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 POTOMAC ECONOMICS, LTD.

Pursuant to the above-captioned Rulemaking initiated by the Federal Energy Regulatory Commission (the "Commission"), Potomac Economics hereby submits these comments. The Commission is proposing to require regional transmission organizations (RTOs)[1] to reform their rules concerning (1) settlement intervals for energy and operating reserves and (2) shortage pricing triggers. We believe these reforms are important and will help improve the RTO/ISO markets by providing incentives for better resource performance and by improving price signals during shortages. These reforms will improve the markets' short-run commitment and dispatch of existing resources and provide incentives for investment in resources that more efficiently meet the system planning requirements.

Potomac Economics is the Independent Market Monitor for the Midcontinent ISO (MISO) and ERCOT, the Market Monitoring Unit for the New York ISO (NYISO), and the External Market Monitoring Unit for ISO New England. In these roles, we are responsible for monitoring and evaluating the performance of each RTO's energy and operating reserve markets. We also

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[1] We use the term RTO to also include Independent System Operators (ISOs). In this way, an RTO refers to one of the various transmission system operators that administer centrally-organized wholesale markets in the U.S. See Table 1 of the Commission's NOPR which list the market to which this NOPR applies.

recommend market design changes to improve the performance of the markets and evaluate design changes proposed by the RTOs or market participants.

I. NOTICE AND COMMUNICATIONS

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II. BACKGROUND

Potomac Economics' role as market monitor for a number of RTOs involves us in a wide variety of wholesale market issues in RTO markets, including the price formation issues raised in the Commission's Rulemaking. We have participated and submitted comments in a number of technical conferences held by the Commission to address these issues.[2] Over time, we have also addressed these price formation topics in our State of the Market Reports for the RTOs that we monitor. We have emphasized the importance of these pricing issues and, like the Commission in its proposed rules, we have recognized their critical impact on efficient price formation and short run incentives for participants. Proper treatment of these issues also provides long-run incentives for participants to make efficient investment, retirement, and long-term consumption decisions. Hence, we strongly support the focus of this Rulemaking.

In accordance with the issues raised in the Rulemaking, our comments are in two parts. First, we address the Commission's proposed rules to align the settlement intervals with the dispatch intervals. We support these rules because of they will improve market incentives the

[2] See, e.g., Comments and Workshop Presentations in Docket No. AD14-14-000, (September 8, 2014, February 24, 2015, and March 6, 2015)

associated efficiency of the market outcomes. Second, we support the Commission's rules to improve shortage pricing triggers and agree that when RTOs fail to invoke shortage pricing during a physical shortage, prices will not reflect the value of energy or operating reserves supplied. The reform, therefore, will improve price formation and provide important incentives for suppliers to be flexible and responsive.

With regard to shortage pricing triggers, we recommend the Commission also address transmission shortages. Transmission shortages create comparable price formation issues that are just as important as energy and operating reserve shortages addressed by the Commission. Hence, we recommend that the Commission's rule be expanded to address transmission shortages, which occur when an RTO does not have sufficient redispatch capability to reduce the flow on a transmission constraint to the operating limit for the constraint. This is sometimes referred to as a transmission violation. When this occurs, the RTOs should recognize the shortage in the congestion component of the locational marginal price (LMP). As we explain in these comments, transmission shortages raise all of the same price formation issues as shortages of operating reserves or energy.

III. COMMENTS ON SETTLEMENT INTERVALS

The Commission is proposing that RTOs adopt rules that settle real-time energy and operating reserve market transactions in the same time interval as it dispatches these products. We strongly agree with the Commission's rationale for proposing these rules, which are consistent with recommendations we have made over time to improve pricing in RTO markets. As the Commission has recognized, aligning settlement intervals will improve efficiency in both the operating horizon when dispatch decisions are made, as well as in the planning horizon when investment and retirement decisions are made.

In the operating horizon, aligning real-time dispatch and settlement intervals will improve incentives for resources to respond to dispatch instructions. This will have both reliability and economic benefits. Improvements in generator performance increases reliability and reduces the need for higher cost actions by the RTO that compensate for poor performance. Aligning real-time dispatch and settlement intervals will improve incentives to be flexible and thereby create better investment conditions for building and maintaining appropriate resources in the long-term.

As we have shown in some of our past State of the Market reports for MISO, flexible resources earn more revenues when RTOs align their dispatch and settlement intervals because they can respond and benefit much more as prices fluctuate. In the long-run, these improvements would induce greater flexibility from new and existing resources and, consequently, would lower dispatch costs and improve reliability.

MISO generators receive a 5-minute dispatch instruction but settle based on an hourly-average price. We have shown that this inconsistency between dispatch and settlement intervals creates incentives for generators to not follow the dispatch signal or to simply be inflexible by: a) restricting dispatch range (difference between a generators minimum dispatch level and maximum dispatch level) or b) offering a slower ramp rate. MISO makes uplift payments to generators to alleviate these incentive issues. They are called Price Volatility Make Whole Payments (PVMWPs). These payments ensure that a generator that follows the MISO dispatch instruction will be "made whole" if following MISO's dispatch instruction adversely affects the supplier's settlement based on the hourly price.[3]

While PVMWPs have been effective at mitigating the adverse effects of un-aligned settlement and dispatch intervals, it is an inferior substitute for a true alignment where each

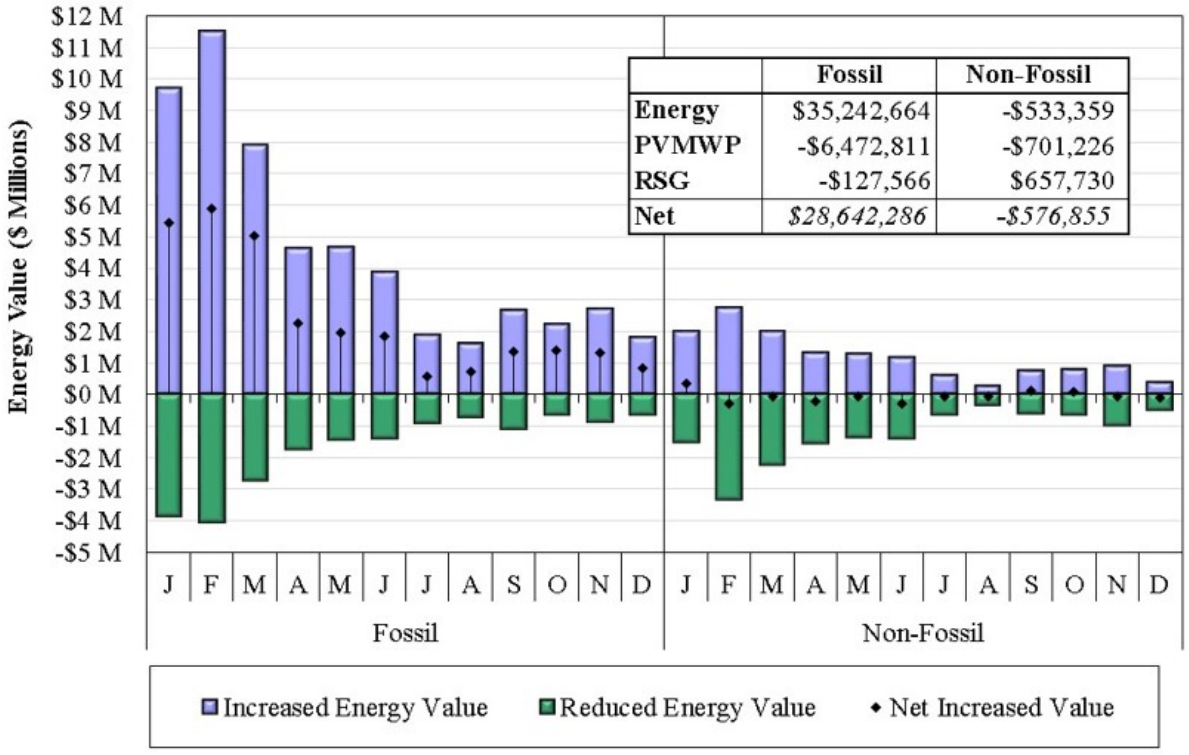
[3] These make-whole payments are calculated to restore day-ahead profit margins earned for resources that are scheduled in MISO's day-ahead market.

generator, importer, or exporter would settle based on the actual value of energy corresponding with its production or transactions in each five-minute interval.

We conducted an analysis in our 2014 MISO State of the Market Report that quantifies this shortcoming. Figure 1 summarizes our analysis. It shows how five-minute settlements would change the total payments to resources relative to the current hourly settlement. In other words, we measure how energy market settlements would change if the resources were paid in accordance with dispatch intervals. This is important, because these changes in settlements would produce more efficient incentives that will: induce more flexibility, improve generators' dispatch performance, and increase investments in flexible more resources.

In the figure, we distinguish between fossil-fueled resources and non-fossil-fueled resources because fossil-fuel resources tend to be more flexible and better able to respond to dispatch instructions than other resources (e.g., intermittent resources).

Figure 1: Net Energy Value of Five-Minute Settlements
2014



	Fossil	Non-Fossil
Energy	$35,242,664	-$533,359
PVMWP	-$6,472,811	-$701,226
RSG	-$127,566	$657,730
Net	*$28,642,286*	*-$576,855*

The table in the figure shows that fossil-fueled resources in 2014 received settlements that were $35 million less than they would have received if settlement were based on the five-minute prices and output. Most of these differences were accrued in the first half of the year, when shortages and congestion-related price spikes were far more frequent. Only about 20 percent of this lost value, however, was paid to resources in the form of PVMWP.

Of the $35 million in "missed" settlements, much of it was attributable to flexible steam units, who earned $19 million less than what would have been paid under a five-minute settlement regime. Non-fossil-fueled resources were paid on net nearly the same in hourly energy revenues as their actual five-minute energy value (actually slightly more on net).

The fact that fossil-fueled units likely would receive more revenue under a five-minute settlement is consistent with the fact that flexible, controllable resources are generally more valuable to the system and, therefore, would benefit from aligning settlement and dispatch. In the absence of congestion, dispatchable wind resources are typically infra-marginal at full output, so normally they cannot ramp up in response to higher prices. Additionally, wind resource output is negatively correlated with load and often contributes to congestion at higher output levels, so hourly-integrated prices often overstate the economic value of wind generation.[4] This is the primary reason why non-fossil resources do not benefit from alignment in the same manner as dispatchable fossil-fired resources.

These results show there are substantial discrepancies between the actual value of energy on a five-minute basis and settlements currently made on an hourly basis. The PVMWPs alone are not sufficient to address these discrepancies. The Commission's proposal to align dispatch and settlements will improve the incentives for generators to follow dispatch instructions,

[4] RSG payments to non-fossil-fueled units (shown in the table) are largely caused by the reduction in energy payments to pumped storage units committed by MISO since they frequently do not cover their offered costs.

provide more flexibility, and provide incentives for participants to schedule imports and exports more efficiently. Hence, we support the Commission's proposed rule.

IV. COMMENTS ON SHORTAGE PRICING

The Commission is proposing rules that would require RTOs to trigger shortage pricing in all dispatch intervals during which a physical shortage of energy or operating reserves occurs. We are highly supportive of this proposal and believe that pricing all shortages, regardless of duration, provides efficient incentives for resources to be flexible and to perform well, which ultimately lowers costs to consumers and improves reliability.

Together with the alignment of dispatch and settlement intervals, the requirement for RTOs to price transitory shortages will reward units that can respond quickly to help the RTO remedy the shortage and, in doing so, addresses the diminished reliability caused by the shortage. The NYISO already substantially complies with both proposed rules. MISO is generally compliant with the shortage pricing proposal, but settles with its generators based on an hourly average price (rather than the 5-minute prices). Since its hourly settlement undermines these efficiency benefits, we have been recommending that MISO move to a 5-minute settlement in its real-time markets.

While we believe the proposed rules will produce substantial economic and reliability benefits, it should be expanded to address transmission shortages. Transmission shortages occur when an RTO cannot move its resources to reduce the flows over a transmission line to less than its limit – i.e., the transmission constraint is violated.

As we explain below, transmission shortages are analogous to the energy and operating reserve shortages that the Commission addresses in its proposed rule. However, transmission shortages occur more frequently and are priced inefficiently by most of the RTOs.

Finally, RTOs that allow off-line resources to set prices in their real-time market can, in some cases, fail to price shortage as proposed by the Commission. We discuss below how this can occur and recommend that the Commission require the RTOs to evaluate such rules when making their compliance filings.

A. Pricing Energy and Operating Reserves Shortages

Real-time shortages of energy or operating reserves should be reflected in real-time prices whenever the system's requirements cannot be satisfied, even if only for five minutes. These shortages are real regardless of their duration. Typically, these transitory shortages occur when the system is ramp-constrained (output is increasing as rapidly as possible). These are true shortages because if a large contingency occurs during this period (for example, a generator tripping off-line), the RTO will not have the ability to replace the capacity because its other generators are already ramping as quickly as possible. Hence, reliability is degraded when this occurs and RTOs' real-time prices should reflect this.

Coupled with the alignment of settlement and dispatch intervals, pricing transitory shortages provides efficient compensation for flexible, fast-ramping resources. These are the resources that can respond quickly to help resolve shortages. There are many dimensions of resource flexibility that the Commission's proposed rules will motivate in the operating timeframe, including:

- Offering faster resource ramp rates;
- Offering wider dispatch ranges and not self-scheduling resources; and
- Offering shorter start times for natural gas turbines.

Additionally, these incentives have important long-term implications. They provide efficient incentives for participants to build more flexible, fast-ramping generating resources, and to make maintenance decisions on existing resources to increase their flexibility.

All of the markets that we monitor (ISO-NE, NYISO, and MISO) are designed to price all shortages, regardless of duration. This occurs because the operating reserve demand curves will clear the market in any five-minute interval in which the operating reserve requirements cannot be fully satisfied. However, as discussed in the following section, it is possible in some circumstances for off-line units to interfere with efficient shortage pricing for those RTOs that allow off-line units to set real-time prices.

B. Shortage Pricing Involving Off-Line Units

Some RTOs allow the offers of off-line quick-start units to set real-time energy and ancillary services prices. This occurs in different ways. For example, MISO allows such units to set prices through its ELMP model only in intervals when it is in an operating reserve or transmission shortage. Other RTOs allow quick-start natural gas turbines to set prices in any interval. In either case, there are conditions under which this is efficient and conditions when this can artificially lower energy prices and obscure shortages.

Allowing off-line units to set prices is reasonable if starting up an off-line unit is actually the least-cost option for satisfying a system requirement or managing a constraint. In most cases, the real-time market cannot detect that a natural gas turbine has received a start instruction and is in the midst of starting, so it frequently will not contribute to setting prices until it is online. In the meantime, the market may set inflated prices because the unit is not recognized until it is online. The RTOs can address this concern by allowing these units to set prices when they are off-line.

If these units are ultimately not started when they have set prices, it indicates that the RTO determined that the unit was either uneconomic (perhaps because of its start-up cost or minimum run time) or would not be a feasible option for satisfying the requirement (perhaps

because it could not start quickly enough). Hence, off-line units should only set prices in the real-time market when they are both feasible and economic.

If an RTO's pricing model allows infeasible or uneconomic units to set prices, it will interfere with efficient price formation by cause prices to be understated. This can happen if the pricing model is not sufficiently discriminating and allows units to set price when these units are either infeasible for addressing the need or are not economic. In such cases, the off-line units represent an artificial increase in real-time supply that will depress real-time prices. This can have a large effect when the system is experiencing an operating reserve or transmission shortage, which is ultimately not priced as a shortage because an off-line unit has set the price.

To avoid this, the RTOs' pricing models and processes should only allow off-line units to set real-time prices when they are a) truly feasible for satisfying a system requirement or managing a constraint, and b) the most economic option. MISO's ELMP model attempts to ensure that only truly economic units are selected by amortizing the unit's startup costs into the energy offer over four intervals (20 minutes). This is reasonable because the system need prompting MISO to rely on an off-line unit frequently lasts only 10 to 20 minutes. Hence, if a natural gas turbine cannot fully recover its commitment costs in 20 minutes, then it will frequently be uneconomic to commit and, therefore, should not set prices. Since the ELMP model only evaluates the next five minutes, amortizing the costs over an hour would cause the ELMP model to utilize off-line units that would not recover their commitment costs.

Because allowing off-line units to set real-time prices can cause an RTO to fail to price a real shortage, these types of pricing models can interfere with the Commission's objectives in its proposed rule. Therefore, we recommend that the Commission in its final rule require RTOs to demonstrate that their real-time pricing models do not allow off-line units to set prices in a manner that undermines its real-time shortage pricing. This can be demonstrated by:

- Describing how and when off-line units set real-time prices; and
- Showing that when off-line units have set price historically, that they are generally committed and dispatched as well.

If RTOs cannot demonstrate this in their compliance filing, then they may need to make changes to their pricing models to ensure that they satisfy the Commission's price formation objectives.[5]

C. Pricing Transmission Shortages

As we introduced above, while we strongly support the Commission's rules focusing on shortage pricing, we believe the focus should extend to transmission shortages. This is because the logic that motivates the proposed rules regarding energy and operating reserve shortages supports additional rules aimed at ensuring appropriate transmission pricing during shortages.

A transmission shortage occurs when the flows on a transmission line or facility exceeds the facility's operating limit. This generally occurs when the real-time dispatch lacks the resources or ramp capability in the right locations to reduce flow below the transmission facility's limit. This is a shortage that is analogous to an operating reserve shortage. In both cases, the system's requirements cannot be satisfied for some period of time.

In order to determine when to violate a transmission constraint (i.e., when and by how much to be in shortage), all RTOs employ a modeling parameter to specify how valuable it is to keep the flow over a transmission facility below its limit. The modeling parameter has various names, including:

- Marginal Value Limits (MVLs);

[5] We recognize that the Commission recently issued an "Order Directing Reports" on November 20, 2015 in Docket No. AD14-14. The Order requests, in part, RTOs to explain whether and how off-line units are used to set prices in RTO energy markets. Our recommendation in this rulemaking goes further by proposing that RTOs demonstrate that procedures used to allow off-line units to set prices do not interfere with shortage pricing.

- Constraint penalty factors; and
- Transmission constraint demand curves.

For ease of discussion here, we will refer to these as "transmission constraint demand curves" or "TCDCs". When the cost of re-dispatch to maintain the flow under the transmission limit exceeds the TCDC value, the model allows transmission to be used above its operating limit; that is, it allows the system to be short transmission. In this way, the modeling parameter represents the cost of the transmission shortage.

This is analogous to the reserve demand curves that indicate the cost of being short of reserves. However, the approach some RTOs take in managing transmission shortages (as opposed to managing energy and operating reserve shortages) is problematic in at least three ways.

1. Transmission Constraint Demand Curves are not in some RTOs' Tariffs

Reserve demand curves that are essential in managing and pricing during energy and operating reserve shortages are filed in the RTOs' tariffs and approved by the Commission. This is necessary because shortage pricing will only be just and reasonable if the operating reserve demand curves are just and reasonable. However, the TCDCs that play the same role during transmission shortages often are not filed or approved by the Commission.

The TCDCs play a pivotal role in the RTO's dispatch and its prices. In the dispatch, they limit the redispatch of generating resources to manage the constraint. For example, if the penalty factor is $1000 per MW of flow and redispatching of units that are needed to relieve the constraint would cost $1200 per MW of flow, the constraint will be violated and the congestion costs will be capped at $1000. The $1000 TCDC, when it binds, should result in a "shadow cost" of $1000 for that constraint. Typically, this will result in locational price effects of between $20/MWh and $200/MWh, depending on the "shift factor" on the constraint at the

pricing location. These congestion prices would drop by half if the TCDC were set at $500 per MW and could double if the TCDC were set at $2000 per MW. Clearly these parameters can substantially affect prices and dispatch patterns. Additionally, because TCDCs directly affect real-time prices, they will also affect the day-ahead market outcomes. Higher shortage pricing for transmission shortages will generally result in more generators begin scheduled in the day-ahead market and can help manage the constraint. Hence we believe they should be approved by Commission.

2. Some RTOs Change the TCDCs in Real Time

The TCDCs that are intended to lead to efficient dispatch and prices when a constraint is violated are sometimes changed during the operating horizon. To the extent that these changes during the operating horizon are justified, this suggests that the original TCDC may not have reflected the reliability value of managing the constraint. To the extent that the changes are not justified, they will artificially change the RTO's LMPs. In either case, such changes should be subject to Commission oversight. Such oversight can only be employed if the TCDCs and the process to change them are well-specified in the RTOs' tariffs.

Therefore, we recommend in the Final Rule in this docket that the Commission require each RTO that has not already done so to file tariff provisions that:

(1) Establish TCDCs that reflect the reliability value of managing the constraints (which may vary by type of constraint);

(2) Specify the procedures and criteria for RTOs to use to modify the parameters in real time.

3. TCDC Should Set Prices During Transmission Shortages

Even when the TCDC is not changed at the discretion of the RTO, the constraint is sometimes "relaxed", meaning the TCDCs is not used to set the shadow price on the constraint.

It is extremely important for these penalty factors to set prices when a constraint is violated. If an RTO has set its penalty factor to $1000, it will utilize all redispatch up to $1000 to manage the constraint. If the last MW of flow relief cost $999 in redispatch costs, its LMPs will reflect this shadow cost. However, when the constraint becomes violated, some RTO's "relax" the constraint to set a shadow cost less than the TCDC, which reduces the resulting congestion component of the locational prices. When this happens, shortage conditions have worsened and reliability has degraded, yet the shadow price on that constraint has fallen. This is both logically inconsistent and inefficient.

MISO used to employ this practice, but has discontinued it for most constraints. Prior to curtailing this practice, roughly $300 million in congestion costs per year were unpriced, which raised some of the most serious price formation concerns we have had as MISO's Independent Market Monitor.

When an RTO does not fully price transmission violations, it affects scheduling in the day-ahead market, and investment and retirement decisions in the long term. Hence, we recommend the Commission address this issue in the Final Rule by requiring the RTOs to discontinue the practice of relaxing the pricing of violated transmission constraints and, instead, to set LMPs that are consistent with the filed TCDCs for those constraints.

We recognize this may not be advisable until an RTO has the ability to set TCDCs that are constraint-specific. In reality, the reliability implication of violating some constraints is much higher than violating others. For RTOs whose software can only accommodate on TCDC for all constraints, including the New York ISO, it would be advisable to first improve the software to use constraint-specific TCDCs before allowing the TCDCs to set prices directly.

V. CONCLUSION AND RECOMMENDATIONS

We appreciate the Commission's focus on these issues because we believe good price formation is a primary driver of many of the RTOs' benefits. The Commission's proposals in these NOPRs address a number of key price formation issues. Consistent with our comments above, we respectfully recommend that the Commission modify its final rule to include the following compliance requirements:

1. To demonstrate that their real-time pricing models do not allow off-line units to set prices in a manner that undermines its real-time shortage pricing. This can be demonstrated by:
    a. Describing how and when off-line units set real-time prices, showing that when off-line units have set price historically, that they are generally committed and dispatched as well; or
    b. Proposing changes to their pricing models to ensure that they satisfy the Commission's price formation objectives.

2. For each RTO that has not already done so to file tariff provisions that:
    a. Establish TCDCs that reflect the reliability value of managing the constraints (which may vary by type of constraint);
    b. Specify the procedures and criteria for RTOs to use to modify the parameters in real time; and
    c. Use the TCDCs to set the congestion component of the LMP at any location affecting the constraint.

Respectfully submitted,

/s/ David B. Patton

David Patton
President
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November 30, 2015

CERTIFICATE OF SERVICE

I hereby certify that I have this day e-served a copy of this document upon all parties listed on the official service list compiled by the Secretary in the above-captioned proceeding, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated this 30th day of November 2015 in Fairfax, VA.

/s/ David B. Patton

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