



Potomac Economics filed comments on the NOPR on October 18, 2017. Many other parties filed comments on the NOPR that were generally consistent with the comments of Potomac Economics, including the PJM Interconnection, LLC (“PJM”). Potomac Economics submits these comments in response to PJM’s initial comments in this proceeding.<sup>2</sup> We agree with PJM’s assertion in its initial Comments to the NOPR that the proposed rulemaking “is a direct assault on competitive markets that the Commission and RTOs have spent years building and refining.”<sup>3</sup> However, PJM’s initial comments indicate that PJM is exploring pricing changes as an alternative to the NOPR that we believe will be highly inefficient and destructive to existing energy markets in the Eastern Interconnection.

These pricing changes were discussed in greater detail in a White Paper issued by PJM in June 2017.<sup>4</sup> The changes PJM discusses in this report would allow baseload resources operating at their minimum output level to set the energy price in the PJM energy market. Several other commenters argued that FERC should declare PJM’s current tariff unjust and unreasonable, and order PJM to adopt such pricing changes.

As explained in the comments herein, the pricing alternative proposed by PJM is not just and reasonable. It is inconsistent with the economic fundamentals underlying efficient LMP markets and would critically undermine the pricing and dispatch of the wholesale electricity markets. Hence, Potomac Economics strongly recommends that the Commission reject PJM and its Suppliers’ arguments that PJM should adopt price formation changes beyond those articulated by the Commission in its NOPR on Fast-Start Pricing.

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<sup>2</sup> Initial Comments of PJM Interconnection, L.L.C. on the United States Department of Energy Proposed Rule, Docket No. RM18-1-000 (October 23, 2017). (“PJM Comments”)

<sup>3</sup> PJM Comments, p. 27.

<sup>4</sup> PJM Interconnection, LLC. Energy Price Formation and Valuing Flexibility (June 5, 2017). (<http://www.pjm.com/~media/library/reports-notice/special-reports/20170615-energy-market-price-formation.ashx>). (“PJM White Paper”)

Potomac Economics is the Independent Market Monitor for the Midcontinent ISO (MISO) and the external Market Monitoring Unit for the New York ISO (NYISO) and ISO New England. In these roles, Potomac Economics is responsible for monitoring and evaluating the performance of each RTO/ISO's energy and operating reserve markets. We also are required to recommend market design changes to improve the performance of the markets and evaluate design changes proposed by the RTOs, market participants, or other parties.

## **I. NOTICE AND COMMUNICATIONS**

All communications, correspondence, and documents related to this proceeding should be directed to the following persons and such persons should be placed on the official service list maintained by the Commission's Secretary for this proceeding:

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## **II. REPLY COMMENTS**

In our initial comments, we argued that the proposal put forth in the Grid Resilience NOPR would undermine and potentially destabilize the wholesale electricity markets.<sup>5</sup> PJM's filed comments in opposition to the NOPR proposal that were largely in alignment with ours comments. PJM argued that the proposal would degrade reliability, reduce market efficiency,

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<sup>5</sup> Comments of Potomac Economics, Ltd., Docket No. RM18-1-000 at p. 15 (October 20, 2017). ("PE Comments")

increase costs, and have negative impacts on long-term investment decisions.<sup>6</sup> Additionally, PJM contended that the proposal hinders states’ rights, repudiates “fundamental rate-making requirements under the FPA,”<sup>7</sup> and “represent[s] a radical departure from years of Commission approval of single-clearing price markets.”<sup>8</sup>

Although we are largely in agreement with PJM on the NOPR proposal, PJM’s initial comments focus on price formation changes as a potential alternative to the NOPR proposal. A number of suppliers from PJM also supported these changes in their initial comments on the NOPR. The price formation changes alluded to in PJM’s initial comments and discussed other documents issued by PJM raise serious concerns, which we describe in this section.

#### **A. PJM Price Formation Discussion**

In its initial comments, PJM acknowledges that the DOE Staff Report pointed to price formation issues that PJM faces that can be addressed through market pricing reforms.<sup>9</sup> Leveraging the December 2016 Fast Start Pricing NOPR issued by the Commission to address price formation issues in the RTOs/ISOs, PJM proposes an alternative pricing reform that would broaden the set of resources that can set prices in the “Extended LMP” construct.<sup>10</sup> PJM discusses the Extended LMP pricing methodology that allows inflexible resources to set prices when they are needed to satisfy the system’s needs. This methodology has been used by other

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<sup>6</sup> See Initial Comments of PJM Interconnection, L.L.C. on the United States Department of Energy Proposed Rule, Docket No. RM18-1-000 at p. 3 (October 23, 2017). (“PJM Comments”)

<sup>7</sup> PJM Comments, p. 3.

<sup>8</sup> Id.

<sup>9</sup> Staff Report to the Secretary on Electricity Markets and Reliability, U.S. Department of Energy (Aug. 17, 2017) (“DOE Staff Report”).

<sup>10</sup> Fast-Start Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators, Notice of Proposed Rulemaking, FERC Stats.&Regs. ¶ 96,391 (2016). (“Fast Start Pricing NOPR”)

RTOs to allow fast-start resources, such as gas turbines, to set prices during peak conditions. This approach was proposed by the Commission in its Fast-Start Pricing NOPR.

PJM notes that it “has not yet adopted the level of reforms as other regions with respect to fast-start pricing.”<sup>11</sup> However, it notes that it requires a “prompt remedy” to address price formation issues.<sup>12</sup> Pointing to an increasing penetration of renewables and an abundance of low-cost gas that have contributed to a relatively flat supply curve in the range of its peak summer and winter loads, PJM expresses that price formation reforms are timely and pertinent. These changes have led to low energy market prices that PJM argues do not cover the costs of large baseload resources in all hours of the day, particularly during off-peak, low-load periods.<sup>13</sup>

As a result, PJM indicates that “...it needs to enhance price formation as it relates to all resource types.”<sup>14</sup> PJM asserts that few resources currently exist in PJM’s footprint that would meet the Commission’s clearly-defined “fast start” requirements.<sup>15,16</sup>

PJM’s comments are vague on how its proposed Extended LMP method would differ from the fast-start pricing implemented by other RTOs and proposed in the Commission’s Fast Start Pricing NOPR. However, in its June 2017 White Paper, PJM promotes broadening the eligible resource set “to include *all* units whose output is needed to serve load or control transmission constraints in a given interval.”<sup>17</sup> This paper and other comments made by PJM

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<sup>11</sup> PJM Comments, p. 40.

<sup>12</sup> Id.

<sup>13</sup> Id., pp. 36-37.

<sup>14</sup> Id., p. 42.

<sup>15</sup> Id., p. 41.

<sup>16</sup> *E.g.* The Fast Start NOPR should “[a]pply fast-start pricing to any resource committed by the RTO/ISO that is able to start up within ten minutes, has a minimum run time of one hour or less, and that submits economic energy offers to the market;” Id. at p. 44.

<sup>17</sup> PJM White Paper, p. 2.

suggest that PJM would propose that large baseload units that are operating at their minimum output level be eligible to set prices in the pricing construct outlined in the Fast Start Pricing NOPR. Currently, these units are not eligible to set the real-time price in any RTO because they are not the marginal source of supply when operating at their minimum output level.

In the Fast-Start Pricing NOPR, the Commission defines a fast start resources as a “resource committed by the RTO/ISO that is able to start up within ten minutes, has a minimum run time of one hour or less, and that submits economic energy offers to the market.”<sup>18</sup> The Fast-Start Pricing NOPR requires that all commitment costs of the fast start resources are embedded in pricing because all of these costs are incurred to provide the next MW of supply when the resources are brought on in real-time. Because fast start resources are often inflexible units that are dispatched at their minimum output level, and therefore would normally not be eligible to set prices, RTOs/ISOs must relax the minimum dispatch parameters of these units in the pricing dispatch model. If this model would continue to utilize these resources (i.e., would not dispatch them down to zero), then they can be marginal and set the real-time price.

PJM’s pricing proposal is very different than the pricing proposed in the Fast-Start Pricing NOPR. Under PJM’s proposal, we believe that the relaxation methodology described above would be applied to all resources. Therefore, all resources would be eligible to set the price when operating at their economic minimums, including large baseload units and resources with long startup times and minimum run times.

Certain parties went even farther in their initial comments in apparent support of PJM’s pricing proposal.<sup>19</sup> Citing negative prices during off-peak periods and the inability of baseload

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<sup>18</sup> Fast Start NOPR, p. 44.

<sup>19</sup> These parties include Exelon, PSEG, PJM Power Providers Group, and NRG, which we will refer to collectively in these comments as the “PJM Suppliers”.

resources to recover their full costs, the PJM Suppliers filed initial comments in support of PJM’s proposed pricing reforms. Most of these parties, including Exelon, PSEG, and the PJM Power Providers Group, called on the Commission to issue an order under Section 206 of the Federal Power Act declaring PJM’s current pricing unjust and unreasonable.<sup>20,21,22</sup> NRG does not specifically call for a 206 filing on the PJM pricing reforms, but they “[urged] the Commission to direct each ISO/RTO to propose a plan for implementing these reforms necessary for a long term sustainable market structure by a date certain.”<sup>23</sup>

We strongly disagree with assertions that conventional LMP markets are not just and reasonable. While the implementation of fast-start pricing is a clear improvement, extending this pricing methodology in the manner suggested by PJM and the PJM Suppliers is unreasonable and would generate substantial inefficient costs, as we describe in these comments.

## **B. Economic Evaluation of PJM’s Proposal**

Among the most fundamental conclusions of economic theory is that competitive markets for any good will establish clearing prices that reflect the marginal cost of producing the next increment of the good (and the marginal value of the good to the consumer). By charging this price to all demand and paying this price to all supply, every participant in the market will be motivated to produce and consume the good efficiently.

The design of the wholesale electricity markets is founded on this fundamental economic principle. The LMP at every location in the RTO markets is intended to reflect the marginal cost

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<sup>20</sup> Exelon Corporation. Comments of Exelon Corporation, Docket No. RM18-1-000, (October 23, 2017). (“Exelon Comments”), p. 11.

<sup>21</sup> PSEG, Comments of the PSEG Companies, Docket No. RM18-1-000, (October 23, 2017). (“PSEG Comments”), p. 5.

<sup>22</sup> PJM Power Providers Group, Comments of the PJM Power Providers Group, Docket No. RM18-1-000 (October 23, 2017). (“P3 Comments”), p. 14.

<sup>23</sup> NRG. Grid Resiliency Rulemaking Comments, Docket No. RM18-1-000, (October 23, 2017). (“NRG Comments”), p. 16.

of serving the next increment of load at that location, given network losses and constraints. As we describe in this section, the PJM pricing proposal apparently abandons this fundamental economic principle by establishing prices that depart from marginal costs and provide inefficient incentives to its market participants. Although PJM characterizes its proposal as an expansion of the Extended LMP methodology proposed by the Commission to price fast-start resources, it is a profound and fundamental change, as we describe below.

#### *Fast-Start and Emergency Pricing*

Well-designed fast-start pricing rules allow real-time prices to include the cost of committing and running peaking units when they are the marginal source of energy. Hence, fast-start pricing is fully consistent with economic principle discussed above that the competitive price for any good should reflect the marginal cost of supplying the good. To understand why this is the case, one must recognize that the commitment of fast-start units is a fundamentally different action than the commitment of other resources.

Most RTOs are dispatched on a time interval of 5 to 15 minutes. In this time horizon, altering the output of online generation is the primary supply action that can be taken by the market to balance supply and demand and manage congestion. However, there is one class of resources that may be started in this time horizon as an alternative to ramping up online resources – fast-starting peaking resources. The costs of utilizing these resources should be reflected in real-time prices because they are marginal costs. Indeed, the Commission has already opined “that given the unique operating characteristics of fast-start resources, their commitment costs, i.e., start-up and no-load costs, should be viewed as marginal costs and, as such, should be included in prices.”<sup>24</sup>

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<sup>24</sup> Fast Start NOPR, p. 51.



This concept is confusing to some because the commitment costs of most resources are not marginal costs. One can define marginal costs as *the additional cost incurred to produce additional output*. Most units are committed well in advance, particularly baseload units that may be started many days in advance of the current real-time interval. Therefore, these units' start-up and minimum generation costs are sunk and are not marginal for providing additional energy. Therefore, only their incremental energy costs can be marginal when they are dispatched between their minimum and maximum output levels.

However, offline resources that can be started quickly (e.g., within 10 minutes) are different. The start-up and minimum generation costs of these resources have not been incurred when they are offline. As load grows or a constraint begins binding, an RTO may incur these costs in the real-time horizon (5 to 15 minutes) as an alternative to ramping up online resources. Therefore, the commitment costs of these resources do constitute the marginal costs of satisfying the system's demand, which is the economic rationale for the fast-start pricing that has been implemented by a number of RTOs. This pricing innovation is particularly important because gas turbines constitute most of the resources at the high-priced end of the supply curve – when they do not set price, the prices are often set by a much lower-cost unit. If the portfolio of higher-cost resources included a mixture of flexible and inflexible units, this pricing concern would not be as large because one could expect high-cost flexible units to set prices when the inflexible units could not. Unfortunately, the high-cost supply is not sufficiently diverse.

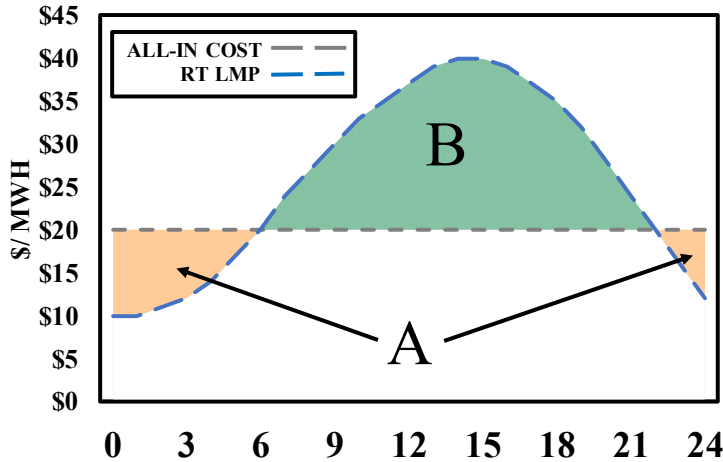
Failure to reflect these costs in real-time prices results in the need to make guarantee payments to these resources to cover their costs, which must be collected from RTO customers through uplift charges. Additionally, the resulting understatement of the real-time prices results in lower day-ahead prices, causing some economic resources to not be scheduled and increasing the need to continue to rely on high-cost fast-starting peaking resources. MISO has also applied

this pricing approach to emergency resources and actions taken by MISO operators to acquire additional supply (or curtail load) under emergency conditions. This is a valuable innovation that should significantly improve price formation.

*PJM’s Proposed Pricing*

Although PJM’s price formation proposal is superficially similar to fast-start pricing in its mechanics, it is substantively very different. It would, for the first time, introduce fixed costs into real-time pricing that are clearly not marginal in the real-time dispatch horizon. In effect, PJM would be requiring that the average costs of all resources needed to service load be reflected in every five-minute interval. This is fundamentally inconsistent with economic theory and good market design. To understand why, we illustrate in Figure 1 below how baseload resources recover their fixed commitment costs in an efficient LMP market.

*Figure 1: Cost-Recovery for a Baseload Unit*

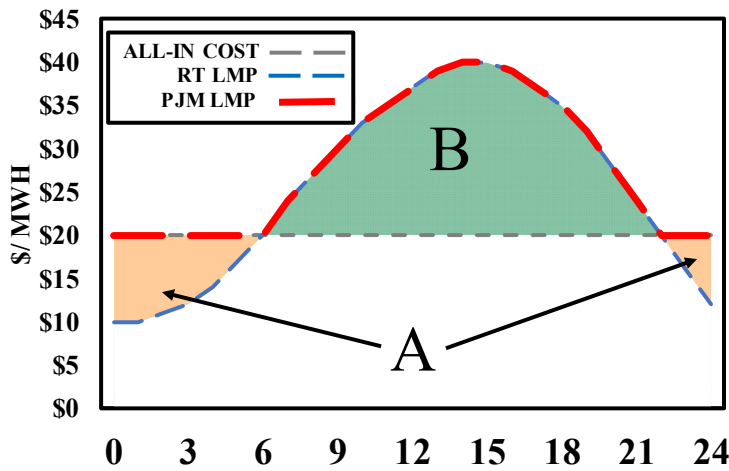


This figure depicts the all-in average cost of a baseload unit (including start-up, no-load and variable energy costs) along with the real-time prices over the day. During the peak hours of the day when load is highest, prices are generally well above the

marginal costs of baseload resources. The margins in these hours cover the commitment costs of resources that are economic to commit. In the context of the average costs depicted in this figure, the excess revenues in area B will exceed the amount by which the revenues fail to cover average costs in area A. This is efficient and establishes appropriate economic incentives for the supplier to commit the baseload resource in this example.

Under the PJM proposal, prices must cover the average cost of all baseload resources that are needed to serve load in all intervals. Effectively, this would change the current locational marginal pricing framework to set prices as depicted in Figure 2. This would effectively establish a price floor at the average costs of a baseload resource, likely even in cases when the system is over-committed and efficient prices would be very low or negative.

Figure 2: PJM's Pricing Proposal



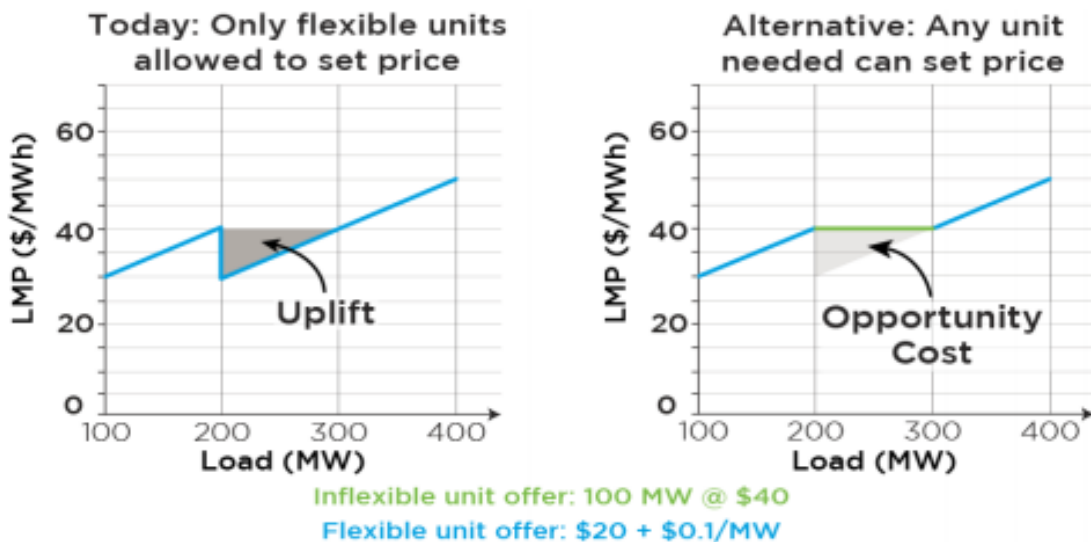
Under this approach, the prices and the dispatch instructions would no longer be consistent. Units with marginal costs of \$14 per MWh may be asked to reduce output when prices are set at \$30 per MWh. To maintain control of the system, PJM

has recognized that it would have to institute opportunity cost payments to guarantee generators the lost profit for economic output they are instructed not to produce. For example, the unit described above would have to receive an opportunity cost payment of \$16 per MWh (\$30 minus \$14) to reduce its output. Absent this payment, it would seek to produce as much output as would be profitable at the \$30 per MWh real-time price and the RTO would likely lose its ability to efficiently dispatch the system.

Assuming suppliers would continue to offer resources competitively, we expect that these costs would be enormous. However, this pricing regime would change the offer incentives of the suppliers. For example, it is likely that an inframarginal supplier could earn larger opportunity cost by lowering its offer price. Not only would this further increase the costs to the RTO's consumers, it would also distort the dispatch and commitment of the system.

Finally, we have seen no evidence of significant price formation problems associated with lower-cost baseload or intermediate resources. If the inflexibility of these resources were truly a problem, such that economically committed baseload resources could not cover their full costs, there would be evidence of that problem in the uplift costs. Figure 3 is reproduced from the PJM Whitepaper, which illustrates why they believe that all inflexible resources should set prices.<sup>25</sup> The uplift shown in the left panel would emerge if inflexible units that were needed were not covering their costs. While this is a useful illustration for fast-start peaking resources, this illustration is not accurate for baseload resources. In MISO, although coal and nuclear resources produce roughly two-thirds of all energy, they receive *less than one percent* of the real-time guarantee payments (uplift) made to ensure that resources cover their full as-offered costs.

Figure 3: PJM's Comparison of Pricing Methods



Hence, there is no support in sound economic theory or market data for PJM's proposed expansion of fast-start pricing to include other types of resources. We urge the Commission to reject the arguments by PJM and the PJM Suppliers to entertain such a proposal in any RTO.

<sup>25</sup> PJM White Paper, p. 4.

### *Effects of PJM's Proposal*

If the Commission were to issue a 206 Order in PJM, determining that its LMPs are not just and reasonable, it would be difficult to justify why this determination would not apply to energy prices in MISO or any other RTO. Therefore, we estimated the effects of implementing such proposal in MISO, which has a similar portfolio of generating resources to PJM.

We evaluated the real-time prices in MISO and how they would likely be affected by expanding the extended LMP logic to include the startup and no-load costs of long-start resources. This would essentially require the real-time prices to cover the average, all-in cost of any baseload resource that is needed to serve load. In reality, baseload resources are needed in almost all hours. Hence, the PJM pricing proposal would effectively establish a floor price in most hours at the all-in cost of a baseload resource.

To evaluate these effects, we estimated how the market-wide system marginal price (the base energy price at every location) in MISO would be affected by the PJM proposal. We analyzed the 12 months from November 2016 through October 2017. This analysis showed that the system marginal price would increase by roughly 30 percent, demonstrating that the proposal would substantially distort LMPs in MISO.

We also estimated the opportunity cost payments that would be required to ensure that generators have the incentive to follow MISO's dispatch instructions. Given the sizable and inefficient increase in the real-time energy price, one should expect these opportunity cost payments to be sizable. We estimate that the required opportunity cost payments in each 5-minute interval over the 12-month study period by:

- Estimating the difference in the economic output based on each online resource's energy offer curve. The economic output levels are determined at the current price versus the estimated Extended LMP under the PJM proposal.

- Then calculating the reduction in the suppliers' net margin (i.e., its opportunity cost).

This is the area between the estimated Extended LMP and the offer curve of the resource between the two output levels.

This methodology yielded aggregate opportunity costs in excess of \$400 million in the 12 months studied. As mentioned above, this implicitly assumes that generators continue to submit competitive offers in the real-time energy market. We believe such a regime would distort the offer incentives, creating opportunities for generators to alter their offers to increase the opportunity cost payments. Hence, the cost exposure would likely be substantially higher than we estimated.

### **III. CONCLUSION**

Although price formation issues are essential because they improve suppliers' incentives to be available and perform well in the short-term, and to maintain the resources needed to satisfy reliability (and resilience) objectives in the long term, price formation initiatives must be guided by sound economic theory.

The price formation ideas advanced by PJM are vague and lack any meaningful detail. To the extent that these ideas have been explained in the PJM Whitepaper, the ideas are misguided and would be extremely harmful if implemented in any of the RTO markets. As we demonstrate above, these price formation ideas would distort suppliers' incentives and substantially and inefficiently increase costs to RTOs' customers.

Although we do not support DOE's proposal referenced in the Commission's NOPR, the PJM price formation ideas are not a reasonable substitute for improving resilience in PJM. In fact, it is likely that PJM's pricing proposal, as we currently understand it, would be more harmful, costly, and distortionary than the DOE proposal. Therefore, we respectfully

recommend that the Commission reject the price formation ideas advanced by PJM and advocated by the PJM Suppliers and, instead, continue to pursue the sound price formation objectives advanced in its Fast-Start Pricing NOPR.

Respectfully submitted,

*/s/ David B. Patton*

David Patton  
President  
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November 7, 2017

**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 7th day of November 2017 in Fairfax, VA.

*/s/ David B. Patton*

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