UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators	)	Docket No. RM15-24-000

COMMENTS OF THE INDEPENDENT MARKET MONITOR FOR PJM

Pursuant to a notice of proposed rulemaking issued in this docket on September 17, 2015 ("NOPR"), Monitoring Analytics, LLC, acting in its capacity as the Independent Market Monitor for PJM ("Market Monitor"), submits these comments on the Commission's proposal to amend its regulations to require that PJM Interconnection, L.L.C. ("PJM") and other Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs) reform certain rules related to price formation in the markets that those entities operate.[1] Specifically, the proposed rules: (i) require that each RTO/ISO settle energy transactions in its real-time markets at the same time interval it dispatches energy and settle operating reserves transactions in its real-time markets at the same time interval it prices operating reserves, and (ii) require that each RTO/ISO trigger shortage pricing for any dispatch interval during which a shortage of energy or operating reserves occurs.

---

[1] *See Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Notice of Proposed Rulemaking (NOPR), 152 FERC ¶ 61,218 (2015); 80 Fed. Reg. 58393 (September 29, 2015).

I. COMMENTS

A. Settlement Intervals in the Real Time Energy Market

The Commission states (at P 26):

> The Commission preliminarily finds that the use of hourly integrated prices for real-time settlement may have the unintended effect of distorting price signals and, in certain instances, contributing to markets failing to respond appropriately to operating needs. Specifically, hourly integrated prices for real-time settlement may (1) not accurately reflect the value a resource provides to the system; (2) discourage resources from following dispatch instructions; and (3) cause increased uplift payments. Therefore, the Commission preliminarily finds that the use of hourly integrated prices for real-time settlement may result in rates that are unjust and unreasonable.

The Commission proposes (at PP 33–34): "to require that each RTO/ISO settle energy transactions in its real-time markets at the same time interval it dispatches energy and settle operating reserves transactions in its real-time markets at the same time interval it prices operating reserves."

The Market Monitor agrees that it would be appropriate to implement five minute pricing for the reasons stated by the Commission. The Market Monitor also recommends that five minute pricing in the energy market explicitly cover all resources providing energy including demand side resources and storage resources and that the associated metering necessary to do so be required.

1. Implementation Issues Associated with Five Minute Settlements

The Commission seeks comment (at P 38) "on the potential cost and time necessary to implement the reforms proposed in this NOPR," including specifically, the resulting "required software changes, increased data storage and validation, and required changes to market participant metering or other equipment."

The Market Monitor recognizes that there will be significant cost associated with the implementation of five minute settlements. But the Commission has required, frequently at

the request of PJM, other market changes that had significant costs, in the interest of improving the market design so as to improve market incentives.

The Market Monitor recommends that PJM not be required to conduct cost benefit studies prior to requiring implementation of five minute settlements. While the costs of implementation are possible to approximate, it is effectively impossible to calculate the efficiency benefits of implementing five minute settlements. Better pricing could result not only in short term improvements in incentives and responses by resources but in longer term changes in investments in new units and modifications to existing units as well as improving the transparency of charges for power and positive changes in the response of demand to wholesale market prices.

2. Coordination of Changes Needed to Implement Settlement Interval Reform

The Commission also seeks comment (at P 38) "on whether the changes necessary to implement the settlement interval reform proposed in this NOPR would be necessary in whole or in part to implement other reforms planned by the RTOs/ISOs or sought by stakeholders."

The Market Monitor agrees with the Commission's statement (P 8):

> Requiring settlement intervals to match dispatch intervals would make resource compensation more transparent by, among other things, increasing the proportion of resource payment provided through payments of energy and operating reserves rather than uplift.[10] Apportioning a greater proportion of a resource's revenue through payments for energy and operating reserves, rather than through uplift payments, increases transparency to the market by reflecting the costs of meeting system needs in settlement prices that are factored into a market price. In contrast, uplift payments bundle together a multitude of costs that are not factored into a market price. This increased transparency, in turn, better informs decisions to build or maintain resources and enhances consumers' ability to hedge.

The implementation of five minute settlements would contribute significantly to the reduction of uplift payments, which is an ongoing goal of PJM, of the Market Monitor and of PJM members.

3. Settlement Intervals for Intertie Transactions

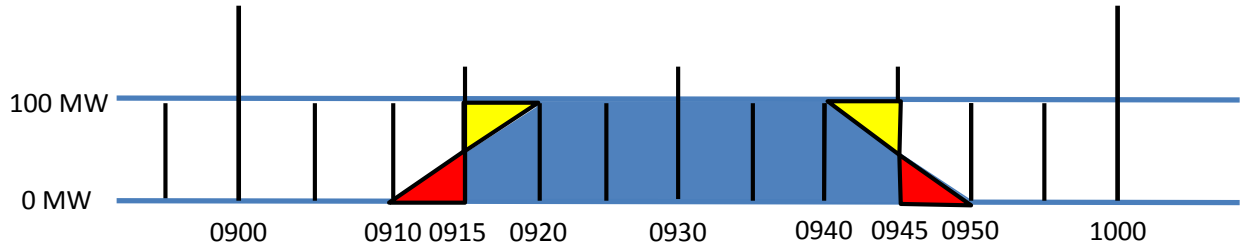
The Commission seeks comment (at P 39) on "whether settlement reforms are appropriate for intertie transactions that are scheduled on intervals different from the intervals on which RTOs/ISOs dispatch internal real-time energy," and "whether it is necessary to align the settlement interval for intertie transactions with external scheduling intervals, i.e., fifteen minutes."

There are at least three potential time periods to use in accounting for intertie transactions: 60 minute integrated settlements; 15 minute scheduling interval settlements; five minute interval settlements.

Currently, intertie transactions are assumed to be block scheduled and are settled on an hourly integrated basis. The Eastern Interconnection uses standard 10 minute ramp durations as the default for interchange transactions. At the start of the transaction, the ramp begins five minutes before the scheduled start time, and ends five minutes after the scheduled start time. At the end of the transaction, the ramp begins five minutes before the scheduled end time, and ends five minutes after the scheduled end time. This is commonly referred to as the "10 minute straddle ramp." The transaction is settled based on the scheduled start and end times.

For example, assume an import transaction for 100 MW is scheduled for 0915 to 0945 at the NYISO Interface (100 MW for 30 minutes is equivalent to 50 MWh). The transaction will start to ramp at 0910 at a rate of 10 MW/minute (100 MW scheduled with a 10 minute ramp = 10MW/minute), reaching the 100 MW scheduled interchange at 0920. The transaction will continue at 100 MW until 0940, and will ramp down at the same 10 MW/minute rate, ending at 0950 (Figure 1).

Figure 1: Interchange Ramp



The portion of the ramp shown in red in Figure 1 represents energy that is flowing outside of the scheduled interchange. This energy is ignored in settlements, but is assumed to be paid for because the transaction is assumed to flow at the full 100 MW for the full 15 minutes. (The quantity shown in red is assumed to equal the quantity shown in yellow in Figure 1).

This import transaction from the NYISO is settled using the hourly LMP, calculated as an average over all of the 12 five minute intervals. For example, in Table 1 the hourly integrated LMP would be $20.00, and the settlement for this transaction would be 50 MWh * $20.00, or $1,000.00.

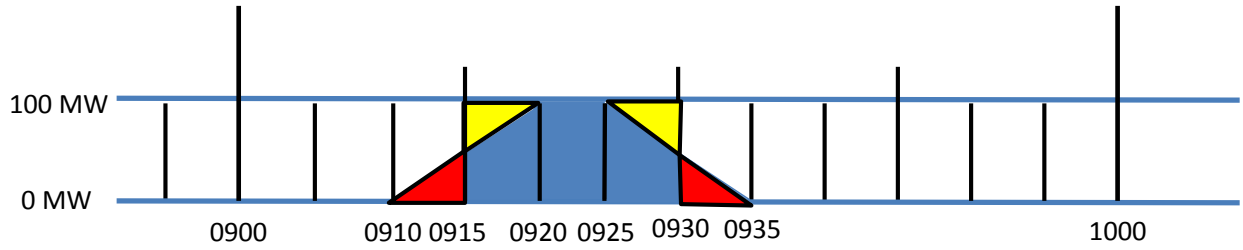
Table 1: Sample PJM/NYISO 5 Minute LMPs

Interval	LMP
0900	$14.00
0905	$15.00
0910	$16.00
0915	$17.00
0920	$18.00
0925	$19.00
0930	$20.00
0935	$21.00
0940	$22.00
0945	$23.00
0950	$24.00
0955	$25.00
1000	$26.00
Hourly Integrated	$20.00

An alternative approach would be to use the integrated price over the same 15 minute interval used in scheduling (segments 0915-0920, 0920-0925 and 0925-0930 for the 15

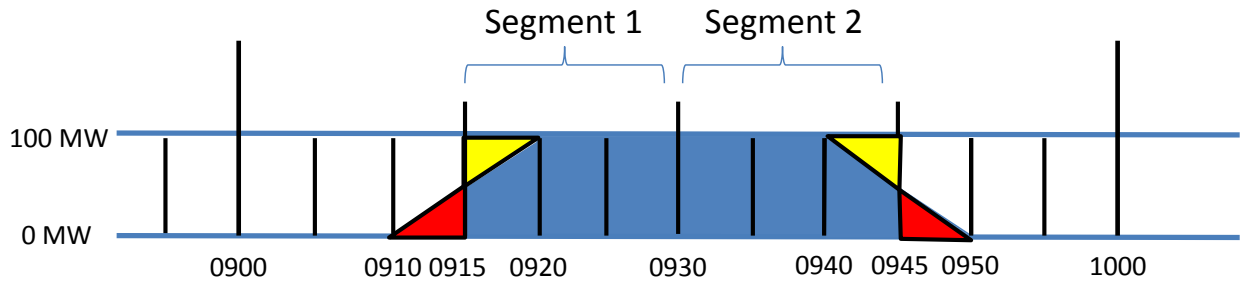
minute schedule between 0915 and 0930 shown in Figure 2). In this example, the 15 minute integrated LMP would be $18.00 (the average of the LMPs in those segments ($17.00, $18.00 and $19.00)), and the transaction would be paid $450.00 (25 MWh * $18.00).

Figure 2: 15 Minute Schedule Example



If a transaction were scheduled for the 30 minute period between 0915 and 0945 (Figure 3), the 0915 to 0930 segment would receive $450 and the 0930 to 0945 segment would receive $525.00. The second 15 minute integrated LMP would be $21.00 (the average of the LMPs in those segments ($20.00, $21.00 and $22.00)), and the transaction segment would be paid $525.00 (25 MWh * $21.00). The total payment for the 30 minute transaction would be $975.00.

Figure 3: 30 Minute Schedule Example



Another alternative for settling transactions would be to use 5 minute intervals. Under this methodology, the transaction would be paid for the actual energy that flows in each 5 minute interval, and would take the MW included during the assumed ramp into consideration. Since the ramp is assumed to be linear during the 10 minute ramping period, intervals 0910-0915, 0915-0920, 0940-0945 and 0945-0950 are each 50 MW. Each 5 minute interval between 0920 and 0940 is 100 MW. The settlement using this methodology is shown in Table 2.

Table 2: 5 Minute Settlement Example

Interval	MW	Integrated MW	LMP	Settlement
0910-0915	50	4.167	$17.00	$70.83
0915-0920	50	4.167	$18.00	$75.00
0920-0925	100	8.333	$19.00	$158.33
0925-0930	100	8.333	$20.00	$166.67
0930-0935	100	8.333	$21.00	$175.00
0935-0940	100	8.333	$22.00	$183.33
0940-0945	50	4.167	$23.00	$95.83
0945-0950	50	4.167	$24.00	$100.00
			Total Settlement	$1,025.00

Table 3 shows the total settlement applicable to each settlement method for the example 30 minute transaction.

Table 3: Summary of Settlements

Settlement Method	Transaction Settlement
Hourly Integrated Settlement	$1,000.00
15 Minute Settlement	$975.00
5 Minute Settlement	$1,025.00

The actual relative payments are a function of the pattern of LMPs by interval and would be different if the pattern of LMPs were different. A broader issue is that the MW of transactions cannot be measured accurately enough to support five minute settlements. For example, the ramp quantities are assumed, using a standard assumption across the Eastern Interconnection. In addition, accurate measurement is difficult as a result of differences between actual and scheduled flows.

The Market Monitor recommends settlement based on the same 15 minute interval used for external scheduling intervals. This approach would more accurately reflect LMP during the actual time period of the transaction and would make the period of the transaction and the settlement of the transaction consistent.

4. Settlement Intervals for Operating Reserves Transactions

The Commission seeks comment (at P 40) on "whether the Commission should require RTOs/ISOs to settle all real-time operating reserves transactions at the same interval

as real-time energy dispatch and settlement intervals or whether a settlement interval that differs from an RTO's/ISO's real-time energy dispatch interval would be appropriate for some operating reserves transactions."

PJM clears markets for regulation and synchronized reserve on an hourly basis, but the markets already incorporate five minute LMP data for the calculation of opportunity costs. In the Synchronized Reserve Market, the offer price includes both the direct short run marginal cost of providing synchronized reserves, which does not vary every five minutes, and the opportunity cost of providing synchronized reserves, if any, which does vary with five minute LMPs. For example, if a unit must be backed down to provide Tier 2 synchronized reserves and the unit would otherwise be producing energy economically, the opportunity cost is the energy revenue foregone as a result of maintaining the ability to produce energy rather than actually producing energy. PJM currently updates the opportunity cost every five minutes using five minute LMP data for the Tier 2 Synchronized Reserve Market and recalculates the clearing price every five minutes. Settlement is based on the average of the five minute clearing prices.

In the Regulation Market, the offer price includes both the direct short run marginal cost of providing regulation, which does not vary every five minutes, and the opportunity cost of providing regulation, if any, which does vary with five minute LMPs. For example, if a unit must be backed down to provide regulation and the unit would otherwise be producing energy economically, the opportunity cost is the energy revenue foregone as a result of maintaining the ability to produce energy rather than actually producing energy. PJM currently updates the opportunity cost every five minutes using five minute LMP data for the Regulation Market and recalculates the clearing price every five minutes. Settlement is based on the average of the five minute clearing prices.

PJM also purchases other forms of operating reserves on a cost basis, including Tier 1 synchronized reserves, non-synchronized reserves and DASR.

While it is appropriate to include the impact of changes in five minute LMPs on the cost of operating reserves in the form of synchronized reserve and regulation, the PJM

design for each of these markets currently incorporates those impacts. No additional changes to the market and non-market mechanisms for acquiring operating reserves are needed at this time in order to incorporate changes in five minute LMPs.

B. Shortage Pricing Triggers

The Commission seeks comment (P 51) on whether: "In order to remedy the potentially unjust and unreasonable rates caused by restrictions on shortage pricing, the Commission proposes, pursuant to section 206 of the FPA, [footnote omitted] to require that RTOs/ISOs trigger shortage pricing for any dispatch interval during which a shortage of energy or operating reserves occurs."

Five minute shortage pricing would correctly reflect actual shortage conditions and should be implemented if PJM could accurately measure the actual level of reserves on a five minute basis. It is the understanding of the Market Monitor that PJM cannot accurately measure the actual level of operating reserves on a five minute basis.[2] Without very accurate measurement of reserves at minute by minute granularity, system operators cannot know with certainty that there is a shortage condition and therefore the trigger for five minute shortage pricing does not exist.

If PJM cannot measure operating reserves on a five minute basis, the Market Monitor recommends that PJM be directed to develop methods to do so. But the Market Monitor also recommends that PJM not be directed to implement five minute shortage pricing until it can measure operating reserves accurately on a five minute basis. The advantages of five minute shortage pricing are all implicitly based on the premise that the RTO knows accurately whether it is in a shortage condition. If an RTO cannot demonstrate that it can accurately measure reserves at minute by minute granularity, it should not implement or continue five minute shortage pricing until it can demonstrate that capability.

---

[2] See e.g., Scarcity and Shortage Pricing, Offer Mitigation and Offer Caps Workshop, Docket No. AD14-14-000, Transcript 29:21-30:14 (Oct. 28, 2014).

II. CONCLUSION

The Market Monitor respectfully requests that the Commission afford due consideration to these comments as the Commission resolves the issues raised in this proceeding.

Respectfully submitted,

Joseph E. Bowring
Independent Market Monitor for PJM
President
Monitoring Analytics, LLC
2621 Van Buren Avenue, Suite 160
Valley Forge Corporate Center
Eagleville, Pennsylvania 19403
(610)-271-8051
joseph.bowring@monitoringanalytics.com

Jeffrey W. Mayes

General Counsel
Monitoring Analytics, LLC
2621 Van Buren Avenue, Suite 160
Valley Forge Corporate Center
Eagleville, Pennsylvania 19403
(610) 271-8053
jeffrey.mayes@monitoringanalytics.com