UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators	)	Docket Nos. RM16-23-000, AD16-20-000

COMMENTS OF THE INDEPENDENT MARKET MONITOR FOR PJM

Pursuant to the Notice of Proposed Rulemaking issued in this proceeding November 17, 2016 ("NOPR"), Monitoring Analytics, LLC, acting in its capacity as the Independent Market Monitor for PJM ("Market Monitor"), submits these comments.[1] [2]

I. COMMENTS

A. Artificial and Natural Barriers to Market Participation Differ in Any Market.

The Commission raises concerns (at P 6) about possible barriers to the ability of electric storage resources to competitively provide all the capacity, energy and ancillary services that they are technically capable of providing. The Commission proposes (at P 48) that RTOs/ISOs modify their tariffs to create market rules to ensure that ability.

Artificial barriers to participation of storage resources in wholesale electricity markets should be eliminated to the extent they exist. Artificial barriers to market

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1 *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 157 FERC ¶ 61,121.

2 PJM Interconnection, L.L.C. ("PJM"). Capitalized terms used herein and not otherwise defined have the meaning used in the PJM Open Access Transmission Tariff ("OATT") or the PJM Operating Agreement ("OA").

participation create inefficiencies and can result in market failure. Natural barriers include product and/or service requirements that define market products so that a market can function efficiently. All markets have natural barriers to entry and market design should not attempt to eliminate them. The removal of natural barriers to entry creates inefficiencies in the same way that the addition of artificial barriers to entry creates inefficiencies. Exclusion caused by artificial barriers is inefficient, but exclusion caused by natural barriers is efficient.

An example of an artificial barrier to market participation would be a rule that limited participation in the regulation market service to generators, despite the demonstrated ability of storage resources to provide regulation. A natural barrier to participating in the regulation market would be a requirement that a resource that can provide regulation have the telemetry and metering needed to permit the market operator to direct and measure the response and performance relative to a regulation signal. A resource that can provide regulation that is capable of adding telemetry and metering but cannot justify the cost of telemetry and metering based on expected revenues from the regulation service should not participate in the market because the resource is uneconomic.

Market rules, including participation models, should not artificially favor specific technologies over others. Market rules should not artificially favor thermal generation over electricity storage or electricity storage over thermal generation in any market role. Market rules should not artificially favor one type of electricity storage over another, such as pumped hydro storage over chemical storage (battery). Rather, markets should clearly define the requirements of a product or service and remain neutral about how or from what technology the service is provided. Such neutrality does not preclude market designs in which the costs of specific technologies or resource types limit rational economic participation. The required characteristics which result in such costs represent natural, not artificial barriers to participation. The goal should be to define the objective and let market participants provide economic solutions rather than imposing resource planning solutions on the market.

Markets should be designed to recognize and reward the provision of identified, clearly defined, necessary services and they should do so at efficient prices free of subsidies, cross subsidies, and artificial administrative interventions that set quotas for resource participation. Efficient markets have clearly defined characteristics for the product, including clear units of measure and transparent prices. Where the units and prices are transparent, market participants, whether existing or potential, can make rational and efficient decisions regarding their participation in the market, regardless of technology. Under these conditions, the most economic sources of supply, regardless of technology, are favored over less economic sources.

PJM's market rules are, in general, designed to clearly define the product requirements, the product's unit of measure and the price per unit sold.

B. Bid Parameters Should Reflect Physical and Operational Characteristics of Resources.

The Commission proposes (at P 67) "that the RTOs/ISOs establish state of charge, upper charge limit, lower charge limit, maximum energy charge rate, and maximum energy discharge rate as bidding parameters for the participation model for electric storage resources that participating resources must submit, as applicable." The Commission also suggests (at P 70) that "[w]hile RTOs/ISOs may be in a better position to effectively manage the state of charge for an electric storage resource that, for example, exclusively provides regulation service in the organized wholesale electric markets, some electric storage resources may be interested in providing multiple services or providing services to another party, such as to a load with which it is co-located." The Commission continues (*id*.) that "[a]ffording electric storage resources the option to manage their state of charge would allow these resources to optimize their operations to provide all of the services that they are technically capable of providing, similar to the operational flexibility that traditional generators have to manage the wholesale services that they offer."

Specific parameters are needed to fully reflect the physical capabilities and limitations of storage resources and allow them to be fully and efficiently used in

optimization markets for energy and ancillary services. A resource's MW basepoint always be set to zero. A battery is either drawing power or providing power. Reducing load on the system is not providing power. With a zero MW basepoint the RTO has information indicating whether the resource is net charging or net discharging in any interval. Using a basepoint of zero MW would make it impossible for the storage resource to be operated in a way counter to its dispatch instruction for the purpose of inflating their capabilities, including capacity, at the expense of system efficiency and other participants.

The RTO should not be responsible for managing a storage resource's state of charge. Managing a resource's state of charge should be the market participant's responsibility. Just as managing fuel, fuel contracts and related offers are the responsibility of generation resources, managing a storage resource's state of charge should be the market participant's responsibility, including the ability to select its available capacity, self-scheduling and elected availability, in any markets it participates in. For instance, a storage resource that offers and clears capacity in the capacity market would need to make sure that its energy offers and offered capacity are structured to allow it to run over a sufficient number of potentially contiguous capacity performance hours to avoid capacity penalty charges for failure to perform as a capacity resource. It should not be the RTO's responsibility to determine and/or manage the resource for the resource owner in a market for capacity and energy.

C. The Storage Participation Model Should Recognize Characteristics of Storage Resources without Favoring Specific Technologies.

The Commission asserts (at P 17) that "participation models are designed to accommodate the unique characteristics of different resources, new technologies may be required to fit into existing participation models when market rules for their unique characteristics have not been developed." The Commission states (at P 29) that, when setting up participation models that facilitate market participation by storage resources, "the qualification criteria for the proposed participation model must not limit participation to any particular type of electric storage resource or other technology." The Commission

states (*id.*) "that those qualification criteria should ensure that the RTO/ISO is able to dispatch the resource in a way that recognizes its physical constraints and optimizes its benefits to the RTO/ISO."

Storage resources should be eligible to competitively participate in all PJM markets where they meet the technical requirements for participation. However, good market design requires clearly defining the product desired rather than specifying technology or characteristic specific participation models. Once the product or service is clearly defined in a given market, resources should, regardless of technology, compete to provide this service. The product definition, in this approach, defines the technical requirements needed to participate. For example, to provide energy, the resource will need the ability to inject energy in the system at a defined node, have offer parameters that will allow the injection of that energy to be optimized and telemetry so that the injections of the resource can be measured and accounted for by the RTO. Storage participating as dispatchable injections and withdrawals should not be considered a participant in demand response programs. Storage should be treated like pumped storage, with charges at LMP for withdrawals and payments at LMP for injections.

D. Storage Resources Should Be Able to Derate Capacity to Meet Minimum Performance Requirements.

The Commission proposes (at P 49) "to require each RTO/ISO to revise its tariff to clarify that an electric storage resource may de-rate its capacity to meet minimum run-time requirements to provide capacity or other services." For RTOs/ISOs with capacity markets, the Commission proposes (*id.*) "that the de-rated capacity value for electric storage resources be consistent with the quantity of energy that must be offered into the day-ahead energy market for resources with capacity obligations."

Storage resources should be able to derate their capacity value so that their offered capability in the capacity market is consistent with their ability to meet the associated obligation in the energy market.

E. Storage Technology with Sufficiently Fast Response Should Be Eligible to Provide Services Based on Ability Rather than Synchronous Status.

The Commission notes (at P 50) that "[n]ewer technologies, particularly electric storage resources, tend to be capable of faster start-up times and higher ramp rates than traditional synchronous generators and are therefore able to provide ramping, spinning, and regulating reserve services without already being online and running." To address this issue, the Commission suggests (*id*.) "that participation in ancillary service markets should be based on a resource's ability to provide services when it is called upon rather than on the real-time operating status of the resource."

The idea of synchronous state does not strictly apply to storage resources. The capability of the resource in should be a more important consideration than the synchronous state. If the storage resource is connected via their inverter a battery should be considered synchronized for purposes of eligibility to provide synchronized reserves. This approach should be reviewed by NERC to ensure that it is consistent with the requirements to maintain synchronized reserves.

F. Storage Resources Can Participate in Ancillary Service Markets without Energy Offers.

The Commission states (at P 51) "that all of the RTOs/ISOs co-optimize energy and ancillary services dispatch and pricing and therefore may condition eligibility to provide ancillary services on having an energy schedule." The Commission seeks comment (*id*.) "on whether the requirement to have an energy schedule to provide ancillary services could be adjusted so that electric storage resources and other technically-capable resources could participate in the ancillary service markets independent of offering energy to the RTO/ISO."

There is no reason to require an energy offer in order for electric storage resources and other technically capable resources to participate in the ancillary service markets.

Energy offers are not needed for participation in the PJM regulation market. A regulation resource has the option of designating, on an hourly basis, its availability to

provide regulation. This allows storage resources a direct means of managing their state of charge related to participation in the regulation market.

G. Resources Should Be Dispatchable in Markets in which They Are Technically Qualified to Participate, Part of the Optimization and Eligible to Set Price.

The Commission proposes (at P 6) a participation model for storage that will "ensure that electric storage resources can be dispatched and can set the wholesale market clearing price as both a wholesale seller and wholesale buyer consistent with existing market rules that govern when a resource can set the wholesale price."

The participation model for storage should allow storage resources to be dispatched and to be eligible to set price on the basis of that dispatch. To be consistent with the rules governing such eligibility, the storage resource would need to meet all other relevant requirements including having the necessary telemetry and metering. The specific nodal location of the resource must be known in order for the resource to be efficiently used in the RTO's security constrained optimization.

H. Storage Resources Should Be Eligible to Participate as a Wholesale Seller and Wholesale Buyer.

The Commission suggests (at P 72) that "[i]mproving electric storage resources' opportunity to participate as both wholesale sellers of services and wholesale buyers of energy could improve market efficiency by allowing the RTO/ISO to dispatch these resources in accordance with their most economically efficient use (i.e., as supply when the market clearing price for energy is higher than their offer and as demand when the market clearing price is lower than their bid)." The Commission further suggests (*id*.) that storage resources be eligible to set price as either supply or demand based on their supply offers and demand bids.

Storage resources should be able to participate as both wholesale sellers of services and wholesale buyers of energy.

I. Resources Should Respond to Market Signals When Deciding Whether to Sell or Buy Energy.

The Commission states (at P 82) that RTOs "must be able to dispatch electric storage resources as supply when the market clearing price exceeds their offers to sell and to dispatch electric storage resources as demand when their bids to buy exceed the market clearing price." The Commission expects (at P 83) "that, through its bidding strategy, a resource using the electric storage resource participation model would be able to prevent any conflicting dispatch signals to itself." The Commission seeks comment on whether this conflict should be automatically prevented.

The bid/offer parameters of resources should prevent conflicting dispatch instructions to storage resources. From basic economics, the offer to provide energy would be higher than the bid to buy energy for a given storage resource. It is not clear why it would be preferable for the RTO to dispatch the storage resources rather than for the storage resources to respond to market prices.

J. Storage Resources Should Decide When It Is Economic To Buy And When It Is Economic To Sell.

The Commission raised the concern (at P 85) that "it is also possible that the RTO/ISO could dispatch an electric storage resource as load when the wholesale price for energy is above the price of their bid to buy (a circumstance under which they would lose the opportunity to earn greater revenues as a supply resource)." The Commission continues (*id*.), "[t]herefore, to help alleviate any potential financial risk to these resources when being dispatched as a demand resource, we seek comments on whether the proposed participation model for electric storage resources should allow make-whole payments when a resource participating under this participation model is dispatched as load and the price of energy is higher than the resource's bid price."

This concern would be addressed by letting storage resources, like other resources, decide when it is economic to buy and when it is economic to sell. It would be preferable to

not create a set of rules under which the market operator could dispatch a storage resource in a way inconsistent with its economics and then make an uplift payment in compensation.

K. Minimum Size Requirements.

The Commission proposes (at P 94) "a minimum size requirement for participation in the organized wholesale electric markets that does not exceed 100 kW."

There should be a minimum size requirement for participation in the organized electric markets and that minimum should be 100kW.

L. Resources that Wish to Be Paid or Charged the Wholesale Price Must Be in Front of the Meter.

The Commission states (at P 100) that "[t]he sale of energy from the organized wholesale electric markets to an electric storage resource that the resource then resells back to those markets must be at the wholesale LMP." The Commission recognized (at P 102) the "concern that behind-the-meter electric storage resources should not be allowed to charge at a wholesale rate and discharge to serve a retail customer as a means for the retail customer to avoid paying the retail rate." The Commission also recognized (*id*.) that "[t]his situation could be even more complex if the retail customer in question also uses a behind-the-meter generator in conjunction with its storage device."

Behind the meter electric storage resources should not be allowed to charge (withdraw energy) at wholesale rates and then discharge (inject energy) to serve a retail customer allowing the retail customer to avoid paying the retail rate. A retail customer with behind the meter generation and storage capability provides a similar concern.

This wholesale/retail issue can be corrected through strict metering requirements that require that generation and storage facilities that wish to buy or sell at wholesale LMP have their own meters and telemetry that would link them to the RTO. These resources should be in front of the retail meter with a clear separation between retail load, with retail rates, and wholesale injections and withdrawals from the storage device and/or the generator, which would be charged and compensated at the wholesale LMP.

M. RTOs Should Allow Distributed Resource Aggregators to Participate as Wholesale Participants in RTO Markets, if They Can Meet Technical and Commercial Requirements for Participation.

The Commission expressed a concern (at P 13) "that existing RTO/ISO tariffs impede the participation of distributed energy resources in the organized wholesale electric markets by providing limited opportunities for distributed energy resource aggregations." The Commission notes (*id*. & P 126) that some of these barriers can be artificial, such as artificially limiting distributed generation "to be used as demand response or load-side resources when they are located behind a customer meter," and others are natural, such as "costs of the necessary metering, telemetry and communication equipment."

To address the artificial barriers to participation of distributed resources through aggregators, the Commission preliminarily found (at P 128) that RTOs should "define distributed energy resource aggregators as a type of market participant that can participate in the organized wholesale electric markets under the participation model that best accommodates the physical and operational characteristics of its distributed energy resource aggregation." The Commission argues (at P 126) that increasing the market opportunities available to aggregators will facilitate the aggregation of distributed resources, which, in turn, "help to address the commercial and transactional barriers to distributed energy resource participation in the organized wholesale electric markets."

Aggregation of distributed energy resources could facilitate wholesale market participation by some distributed resources by potentially lowering transaction and commercial cost. Aggregators could, therefore, provide value to the market, but only to the extent that the addition of the new resources are consistent with the actual nodal location of the resources, improves market efficiency, does not distort the market through direct or hidden subsidies, does not increase costs to other customers and does not jeopardize reliable functioning of the market. This means that in order for aggregated resources to participate in a market, the aggregated resources should be required to meet the same technical and commercial requirements applied to any other resource that participates in

that given market. Such a requirement is not an artificial barrier to entry, it is instead, a requirement to participate in the market. Aggregation should not be allowed to permit the participation in the wholesale power markets by behind the meter resources that do not pay the full costs of such participation, including ancillary services and the use of the transmission system.

N. Distributed Storage Should Not Be Limited to Participation as Demand Response.

The Commission notes (at P 15) that "[d]istributed energy resource aggregations are often limited to participating in organized wholesale electric markets as demand response, which can limit the aggregations' design and operations, as well as the services they may provide." The Commission notes (at P 11) restricting distributed storage to participating as demand response "can limit their ability to employ their full operational range, prohibit them from injecting power onto the grid, and preclude them from providing certain services that they are capable of providing such as operating reserves."

Distributed storage resources should not be limited to participating as demand side resources and should not be limited to participating via behind the meter aggregation with demand side resources.

Distributed storage could participate more effectively as a competitor in the wholesale power markets. This would require that such storage resources meet all the technical requirements for participation in the markets.

O. Resources Being Compensated for a Service as Part of a Retail or Other Program Should Not Be Compensated Again at the Wholesale Level.

The Commission states (at P 134) "it is appropriate for each RTO/ISO to limit the participation of resources in the organized wholesale electric markets through a distributed energy resource aggregator that are receiving compensation for the same services as part of another program." The Commission notes (*id*.) that "[s]ince resources able to register as part of a distributed energy resources aggregation will be located on the distribution system, they may also be eligible to participate in retail compensation programs, such as net

metering, or other wholesale programs, such as demand response programs" and this creates the possibility of duplicative compensation. To ensure that there is no duplication of compensation, the Commission proposed (*id*.) "that distributed energy resources that are participating in one or more retail compensation programs such as net metering or another wholesale market participation program will not be eligible to participate in the organized wholesale electric markets as part of a distributed energy resource aggregation."

Distributed energy resources that are participating in one or more retail compensation programs such as net metering or another wholesale market participation program should not be eligible to participate in the organized wholesale electric markets as part of a distributed energy resource aggregation.

P. For Nodal Wholesale Power Markets, Participation by Aggregated Resources Must Be on an Accurate Nodal Basis.

The Commission notes (at P 138) that "[s]ome RTO/ISO market rules permit only those resources that are located behind the same point of interconnection or at a single pricing node to aggregate." The Commission recognizes (*id*.) that these limitations are typically based on concerns about a lack of system granularity that could jeopardize system reliability and/or locational price formation and signals under security constrained dispatch. However, the Commission raises the concern (*id*.) "that some existing requirements for aggregations to be located behind a single point of interconnection or pricing node may be overly stringent and may unnecessarily restrict the opportunities for distributed energy resources to participate in the organized wholesale electric markets through a distributed energy." To address this, while acknowledging that the appropriate locational requirements may differ based on the services that a distributed energy resource aggregator seeks to provide, the Commission proposes (*id*.) that each RTO/ISO "revise its tariff to establish locational requirements for distributed energy resources to participate in a distributed energy resource aggregation that are as geographically broad as technically feasible." The Commission asks (at P 141) for "comment on potential concerns about dispatch, pricing, or settlement that the RTOs/ISOs must address if the distributed energy

resources in a particular distributed energy resource aggregation are not limited to the same pricing node or behind the same point of interconnection."

Permitting distributed resources to aggregate across nodes while being treated as the same resource is inconsistent with the basic structure of nodal markets.

In PJM and other organized wholesale power markets under the Commission's jurisdiction with locational prices and where location of the resources for system security and price formation is of paramount importance, participation should require wholesale node specific resources definitions. This means limiting aggregation of resources to their specific, actual wholesale nodes, with telemetry and metering that captures activity of the aggregated resources at that node.

Q. Bid in Distribution Factors for Multiple Node Aggregated Resources Is Not a Substitute for Accurate Node Specific Resource Designation.

The Commission notes (at P 142) that "RTOs/ISOs need to know which resources in a distributed energy resource aggregation will be responding to their dispatch signals and where those resources are located" and that "[t]his information is particularly important if the resources in a distributed energy resource aggregation are located across multiple points of interconnection, multiple transmission or distribution lines, or multiples nodes on the grid." To address this issue, and still support multi-node aggregation of distributed resources, the Commission proposes (at P 143) that RTO/ISO revise their tariffs "to include the requirement that distributed energy resource aggregators (1) provide default distribution factors when they register their distributed energy resource aggregation and (2) update those distribution factors if necessary when they submit offers to sell or bids to buy into the organized wholesale electric markets." Further, the Commission proposes "to require each RTO/ISO to revise the bidding parameters for each participation model in its tariff to allow distributed energy resource aggregators to update their distribution factors when participating in the organized wholesale electric markets."

There is no reason for a complex workaround to the basic features of a nodal market. Distributed energy resources at multiple nodes should participate at each such node.

Aggregation of distributed resources is no more necessary or appropriate than aggregation of existing generation resources. The basis for the belief that distributed resources cannot compete at the nodes where they are located is unclear. It is unclear why there need to be special rules. All resources in a nodal market should be treated equally and no specific approach to resources should be provided an advantage over others.

The Commission notes (at P 138) "that recent improvements in metering, telemetry, and communication technology should facilitate better situational awareness and enable management of geographically disperse distributed energy resource aggregations, potentially rendering such restrictive locational requirements unnecessary." Locational requirements are not artificial restrictions in a nodal market but are fundamental to nodal markets. RTOs/ISOs manage geographically dispersed resources with full situational awareness on a regular basis using a fully nodal system. A fully nodal system is the most effective way to maintain this approach.

If distributed resources hope to achieve higher prices for their output as a result of aggregation across nodes, that is a reason to disallow such aggregation. There is no reason why distributed resources cannot be managed with fully nodal wholesale prices. If such resources are economic, they will compete effectively. If such resources are not economic, the results will provide the appropriate incentives. Distributed is not a characteristic that is necessarily a positive or a negative. Like any other characteristic, it will succeed if it provides a competitive advantage and fail if it does not. It would be inappropriate to provide an artificial advantage to such resources for reasons that are unclear, undefined and not based on a competitive advantage.

R. Telemetry and Metering Data Available to the Aggregator Should Be Made Available to the RTO.

The Commission recognizes (at P 145) that "RTOs/ISOs need sufficient information about the distributed energy resource aggregation and the individual resources in a distributed energy resource aggregation to effectively model, dispatch, and settle the aggregation." The Commission sought (at P 147) "comment on these proposed data

requirements and on whether distributed energy resource aggregators should be required to provide additional data to the RTO/ISO."

This discussion is really about the granularity of settlements. The RTOs/ISOs settle participants' interactions with market participants based on nodal injections, withdrawals and prices. That should continue to be the case with distributed resources.

The Commission notes (at P 150) that every "distributed energy resources in an aggregation will need to be directly metered, the metering and telemetry system," so that the aggregator can manage its resources. Given those facts, the nodal information should be provided to the RTO/ISO and the RTO/ISO should provide nodal settlement. Meter and telemetry information should be disaggregated by resource type at each node. For example, distributed generation should be metered and settled separately from distributed storage and metered and settled separately from demand response at the node, to ensure accurate price signals and to prevent gaming of wholesale and retail prices, of demand response base points, of storage base points, of outage rates and of other performance parameters. In addition, given the advent of five minute pricing and settlement, the data must be provided on a 5 minute granularity, in real time.

S. Aggregation Should Not Mix Resource Types at the Bus.

The Commission notes (*id*.) that "there may be different types of resources in these aggregations, some in front of the meter, some behind the meter with the ability to inject energy back to the grid, and some behind the meter without the ability to inject energy to the grid." The Commission sought (*id*.) "comment on whether the RTOs/ISOs need to establish metering and telemetry hardware and software requirements for each of the different types of distributed energy resources that participate in the organized wholesale electric markets through distributed energy resource aggregations, as well as whether we should establish specific metering and telemetry system requirements and, if so, what requirements would be appropriate."

Resource types should be aggregated by type for each wholesale market node. Distributed generation should be aggregated, at the node, with distributed generation. Distributed storage should be aggregated, at the node, with distributed storage.

II. COMMUNICATIONS

Pursuant to 18 C.F.R. § 385.203(b)(3), the Market Monitor designates the following persons as those to receive all notices and communications with respect to this proceeding:

Joseph E. Bowring
President
Monitoring Analytics, LLC
2621 Van Buren Avenue, Suite 160
Eagleville, Pennsylvania 19403
(610) 271-8051
joseph.bowring@monitoringanalytics.com

Jeffrey W. Mayes
General Counsel
Monitoring Analytics, LLC
2621 Van Buren Avenue, Suite 160
Eagleville, Pennsylvania 19403
(610) 271-8053
jeffrey.mayes@monitoringanalytics.com

III. CONCLUSION

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

Respectfully submitted,

Jeffrey W. Mayes

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

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

Howard J. Haas
Chief Economist
Monitoring Analytics, LLC
2621 Van Buren Avenue, Suite 160
Eagleville, Pennsylvania 19403
(610) 271-8054
howard.haas@monitoringanalytics.com

Dated: February 21, 2017

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 21st day of February, 2017.

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