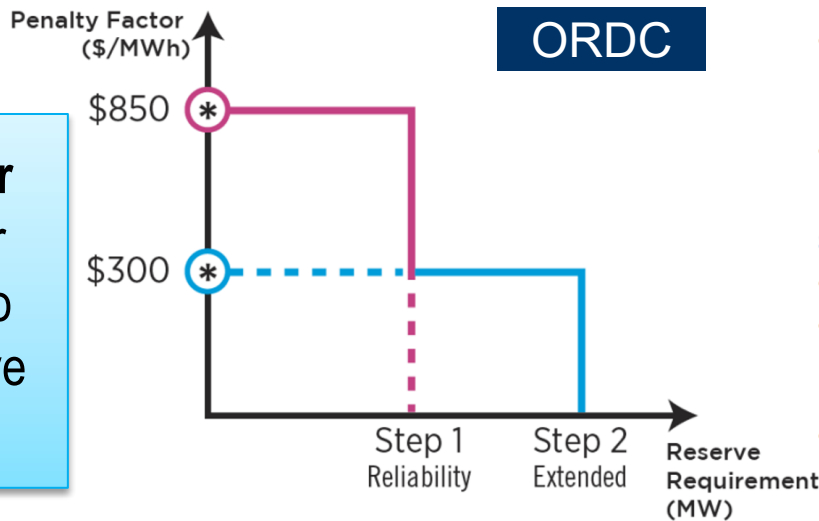
Transmission Constraint Penalty Factors

These are parameters used by the Security Constrained Economic Dispatch (SCED) applications to determine the maximum cost of the redispatch incurred to control a transmission constraint. Default is \$2,000/MWh.

Reserves:

On Jan. 14–17 – Step 2B of the ORDCs extended from 190 MW to 300 MW for 05:00 through 23:00.
(RTO Zone only, DA & RT)

Penalty Factor sets a price for being unable to meet the reserve requirement.

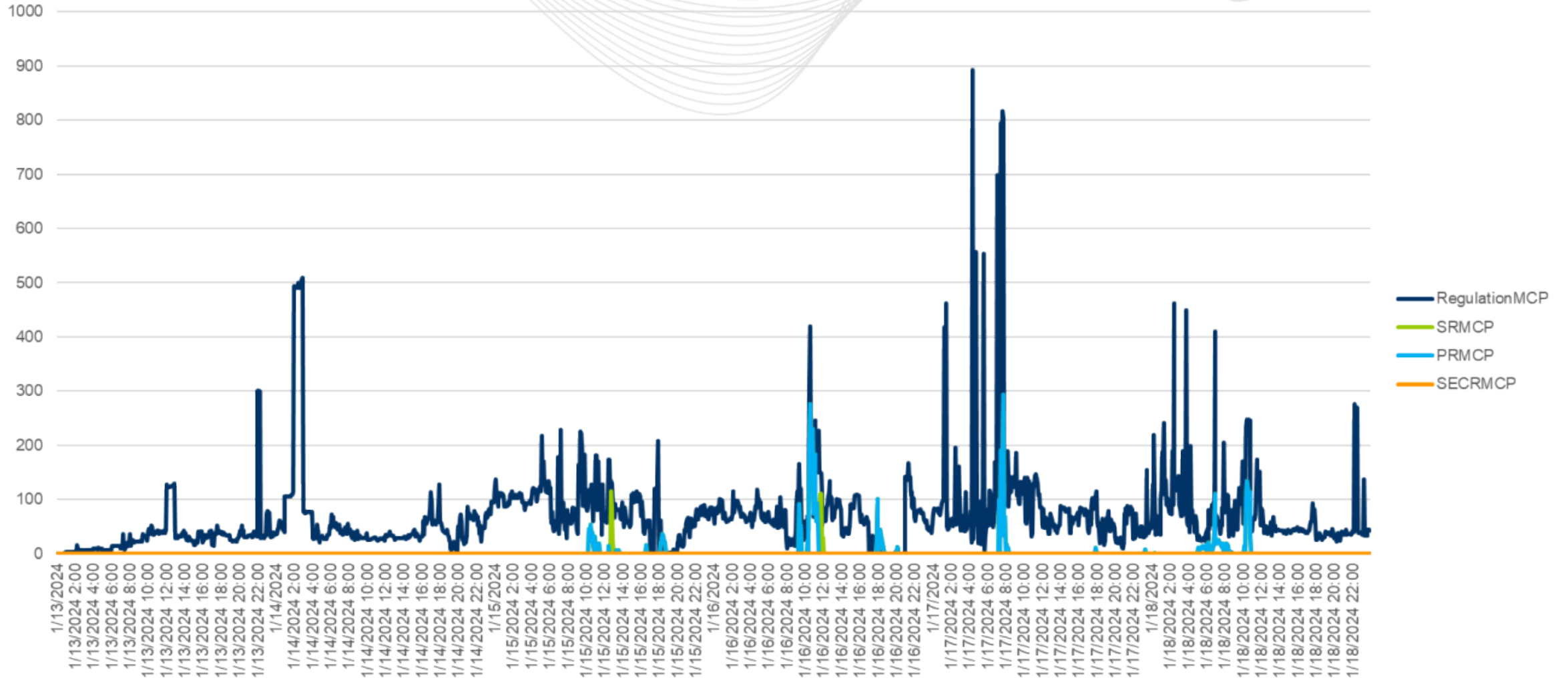


Regulation:

Jan. 14–17 – 800 MW for all hours

Normal requirement is 525 MW, 800 MW for off-peak, on-peak periods.

Updates communicated to stakeholders through Special Notice in Emergency Procedures tool.



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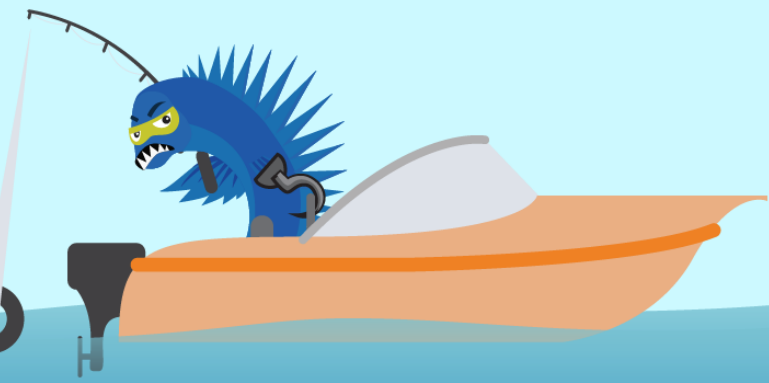
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