

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

PJM Interconnection, L.L.C.

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Docket No. EL19-58-008

ANSWER OF THE INDEPENDENT MARKET MONITOR FOR PJM

Pursuant to Rule 213 of the Commission’s Rules and Regulations,¹ Monitoring Analytics, LLC, acting in its capacity as the Independent Market Monitor (“Market Monitor”) for PJM Interconnection, L.L.C. (“PJM”), submits this answer to PJM’s motion filed January 18, 2022 (“Motion”) for clarification of the order on remand issued in this proceeding December 22, 2021 (“Remand Order”).² In its Motion (at 2), PJM seeks clarification as to whether the Remand Order upholds the Commission’s prior finding, in the first ORDC order issued May 21, 2020 (“May 2020 Order”), that it is just and reasonable “to remove the cap on reserve and energy prices when the PJM system experiences multiple reserve shortages.”³ That finding was overturned by the Commission in the subsequent Remand Order along with several other prior findings related to the ORDC penalty factors. The cap on the number of penalty factors that can affect price is a fundamental part of the current ORDC framework. The cap on the number of penalty factors should be maintained along with the \$850 per MW penalty factors. The Remand Order did not support or affirm the May 2020 Order’s finding to remove capping of the penalty factors.⁴

¹ 18 CFR § 385.213 (2021).

² *PJM Interconnection, L.L.C.*, 177 FERC ¶ 61,209 (“Remand Order”).

³ *PJM Interconnection, L.L.C.*, 171 FERC ¶ 61,153 at P 157 (“May 2020 Order”).

⁴ Remand Order at P 24.

The Remand Order (at n.105) directs PJM to implement a reserve penalty factor for 30 minute reserves that is “the same as the Reserve Penalty Factors for Synchronized Reserve and Primary Reserve.” This creates a new ORDC for secondary reserves. PJM seeks to increase clearing prices by adding this penalty factor to the other penalty factors included in reserve prices and LMP when there are multiple reserve constraint shortages. The Remand Order does not direct PJM to increase the synchronized and primary reserve clearing prices or the LMP to include the new 30 minute reserve penalty factor. Doing so would increase the highest possible reserve prices and energy prices by \$850 per MWh, or by \$1,700 per MWh if PJM models a 30 minute reserve requirement for the reserve subzone. Such an increase in prices is not consistent with the Remand Order’s conclusion (at P 46) regarding the capacity market that energy and ancillary service market (“E&AS”) revenues will not increase to such an extent “that the backward-looking offset does not reasonably reflect future E&AS revenues.” The need for such an increase in prices has not been demonstrated in this proceeding. The Commission should clarify that the Remand Order does not direct PJM to increase the synchronized and primary reserve clearing prices or the LMP to include the new 30 minute reserve penalty factor.

I. COMMENTS

The Commission’s April 19, 2012, order approved the combined \$850 per MWh penalty factors and an overall \$2,700 per MWh combined energy and reserves price cap (“April 2012 Order”).⁵ PJM raised the price cap to \$3,700 per MWh when the Commission approved cost-based offers up to \$2,000 per MWh with Order No. 831.⁶ The Remand Order requires PJM to maintain penalty factors as approved in the April 2012 Order. Given that

⁵ *PJM Interconnection, L.L.C.*, 139 FERC ¶ 61,057 at P 62 (2012) (“April 2012 Order”) (“We accept PJM’s proposed \$850 per MWh reserve price cap and the \$2,700 per MWh combined energy and reserves price cap, subject to conditions.”).

⁶ *See Offer Caps in Markets Operated by RTOs and ISOs*, Order No. 831, 157 FERC ¶ 61,115 (2016), *order on reh’g & clarification*, Order No. 831-A, 161 FERC ¶ 61,156 (2017), *amended by* 165 FERC ¶ 61,136 (2018).

the April 2012 Order linked the \$850 per MWh penalty factors to the overall energy and reserves price cap, both should be maintained.

The Operating Agreement states that only two of the four reserve penalty factors may be applied. The OA caps the market clearing price (“MCP”) for primary reserve at one times the nonsynchronized reserve penalty factor for each zone or subzone, and caps the MCP for synchronized reserve at the sum of the penalty factor for synchronized reserve and the penalty factor for nonsynchronized reserve.⁷ The overall energy and reserve price cap is not explicit in the PJM tariff, but the April 2012 Order is clear that the cap is included in the market design. The cap is two penalty factors out of four. The addition of a fifth penalty factor for 30 minute reserves does not require an increase in the cap to three out of five. A cap of two out of five penalty factors is consistent with the current approach.

The price cap is implemented in the PJM real-time market, where the security constrained economic dispatch (“SCED”) software caps the system marginal price (“SMP”) at \$3,750 per MWh. This cap is the sum of the cost-based Energy Offer Cap (\$2,000 per MWh), the Synchronous Reserve Penalty Factor from the first step on the demand curve (\$850 per MWh), the Primary Reserve Penalty Factor from the first step on the demand curve (\$850 per MWh) and a threshold (\$50 per MWh).

Under the current implementation, if the SMP would otherwise exceed \$3,750 per MWh, PJM solves the SCED optimization by progressively relaxing reserve requirement constraints until the SMP is below the cap. For instance, if the original SMP were above \$3,750, PJM would solve the SCED optimization by disabling the subzone (MAD) primary reserve requirement constraint. If the SMP from the relaxed SCED optimization were still above \$3,750, PJM would solve the SCED optimization by disabling subzone (MAD) primary and synchronized reserve requirement constraints. If the relaxed SCED optimization were still above \$3,750, PJM would solve the SCED optimization by disabling

⁷ OA Schedule 1 §§ 3.2.3A(d), 3.2.3A.001(c).

subzone (MAD) primary and synchronized reserve requirement constraints and the RTO primary reserve constraint.⁸ The existing capping process can change the economic dispatch of resources, especially if the RTO synchronized reserve constraint is relaxed.

Relaxing the 30 minute reserve constraint to maintain the price cap is not likely to affect economic dispatch, because most 30 minute reserves are provided by offline resources which are not dispatched by SCED. Regardless of the implementation process, the additional additivity of the penalty factors at \$850 per MWh each in LMP is not justified. There is no anticipated supply or demand response that would be elicited at \$6,250 per MWh or \$4,550 per MWh that would not be elicited at \$3,700 per MWh. There are no energy offers in the PJM supply curve that provide additional energy or reserves at a price of \$6,250 or \$4,550 per MWh than at a price of \$3,700 per MWh. These values all exceed the default energy offer cap of \$1,000 per MWh and the cost-based offer cap of \$2,000 per MWh. The higher prices would result in wealth transfers from customers to suppliers with no added economic benefit. The necessity of such a change has not been demonstrated in this proceeding.

A. Instances of Energy Price Capping in the Real-Time Energy Market

Since 2018, the SMP has been capped in 95 SCED solutions, of which four SCED solutions were approved and used in the LPC to set the five minute LMPs in the PJM real-time market.

Table 1 shows the shadow price, MCP and SMP for all reserve constraints for SCED cases that were solved using PJM's SMP capping logic and set the prices in the PJM real-time market. The shadow price of a reserve requirement constraint is the marginal cost of satisfying an increase in the reserve requirement. The shadow price equals the penalty

⁸ PJM Whitepaper, "Formation of Locational Marginal Pricing and the System Energy Component of LMP During Reserve Shortage Events," (May 2021), last accessed January 24, 2022 at <<https://www.pjm.com/-/media/markets-ops/energy/real-time/shortage-lmp-whitepaper-example.ashx>>.

factor of the reserve requirement constraint if the total cleared reserves are below the requirement.

Table 2 shows the components of the SMP for the five minute intervals that used SMP capping logic since 2018. The SMP is the marginal cost of satisfying an increase in load at the load-weighted reference bus. That marginal cost includes the marginal cost of generation, the marginal cost of congestion and the marginal cost of reserves. By definition, all of these marginal costs are included in the marginal energy component of LMP at the load-weighted reference bus, which is referred to as the system marginal price (SMP). The marginal cost of generation is the incremental offer price of the marginal generation resource adjusted for the marginal cost of losses. The marginal cost of congestion reflects the marginal cost of the unit required to meet the load if there are transmission constraints, including transmission penalty factors when relevant. If the marginal unit is also providing reserves, the marginal cost of reserves reflects the marginal cost incurred to meet the reserve requirement.

For example, the SMP for the five minute interval beginning at 10:10 on March 17, 2021, was \$3,653.98 per MWh. The MAD primary reserve constraint was disabled for this interval. Of the \$3,653.98 per MWh, the marginal unit's incremental energy cost after accounting for the marginal cost of losses was \$17.85 per MWh, the congestion cost was \$1,546.98 per MWh and the reserve opportunity cost was \$2,086.15 per MWh. The remaining \$3.00 is rounding error.⁹ The SMP, without the use of the capping logic, would have been at least \$3,965.08 per MWh.¹⁰

⁹ The final SMP does not precisely match the sum of components due to rounded network parameters such as distribution factors and loss penalty factors used for deriving the components of the SMP. This difference is shown as rounding error.

¹⁰ The original SMP shown in the table represents the lower bound of the uncapped SMP. PJM does not report the segment of the disabled reserve constraint. To derive the original SMP, the lowest priced segment that results in the SMP exceeding the cap was used.

The contribution of the transmission penalty factor of a violated transmission constraint to the SMP depends on the location of the marginal units relative to the location of the load-weighted reference bus. If the marginal unit is located such that an incremental increase in the load at the load-weighted reference bus results in increased flow on the violated transmission constraint, the SMP reflects the positive contribution of the transmission penalty factor. The marginal congestion component, \$1,546.98, for the five minute interval beginning at 10:10 on March 17, 2021, includes the contribution of transmission constraint penalty factors of two violated transmission constraints.

Table 1 Five minute intervals based on approved SCED cases that used SMP capping logic: January 2018 through December 2021

Five Minute Interval	Reserve Constraint	Disabled	Shadowprice (\$/MWh)	MCP (\$/MWh)	SMP (\$/MWh)
01OCT2019: 15:00:00	MAD Primary Reserve	No	\$0.00	\$300.00	\$3,651.02
01OCT2019: 15:00:00	MAD Synchronized Reserve	Yes	\$0.00	\$1,150.00	\$3,651.02
01OCT2019: 15:00:00	RTO Synchronized Reserve	No	\$850.00	\$1,150.00	\$3,651.02
01OCT2019: 15:00:00	RTO Primary Reserve	No	\$300.00	\$300.00	\$3,651.02
13NOV2020: 18:00:00	MAD Primary Reserve	Yes	\$0.00	\$850.00	\$3,166.28
13NOV2020: 18:00:00	MAD Synchronized Reserve	No	\$850.00	\$2,550.00	\$3,166.28
13NOV2020: 18:00:00	RTO Primary Reserve	No	\$850.00	\$850.00	\$3,166.28
13NOV2020: 18:00:00	RTO Synchronized Reserve	No	\$850.00	\$1,700.00	\$3,166.28
02MAR2021: 06:30:00	MAD Synchronized Reserve	Yes	\$0.00	\$2,782.22	\$2,994.68
02MAR2021: 06:30:00	MAD Primary Reserve	No	\$149.36	\$999.36	\$2,994.68
02MAR2021: 06:30:00	RTO Primary Reserve	No	\$850.00	\$850.00	\$2,994.68
02MAR2021: 06:30:00	RTO Synchronized Reserve	No	\$1,782.86	\$2,632.86	\$2,994.68
17MAR2021: 10:10:00	MAD Synchronized Reserve	No	\$850.00	\$2,000.00	\$3,653.98
17MAR2021: 10:10:00	RTO Primary Reserve	No	\$300.00	\$300.00	\$3,653.98
17MAR2021: 10:10:00	RTO Synchronized Reserve	No	\$850.00	\$1,150.00	\$3,653.98
17MAR2021: 10:10:00	MAD Primary Reserve	Yes	\$0.00	\$300.00	\$3,653.98

Table 2 Components of SMP for five minute intervals based on approved SCED cases that used SMP capping logic: January 2018 through December 2021

Five Minute Interval	Components of Final SMP					
	Lower bound of Original SMP	Final SMP	Marginal Cost of Generation	Marginal Cost of Congestion	Marginal Cost of Reserves	Rounding Error
October 01, 2019 15:00:00	\$3,950.36	\$3,651.02	\$33.88	\$2,436.47	\$1,173.81	\$6.87
November 13, 2020 18:00:00	\$4,049.76	\$3,166.28	\$520.20	\$0.00	\$2,645.22	\$0.86
March 02, 2021 06:30:00	\$3,891.21	\$2,994.68	\$30.51	\$181.10	\$2,780.81	\$2.26
March 17, 2021 10:10:00	\$3,965.08	\$3,653.98	\$17.85	\$1,546.98	\$2,086.15	\$3.00

The Market Monitor recommends in the State of the Market Report that PJM modify its implementation of the price cap. Instead of relaxing constraints in the RT SCED, the Market Monitor recommends limiting the sum of violated reserve constraint shadow prices

used in LPC to \$1,700 per MWh. This would prevent the SMP cap from causing SCED deviations from the least cost solution, and it would prevent the cap from being directly triggered by transmission constraints. But this implementation issue does not change the need to maintain the caps on the additivity of the reserve penalty factors that have been a core part of PJM's shortage pricing design since 2012.

II. CONCLUSION

The Market Monitor respectfully requests that the Commission afford due consideration to this answer.

Respectfully submitted,



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Dated: February 2, 2022

CERTIFICATE OF SERVICE

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

Dated at Eagleville, Pennsylvania,
this 2nd day of February, 2022.



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