UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Electric Storage Participation in Regions with Organized Wholesale Electric Markets	**)** **)** **)**	**Docket No. AD16-20-000**

COMMENTS OF THE ENERGY STORAGE ASSOCIATION

The Energy Storage Association ("ESA") submits these Comments in response to the directives issued by J. Arnold Quinn, Director of the Federal Energy Regulatory Commission's ("FERC" or the "Commission") Office of Energy Policy and Innovation dated April 27, 2016 pertaining to above-captioned docket. As documented below, deployment of electric storage in limited markets has resulted in significant benefits to the grid. Within the scope of the instant docket, there are a number of changes to market designs that FERC can implement in short order that would support greater system flexibility and resource efficiency. Those changes would remove many barriers to storage that exist in most markets.

These Comments highlight the constraints on market participation for electric storage resources and recommend actions for FERC's consideration that include, but are not limited to: establishing resource types that make storage eligible to participate in all markets; designing qualification and performance measures that enable storage to participate fully in all markets where they are eligible to do so; implementing market product reforms to increase competitiveness; and addressing barriers to participation of distributed storage resources.

I. COMMUNICATIONS

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II. ABOUT THE ENERGY STORAGE ASSOCIATION

Since its inception 26 years ago, the ESA has promoted the development and commercialization of competitive and reliable energy storage delivery systems for use by electricity suppliers and their customers. ESA's membership comprises a diverse group of electric sector stakeholders, including utilities, independent power producers, manufacturers of advanced technologies -- such as batteries, flywheels, thermal energy storage, compressed air energy storage, supercapacitors, and other technologies -- component suppliers, and system integrators.

ESA's over 180 member companies have expertise in transmission- and distribution-level grid operations relevant to energy storage, as well as firsthand knowledge of the regulatory challenges to financing and operating commercial energy storage facilities to realize full system benefits.

III. INTRODUCTION

ESA appreciates the Commission's efforts since 2007, as well as those of the ISOs/RTOs, to ensure that the benefits of energy storage technologies are experienced by ratepayers and grid operators nationally. In the instant docket, FERC accurately notes that access to markets is a central concern for electric storage resources and thus designed the instant docket to examine and, where appropriate, eliminate barriers to the participation of electric storage resources in RTO/ISO capacity, energy, and ancillary service markets through tariff and market changes.

Consistent with FERC's statement and as supported by the Reports that each ISO/RTO submitted to FERC on May 16, 2016,[1] electric storage has limited access to markets. When wholesale electric market designs and grid operations were originally developed, cost-effective electric storage was not contemplated. For example, in its Report, MISO acknowledges that when it originally developed the non-Storage Energy Resources categories, it never specifically considered whether such categories could accommodate the unique features of various storage technologies.[2] As a result, despite the maturation of electric storage resources and the ability to operate economically, reliably, and efficiently, grid operators have required advanced resources to participate in markets pursuant to existing market constructs—primarily that of traditional generators. Recognizing that new technologies, including electric storage, do not fit within the market requirements of

[1] Response of the California Independent System Operator Corporation ("CAISO"); Response of ISO New England, Inc. ("ISO-NE"); Response of PJM Interconnection, L.L.C. ("PJM"); Response of the New York Independent System Operator, Inc. ("NYISO"); Responses of the Midcontinent Independent System Operator, Inc. ("MISO"); and Response to Data Request by Southwest Power Pool, Inc. ("SPP").
[2] MISO Report, page 3.

traditional generators, FERC extended participation of non-generator resources into the ancillary services markets.[3]

A. While new and more economic storage technologies are available for grid deployment, market rules and designs have not caught up with technology. This is the opportune time to re-evaluate those market products that can be served by deploying electric storage on the grid.

Since 2007, FERC has encouraged, directed, and worked with RTOs/ISOs to make incremental changes to rules and procedures to open initial market access for electric storage. As is now recognized by FERC and the RTOs/ISOs, the technologies and capabilities of advanced electric storage have developed further such that, in some cases, even those rules, policies, and procedures that were modified over the past nine years are no longer sufficient to enable the diversity of storage technologies to fully participate in the marketplace. Concomitantly, unchanged rules have proven to be inadvertent barriers to storage market participation. RTOs/ISOs have made varying levels of effort to improve market participation for storage resources, although those efforts have tended to be narrower responses to specific concerns, rather than a broader review and revision of tariff language or business practices manuals.

Additionally, market designs that are crafted and focused unnecessarily around the attributes of traditional generators continue to pose inadvertent structural and operational barriers to electric storage participation. These barriers are often couched in disqualifying service requirements, discriminatory operational expectations, or compensation methods that effectively undervalue storage. As explained herein, changes to market designs that support greater system flexibility and resource efficiency, while not specific to storage, will remove many barriers to storage in those markets.

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[3] *Preventing Undue Discrimination and Preference in Transmission Service,* Order No. 890, FERC Stats. & Regs. ¶ 31,241 (2007)

B. Enabling electric storage to enter wholesale electricity markets has resulted in significant system benefits. Energy storage is technically capable of providing all market services, and enabling storage to participate in all services is necessary to ensure fully competitive markets.

Arguably, the most significant change in market designs since the Commission spurred storage-specific changes nine years ago was Order No. 755,[4] which required RTOs/ISOs to implement a "pay-for-performance" structure for frequency regulation service. Following its implementation of Order No. 755, PJM observed a 30% reduction in overall the Regulation reserve requirement as more fast-responding resources, including storage, cleared the market.[5] Similarly, in ISO-NE, the deployment of electric storage resources for Regulation and the "pay-for-performance" incentives for fast-response service since 2005 has contributed to a 50% reduction in the Regulation reserve requirement.[6]

While not a measure specific to storage, adequately compensating resources for flexibility – such as speed of ramp and precision of output – was a critical step in realizing the full value that storage can provide to wholesale markets. As current trends toward more variable generation and higher local and system load factors continue, creating markets for flexibility will be critical to meet future system needs efficiently. Accordingly, once storage can participate in the wholesale markets and is compensated appropriately, the grid can recognize a range of flexibility benefits in addition to lower reserve requirements, such as effective ramp management, reduced uplift allocations for generator start-up and shut-down costs, and absorption of over-generation. For example, a recent National Renewable

[4] *Frequency Regulation Compensation in the Organized Wholesale Power Markets*, Order No. 755, 137 FERC ¶ 61,064 (2011)
[5] See PJM's report *Performance Based Regulation: Year One Analysis*, submitted on October 16, 2013 in Docket No. ER12-1204.
[6] Comments of ISO New England Inc. submitted on May 2, 2011 in Frequency Regulation Compensation in the Organized Wholesale Power Markets, Docket Nos. RM11-7 and AD10-11.

Energy Laboratory study of storage deployment in CAISO demonstrated a significant decrease in generator start-up and shut-down costs, in addition to existing market services.[7]

Electric storage technologies are technically capable of providing any wholesale market service. Accordingly, removing barriers to storage in all wholesale markets is critical to ensuring the efficiency of our markets. Conversely, when including storage on the grid is directly or implicitly prohibited by rules, indirectly prohibited by market design, or inhibited by ambiguity in both rules and market design, the lack of competition results in increased system costs due to the narrower range and limited capabilities of resources available to provide services.

IV. DISCUSSION

A. To eliminate barriers to the provision of energy storage in the capacity, energy, and/or ancillary services markets, ESA respectfully requests FERC to direct ISOs/RTOs to establish a resource type that (1) ensures electric storage is eligible to participate in all markets and (2) utilizes appropriate bid parameters and resource modeling for storage resources.

1. Tariff language that explicitly defines resource types for storage to provide all market services does not exist in most ISOs/RTOs. Because Tariff language is interpreted differently by stakeholders within ISOs/RTOs, there is considerable uncertainty as to the eligibility of electric storage to provide diverse market services.

According to the ISO/RTO Reports, there is diversity in how energy storage resources are designated and allowed to operate in various regions. Only two ISOs – CAISO and PJM – have designated a resource type that explicitly enables storage to participate fully in the general marketplace and does not limit storage resources to certain configurations or to certain services: CAISO's Non-Generator Resource ("NGR") and PJM's

[7] Josh Eichman, et al. "Operational Benefits of Meeting California's Energy Storage Targets." National Renewable Energy Laboratory. December 2015. Available at http://www.nrel.gov/docs/fy16osti/65061.pdf.

Capacity Storage Resource ("CSR").[8] Other ISOs have tariffs that explicitly allow storage to provide services in some markets while prohibiting technically-capable electric storage from participation in other market products. For example, in MISO, ISO-NE, and NYISO, tariff language only explicitly affirms that electric storage is eligible to provide frequency regulation, and storage resources that provide frequency regulation are explicitly prohibited from providing other services.[9]

Moreover, some RTOs/ISOs have ambiguous tariffs on electric storage eligibility for some market services. For example, MISO's notes that there are "several types of resources for which storage resources, *in principle*, are eligible to qualify" (emphasis added), including perhaps Generation Resource and Use Limited Resource designations. Yet, MISO also acknowledges the need to "work with stakeholders to clarify whether storage resources that are not registered as Generation Resources can be Use Limited

[8] CAISO Report page 3 and PJM Report page 6.

[9] MISO's Stored Energy Resource ("MISO's SER"), ISO-NE's Alternative Technology Regulation Resource ("ISO-NE ATRR"), and NYISO's Limited Energy Storage Resource ("NYISO LESR") are the only resource types in those ISOs' tariffs that explicitly allow electric storage participation. Beyond eligibility, these resource types enable these ISOs to offer the bid parameters and meet the unique modeling and dispatch needs, such as an energy-neutral signal or state-of-charge management, of storage. See MISO Report page 3, ISO-NE Report page 7, and NYISO Report page 3.

In addition, NYISO's LESR is limited only to storage resources with less than 60 minutes of duration. Also, while NYISO has previously stated that storage can register as an Energy Limited Resource (ELR), which is limited to resources of at least four hours of duration, no tariff language exists making this explicit. As a result, grid-connected storage resources of between one- and four-hour duration in NYISO have no available resource type to register as, and so are excluded from markets. See NYISO Report pages 2-3.

In ISO-NE, only Alternative Technology Regulation Resources (ATRRs) can elect to receive an energy-neutral Regulation dispatch signal appropriate for electric storage. This limits the options for a storage resource to participate in the Regulation market, as a storage resource that wishes to be able to provide Energy and Reserves in addition to Regulation cannot register as ATRR. Thus, the Energy- and Reserves-targeting storage resource would not be allowed to select an energy-neutral Regulation dispatch signal, which would prohibit it from fully providing Regulation. See ISO-NE tariff, section III.14.6 Delivery of Regulation Market Products.

Resources, including potential Tariff revisions to establish or clarify the permissibility of such a result."[10]

Others, like SPP simply have no tariff language on electric storage and provides no information on how electric storage would be treated or compensated or even allowed to participate in its markets.[11] Without tariff language that explicitly deems storage to be eligible to participate in the capacity, energy and ancillary services markets, uncertainty impedes industry investment and participation in those markets.

Simply stated, storage providers cannot rely on language in a FERC report or a statement made by an ISO staff member at stakeholder meeting to determine whether the provider is eligible to participate in a market. Storage providers need the information to be written in a tariff or a rule, which is the foundation on which to base investment and operational decisions. Thus, ESA respectfully requests that each ISO/RTO be directed to incorporate tariff language establishing a resource type for energy storage to participate in all market services, similar to CAISO's NGR and PJM's CSR. Both of these designations do not by definition limit storage to certain durations or services and affirmatively enable electric storage to participate in all services for which it is technically capable. Alternatively, ESA respectfully requests that RTOs/ISOs should be directed to explicitly determine the eligibility of storage by making affirmative confirmations of eligibility for a given resource type, rather than implicit allowance, so that market participants are certain about the

[10] MISO Report at page 7**.**

[11] The one exception is Protocols section 4.1.2.1.2 Non-conforming Load: "Load associated with *stored energy devices* such as pumped storage hydro or compressed air Resources shall be considered a Non-Conforming Load." (emphasis added). Also, under Appendix G Mitigated Offer Development Guidelines, SPP refers to Hydro Pumped Storage offer cost under its Hydro Guidelines, but makes no mention of other stored energy devices. SPP, as it noted in its Report, is working on a Short-term Stored Energy Resource (STSER), which, similar to MISO's SER and NYISO's LESR, would allow short-duration storage resources the ability to provide frequency regulation only and not any other product, thereby creating barriers to the storage industry upon enactment of the new rules. See SPP Report page 6.

channels for participation and such that storage of any duration has an available channel for participation.

2. *In addition to market eligibility for storage providers, ISOs/RTOs must implement non-discriminatory bid parameters and resource models that allow electric storage to participate effectively in eligible markets. RTOs/ISOs should also provide transparency on how those parameters will be used in storage modeling, optimization, dispatch, and settlement so that market participants have greater certainty on how storage assets will be utilized.*

In establishing a resource type for energy storage to participate in all market services, each ISO/RTO should ensure that such a resource type use bid parameters and resource modeling appropriate to electric storage technical capabilities and limitations, in a comparable manner to what is allowed for conventional resources. By not doing so, RTOs/ISOs constrain storage resources from utilizing their full capabilities, thereby denying those resources the opportunity for full participation in markets.

Certain characteristics of electric storage resources warrant a different modeling in RTO/ISO markets than other resource types. As FERC is aware, all other assets on the grid either only inject or only withdraw electricity, and RTO/ISO resource modeling is designed to allow one or the other. Storage is uniquely able to both inject and withdraw electricity. Thus, RTOs/ISOs must change their resource modeling to allow a resource to attain both positive and negative values for discharging and charging, respectively; lack of this functionality creates a barrier for storage participation.

Current ISO modeling of pumped storage resources may not be sufficient to capture the unique capabilities of advanced storage technologies. For example, ISO-NE models storage as both a generator resource and as a load resource simultaneously.[12] This is a

[12] ISO-NE Report, page 5. ISO-NE's Report describes how "the bidding parameters reflect the physical characteristics of each resource type, including electric storage resources. For example, pumped storage resources that participate as Dispatchable Asset Related Demands will soon have four additional bidding

barrier because it limits the operational functionality available to storage, including prohibiting sub-hourly switching back and forth between charge and discharge states. In contrast, CAISO models storage as a non-generator resource capable of "negative generation," which avoids constraints from modeling storage as load and enables fuller asset participation.[13] The CAISO Report explains: "[T]he Non-Generator Resource model recognizes that a resource can operate seamlessly across a resource's entire operating range. In the case of electric storage resources, this operating range can reflect both charging and discharging configurations" (illustrated in Figure 1). The CAISO model works because the performance parameters inherently acknowledge that "battery storage is a resource which can discharge energy in one interval as positive generation and consume energy in the next interval as negative generation.[14]

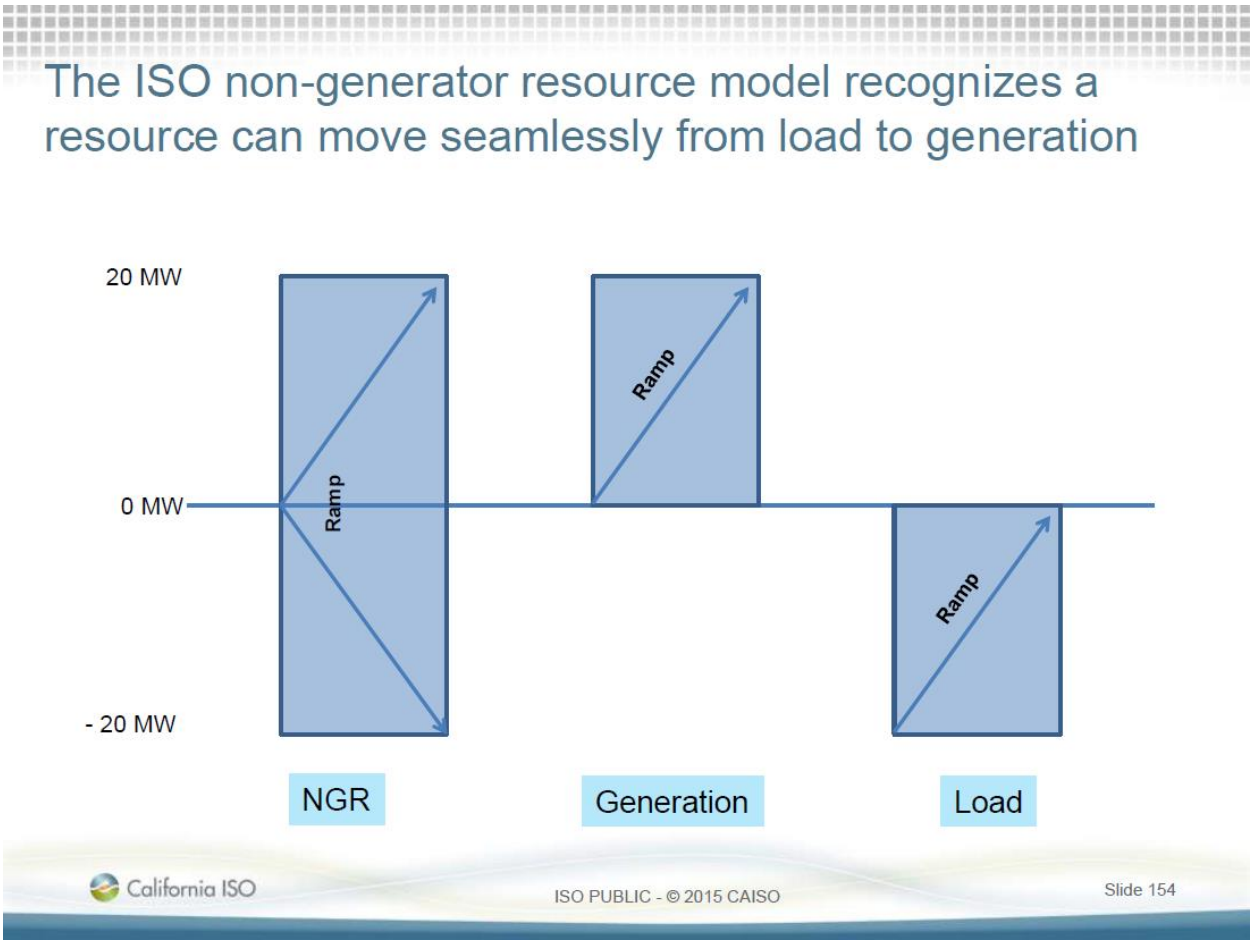
Figure 1 Illustration of Negative Generation Concept in CAISO NGR[15]

parameters to better reflect their physical characteristics." However, even with these additional parameters, including "Max Daily Energy (MWh)," the capabilities of batteries, which can cycle within an hour, will not fully be captured. One key part of the differences between the storage technologies is their technical capabilities. As the ISO-NE "DARD Pump" filing states, "The industrial-sized pumps associated with the existing pump storage hydro generating resources are block-loaded; meaning that they are either on or off with no dispatchable range. They also cannot be dispatched on and off over short time periods without creating excessive wear and tear on the equipment." On the other hand, battery storage does not have to be block-loaded, can be fully dispatchable across its full range (negative to positive), and cycling on and off over short time periods does not create excessive wear and tear on the equipment. See Docket No. ER16-954, ISO New England Inc. and New England Power Pool, DARD Pump Parameter Changes, February 17, 2016, McDonough Testimony at 4.

[13] CAISO Report page 3.

[14] *Id.*

[15] Slide 154 of CAISO's presentation to Energy Storage and Aggregated Distributed Energy Resource Education Forum, April 16, 2015, available at http://www.caiso.com/Documents/Presentation-EnergyStorageandAggregatedDistributedEnergyResource-EducationalForum.pdf.



Because storage has limited output, its energy level at any given moment affects the services it is capable of providing in the subsequent interval. State of charge is thus a significant parameter to incorporate into optimization and dispatch, and its inclusion will remove barriers to full asset utilization. Moreover, electric storage resources have no minimum run time and are capable of changing behavior to meet greatest system needs with short lead times. Yet, while all RTOs/ISOs dispatch resources in real time on a 5-minute basis, the resource offering and selection process happens up to an hour in advance and generally for the full hour. Electric storage resources could provide enhanced system

flexibility if allowed to make and change offers of Energy and Ancillary Services[16] – that is, to change available resource capacity for service - on an intra-hourly basis.[17]

To enable full market participation, ESA respectfully requests FERC to direct RTOs/ISOs to establish appropriate modeling and bid parameters for storage resources, such as the aforementioned "negative generation" and state of charge parameters.[18] These modeling changes, moreover, should be accompanied by transparency. ISOs/RTOs should make available the information needed by market participants to have needed certainty on how storage resources will be operated using the aforementioned parameters. For example, end-to-end walkthroughs of modeling, optimization, dispatch, and settlement using aforementioned parameters would clarify to market participants how a storage asset bids into the market, receives dispatch signals, responds back to those signals, and gets compensated for service–thereby overcoming uncertainty that currently stifles participation of and investment in storage resources. Similarly, RTOs/ISOs should make available representative sample dispatch signal data[19] so developers can understand how their resource is likely to be utilized, as the characteristics of the dispatch affect a resource's service availability, market settlement, and operational costs—factors market participants need to take into account when selecting what technology to use, how to configure the plant

[16] This intra-hour re-offering would be most useful for Energy and Regulation.

[17] Electric storage resources are capable of scheduling at short intervals. ESA would welcome, for example, the use of 5-minute scheduling to match 5-minute dispatch and settlement.

[18] Unit commitment and dispatch algorithms should also be clear in how they use such information. Furthermore, to maximize optionality and flexibility, market participants should be allowed to voluntarily elect whether to manage their own storage resource's state of charge or delegate management to the RTO/ISO.

[19] Despite the importance of access to such dispatch data, it is not widely available. For example, only PJM publishes significant volumes (i.e., up to a year) of Regulation dispatch data on a time scale matching the actual 2-second basis of its dispatch signal. While all ISOs publish 1- and 10-minute Area Control Error (ACE) data in accordance with Order 784, they dispatch Regulation on a much shorter 2-, 4- or 6-second basis. 1-minute ACE data is thus not representative of the Regulation dispatch signal that a fast-responding resource like storage would receive and does not provide the operational information market participants need to plan their service offerings. Making available a year of 2-, 4-, or 6-second representative Regulation dispatch data, or, in the alternative, 2-, 4-, or 6-second ACE data, would provide necessary information to inform storage plant development.

in terms of power and energy capabilities, and what services to offer. Having such sample dispatch data is as essential for appropriately developing an electric storage resource as having information on expected capacity factor is for a planned thermal generator.

The above- requested eligibility and parameter modifications are not especially difficult to achieve and would result in a significant reduction in the barriers to bringing more storage on line in the near future.

B. Electric storage resources that are eligible to participate in a market service are sometimes precluded from doing so due to qualification criteria and performance requirements designed for generators. Accordingly, ESA respectfully requests FERC to direct ISOs/RTOs to ensure that qualification criteria and performance requirements enable storage resources to participate fully in markets.

For those services where electric storage resources are eligible to provide services in a particular market, there are still RTOs/ISOs that tailor their technical requirements for participating in those markets to generation and thus create undue barriers to the participation of electric storage resources.

Despite assertions of resource neutrality in the ISO Reports, many market requirements are based on the technical and operational characteristics of generators, which are either inappropriate or unclear in how they apply to storage technologies. For example, in MISO, the rules suggest that resources that participate in the Regulating Reserve, Spinning Reserve, Supplemental Reserve, or Ramping Capability markets (all of which storage technologies are technically capable of providing) are required to be otherwise offering energy during the scheduled interval.[20] This rule exists because

[20] MISO Report page 11, footnote 9 refers to Business Practice Manual (BPM) sections that describe requirements for these products, which state "Committed Generation Resources" are eligible to provide these products. This is believed to mean Generation Resources that are scheduled to provide Energy. The BPM also states "Synchronized Generation Resources" are eligible to provide these products, which means Generation Resources that are synchronized. Further, it is not clear that electric storage resources

conventional generators have ramp rate constraints, and providing Energy enables the quick response times these services require. However, because an electric storage resource can respond nearly instantaneously at full output to a signal, there is no reason that it should be required to be discharging Energy to participate in those ancillary services markets. Requiring storage to offer Energy greatly diminishes its capability in ancillary services markets since storage resources are energy-limited. As another example, in NYISO, the rules suggest that grid-connected storage resources may be prohibited from providing synchronized reserves, as the required settings inherent to synchronous generators are inapplicable to inverter-based resources like electric storage.[21] However, electric storage response to system signals is sufficiently rapid and precise to provide meet the performance required for synchronized reserves. Furthermore, SPP states that it has a qualification criterion of 60-minute sustained output for Regulation and other services,[22] which prior Commission rulings in other ISOs has found prohibitive to the participation of technically-capable electric storage resources.[23]

Accordingly, ESA respectfully requests that FERC require ISOs/RTOs to ensure that qualification and performance metrics are established such that energy storage resources that are eligible to participate in the capacity, energy and ancillary services markets are not precluded from doing so simply because qualification and performance metrics are set for traditional generators. It is important to remember that markets were originally designed

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can register as Generation Resources, be appropriately modeled, and meet the performance requirements of these products.

[21] NYISO Report page 3, footnote 4, and page 7, footnote 16. Because the qualification criteria is based on Northeast Power Coordinating Council (NPCC) rules, such a prohibition would affect storage resources in ISO-NE as well.

[22] SPP Report, page 2.

[23] See, for example, Midwest Independent Transmission System Operator, Inc., Docket No. ER09-1126, Order on Compliance Filing and Stored Energy Resources Proposal, issued December 31, 2009, and California Independent System Operator Corp. Docket No. ER11-4353, Order Accepting Proposed Tariff Revisions, issued November 30, 2011.

around the ramp rate limitations of conventional generators, and many features of markets still accommodate that inflexibility. Electric storage does not face those ramp rate limitations and can offer significant system value because of its freedom from that operational constraint; yet, by being required to meet qualification criteria designed to those constraints, storage is limited from providing its full value. Technically-capable energy storage resources should be allowed to participate in a given market in accordance with appropriate performance metrics. This requires a shift of market design from one based on entrance criteria to one based on performance requirements.

At the same time, electric storage attributes merit equitable accommodation in market design and performance requirements. Storage has limitations to the energy it can provide continuously before needing to recharge. Ostensibly technology neutral market designs and performance requirements, however, often do not accommodate energy-limited resource participation. RTOs/ISOs should consider reasonable avenues for energy-limited storage in markets even when duration of service is important, such as by using price differentiation to signal different value of energy-limited resources rather than exclude them outright from market participation (see Section C).

C. Reform market product designs to remove structural barriers to storage, value flexibility, and make markets more competitive by (1) creating an avenue for energy-limited storage resources to participate in Capacity markets and (2) making appropriate obligations for energy-limited storage resources that participate in Energy and Ancillary Service markets.

1. Capacity Markets should value and compensate flexible, energy-limited resources by offering an avenue for such resources to participate.

Capacity markets were designed for electric grids reliant on conventional generation to provide resource adequacy; as such, they only compensate the future provision of firm

capacity. As a result, Capacity market designs pose structural barriers to storage.[24] Capacity markets rules have not changed sufficiently to compensate future provision of fast, flexible resources, despite increasing system needs for flexibility and increasing availability of resources like storage to meet those needs.[25]

In general, RTOs/ISOs lack markets to capture the value of flexibility services. Instructive exceptions exist in CAISO, which is working on both forward procurements of flexible resources and real-time bids of flexible service in its Flexible Capacity product and Ramping product, respectively. While the instant docket seeks to understand barriers to participation in existing wholesale market services, including Capacity, ESA respectfully points out that the improved price formation and/or new markets for flexibility would more effectively overcome those barriers than modifications of existing Capacity markets (see Section F.2). ESA respectfully asks FERC to consider directing RTOs/ISOs to establish such markets.

In the absence of such markets, though, Capacity markets should provide a means for the participation of energy-limited storage, which can meet some system resource adequacy needs. There are several barriers to the participation of energy storage in

[24] ESA's prior discussion on this topic can be found at Post-Technical Conference Comments of the Energy Storage Association, filed on January 8, 2014, in Docket No. AD13-7-000.

[25] Capacity markets in all RTOs/ISOs have focused on resource adequacy – having enough firm resources to meet the highest expected level of demand, planned on investment timescales – without taking into account system quality – the optimal mix of capabilities deployed to ensure that in every moment supply balances with demand, deployed on operational timescales. Traditionally, this orientation has not been problematic, as the need for flexibility was bounded and predictable, and thus resources procured for resource adequacy could be relied upon to provide system quality at operational timescales. If trends of recent years continue, however—with more variable generation and higher local and system load factors—the demand for the kind of flexibility traditionally associated with peaking and cycling plants will no longer be either bounded or predictable. System quality will fundamentally need to be a concern on investment timescales as well, since simple resource adequacy may not be capable of meeting system quality requirements in the future. Similarly, planning studies that inform Capacity needs will need to reflect system operations more closely. The process today requires that generation be available every hour of every day, but as the system becomes more flexible, there will be need for resources that offer flexible attributes that may not be needed every hour of every day. This broad thinking underlies several necessary enhancements in Capacity markets to improve the investment signals for and appropriate utilization of fast, flexible, dependable resources.

Capacity markets, which stem from the traditional focus on signaling investments only in firm capacity: (1) open-ended performance requirements (PJM and ISO-NE), (2) a lack of clarity in qualification criteria (PJM, ISO-NE, NYISO, MISO), (3) an inability to combine storage with other resources (all except PJM), and (4) a need for Offer obligations and offer reference prices (all except CAISO and PJM).

a. RTOs/ISOs with open-ended duration requirements for Capacity (PJM and ISO-NE) should consider a role for defined duration assets and price differentiation to reflect their value to the system.

Both ISO-NE and PJM recently adopted new Capacity market rules with a 'no-excuses policy' where Capacity resources must provide Energy at least at the level of their Capacity obligation for the duration of performance hours/shortage events, or else face significant financial penalties.[26] In PJM and ISO-NE, the open-ended Capacity market performance requirement greatly inhibits storage participation, as energy-limited storage resources cannot meet calls of undefined duration with certainty and so face significant risk of non-performance penalties. This is evidenced by the lack of any battery-based Capacity Storage Resource offers into the 2015 and 2016 Base Residual Auctions (BRA) in PJM and the lack of any battery-based storage resource bids into the 2015 and 2016 Forward Capacity Auctions (FCA) in ISO-NE.

ISO and stakeholder analysis shows there is value to even relatively short duration injections or load reductions at peak times. Many peaker plant starts could be met by short-duration electric storage resources. For example, in PJM and ISO-NE, over half of all peaking generator starts ran for three hours of duration or less relative to nameplate

[26] See PJM: Docket Nos. ER15-623 and EL15-29 and PJM Interconnection, L.L.C., 151 FERC ¶ 61,208 (2015); ISO-NE: Docket Nos. ER14-1050 and EL14-52 and ISO New England Inc. and New England Power Pool 147 FERC ¶ 61,172 (2014.

capacity (see Figure 2 and Figure 3).[27] Shorter, defined-duration electric storage could respond capably to a substantial fraction of Capacity needs.

Figure 2 PJM Peaker Run Times (Year Ending September 31, 2015)[28]

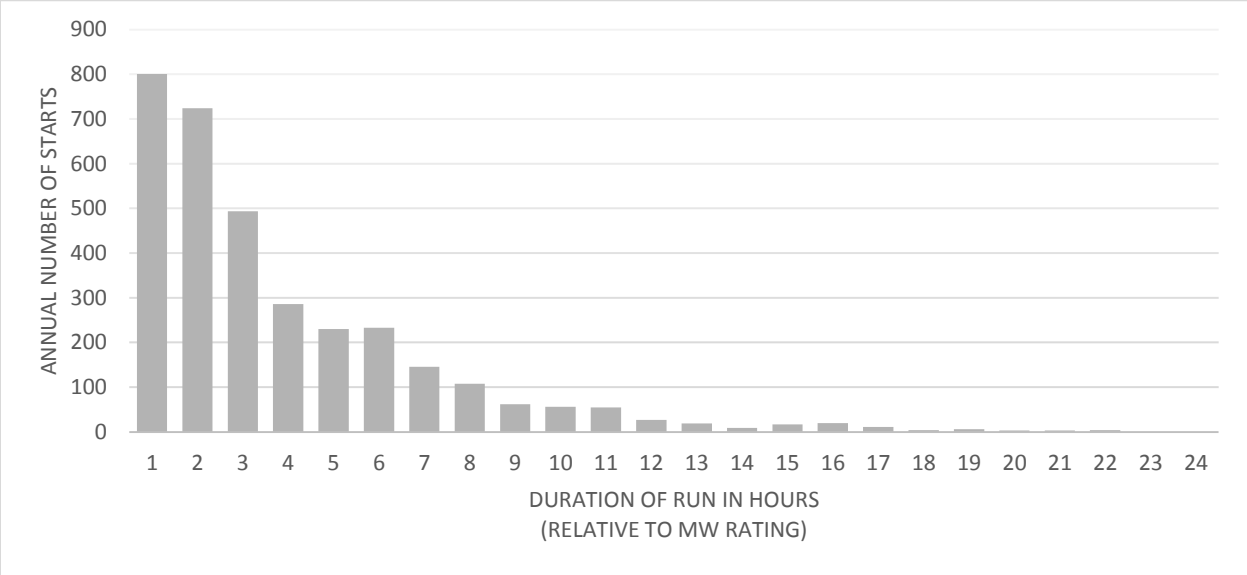
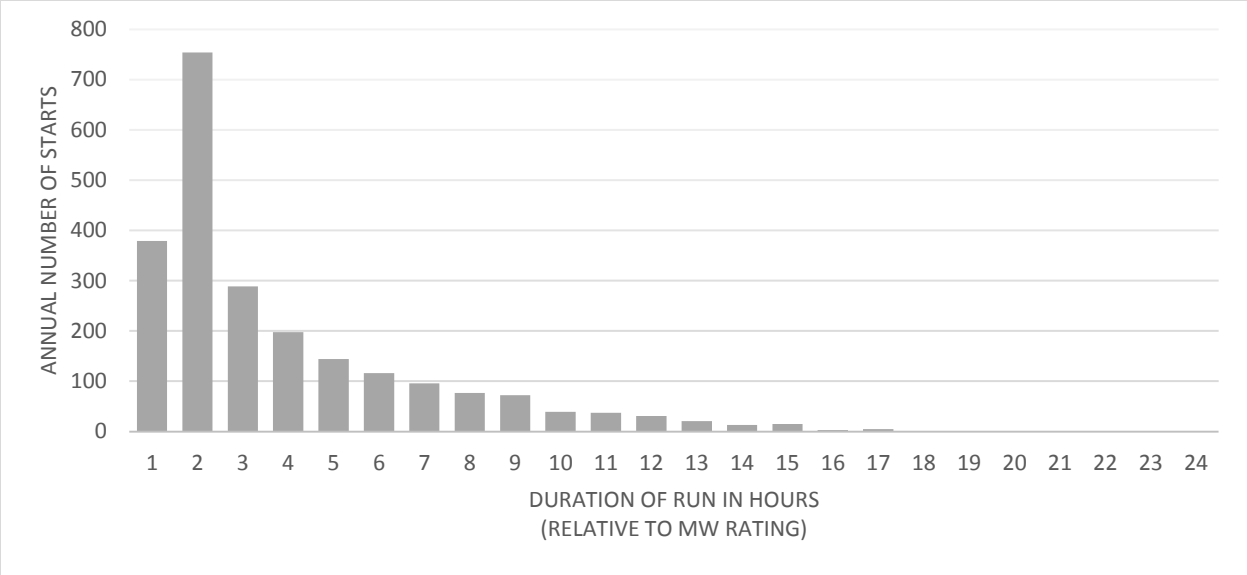


Figure 3 ISO-NE Peaker Run Times (Year Ending December 31, 2015)[29]

[27] Durations were computed relative to nameplate capacity. For example, a generator that operated for 4 hours at half of nameplate capacity would be said to run for 2 hours relative to nameplate capacity. ESA presents the data in this form to facilitate comparison of storage capabilities to deliver a given power level for a specified duration, as generators ofte inject at a fraction of nameplate capacity and require start-up and shut-down activities that prolong such injections.

[28] Analysis of Velocity Suite/EPA Carbon Emissions Monitoring System data on all coal- and gas-fired generation units in PJM with annual net capacity factor less than or equal to 10% over the period October 1, 2014 – September 31, 2015.

[29] Analysis of Velocity Suite/EPA Carbon Emissions Monitoring System data on all coal- and gas-fired generation units in ISO-NE with annual net capacity factor less than or equal to 10% over the period January 1, 2015 – December 31, 2015.



While most peaker plants ran for many hours of duration following starts, nine peaking generating units each in PJM and ISO-NE never ran for more than three hours of duration relative to nameplate capacity (see Figure 4 and Figure 5). This suggests that energy-limited electric storage resources might be capable of providing similar service to some peaking generation units that are Capacity resources, thereby increasing market competitiveness.

Figure 4 PJM Peaker Plant Average and Maximum Run Times (Year Ending September 31, 2015)[30]

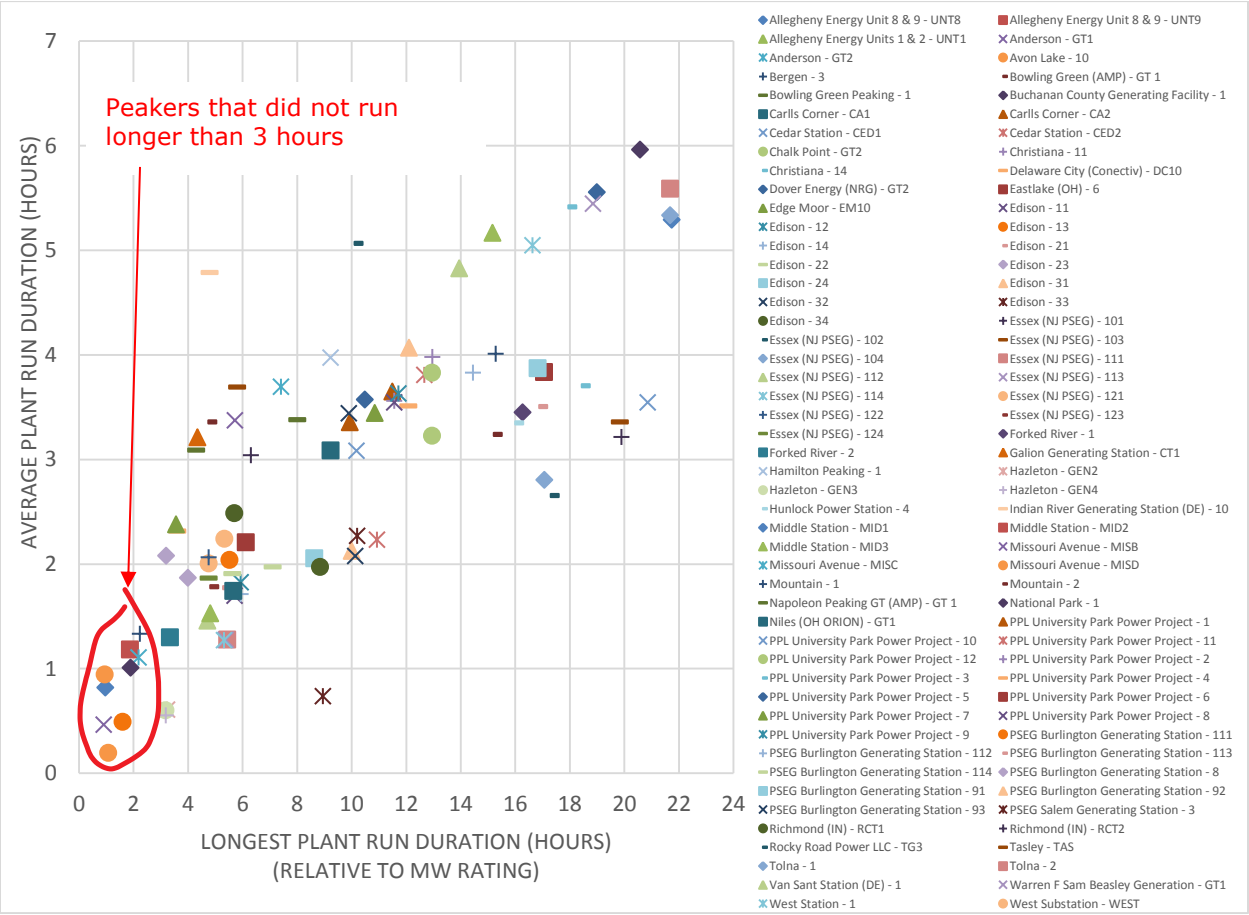
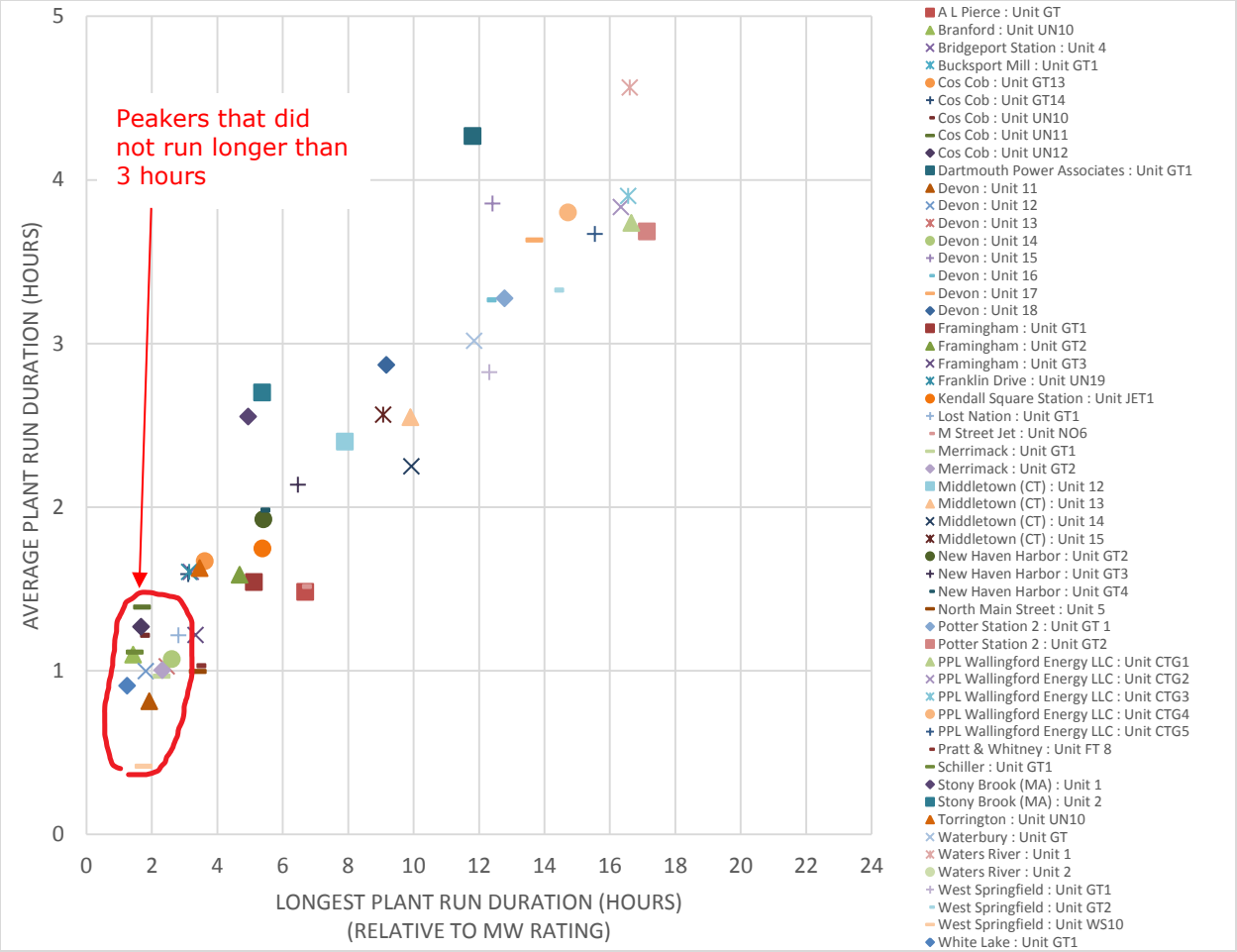


Figure 5 ISO-NE Peaker Plant Average and Maximum Run Times (Year Ending December 31, 2015)[31]

[30] Analysis of Velocity Suite/EPA Carbon Emissions Monitoring System data on all coal- and gas-fired generation units in PJM with annual net capacity factor less than or equal to 10% over the period October 1, 2014 – September 31, 2015.

[31] Analysis of Velocity Suite/EPA Carbon Emissions Monitoring System data on all coal- and gas-fired generation units in ISO-NE with annual net capacity factor less than or equal to 10% over the period January 1, 2015 – December 31, 2015.



PJM and ISO-NE should consider ways to ameliorate the barrier of open-ended duration requirements to enable useful participation from flexible, defined-duration resources like storage. ESA suggests that the use of price differentiation for defined duration resources in “performance” Capacity markets, rather than non-performance penalties for energy-limited resources, would enable the participation of storage resources and increase the competitiveness and efficiency of the market. For example, a 3-hour resource could not only be qualified to provide Capacity, but could also be compensated, albeit at less than the standard Capacity market price, for providing only that defined duration; non-performance penalties should not apply if the resource meets that defined duration before running out of charge.

Further, both PJM and ISO-NE have no explicit qualification criteria for Capacity related to minimum discharge duration,[32] making it unclear what duration a resource would need to be allowed to qualify. It is not specified how electric storage resources' qualifying capacity value would be determined. Further, even once a given storage resource is qualified by PJM or ISO-NE, the open-ended nature of the Capacity market performance requirements means that resource might still face non-performance penalties if a performance period lasted longer than the discharge capability of the storage resource. Thus, for storage to operate in the Capacity market, it is necessary for ISOs/RTOs to adopt clear qualification criteria for Capacity storage resources.[33]

b. RTOs/ISOs with defined duration requirements (MISO and NYISO) should make clear the eligibility of storage to participate and explicitly enable storage resources to de-rate capacity to meet the product qualification criteria.

NYISO and MISO each have resource types that enable resources that can sustain output for 4 consecutive hours each day to be eligible to participate in the Capacity markets,[34] but it is not clear from tariff language whether those rules are applicable to electric storage or whether storage can even register as those resource types. Thus, it is essential that tariffs include language that specify that storage resources capable of 4-hour duration at nameplate capacity are qualified to provide Capacity.

Further, in Capacity markets with fixed minimum duration requirements, like NYISO and MISO, it should be made explicit that an energy-limited resource can de-rate its

[32] PJM: "[T]he tariff changes in this filing are not overly prescriptive on qualification or eligibility requirements of a Capacity Performance Resource." PJM Interconnection, L.L.C. filing on December 12, 2014, in Docket No. ER15-623-000, page 22. ISO-NE Report page 16.
[33] For example, CAISO has explicit rules for storage resources providing Resource Adequacy (RA), including qualifying capacity rules for System and Flexible Capacity. Section 40.10 of the CAISO tariff describes how non-generator resources can meet the Flexible RA requirements. In Docket ER15-1825, FERC approved a four hour qualifying capacity requirement for System RA for Energy Storage.
[34] NYISO "Energy Limited Resource (ELR)" NYISO Report, page 3; MISO "Use Limited Resource (ULR)" MISO Report page 7.

capacity to meet the product qualification criteria. For example, in NYISO and MISO, a storage resource with duration of less than 4 hours relative to nameplate capacity should be able to qualify for Capacity at a lower power level that it can sustain for 4 hours.

c. RTOs/ISOs should clarify offer reference prices and offer obligations in a manner that accommodates energy-limited resources.

ISOs generally have not established Capacity offer reference prices for electric storage resources, which are used to determine the appropriateness of Capacity supply offers from the various resource types. For example, ISO-NE does not define an offer review trigger price (ORTP) for electric storage, which is necessary to ensure Capacity offers pass the review by the market monitor.[35]

Further, outside of CAISO and PJM,[36] ISOs do not explicitly define offer obligations for electric storage resources that are providing Capacity. For example, the general requirement for a Capacity resource to offer its Capacity obligation into the Day Ahead Energy market 24 hours a day is not appropriate for limited-energy resources (including storage).[37] Capacity resource offer obligations were written for traditional, energy-unlimited generators, and their application to energy-limited storage resources is not clear. In order for electric storage resources to truly have access to Capacity markets, must offer obligations must respect the limited-energy nature of these devices.

[35] ISO-NE calculates a benchmark price, known as an offer review trigger price (ORTP), for each resource technology type based on certain revenue and cost assumptions. ISO-NE compares capacity supply offers from new resources to these ORTPs in order to screen for market power that could inappropriately suppress capacity prices. There is not a calculated ORTP for electric storage.

[36] See CAISO Report page 9 and PJM Report page 7. CAISO offer obligations for System and Flexible Capacity for NGRs were approved by FERC in Docket No. ER15-1825.

[37] Existing pumped hydro storage resources supplying Capacity are accommodated in offer obligation rules through a combination of specific resource types, bid parameters, and modeling. The same accommodation can be accomplished for advanced storage resources through the same structure, as described in the preceding sections of these comments.

d. RTOs/ISOs should develop explicit rules enabling storage and generators to combine and offer as a single Capacity resource, as well as recognition of increased Capacity value for variable renewable generators with integrated storage.

With its Capacity Performance market design changes, PJM instituted rules for certain resource types[38] to combine and offer as a single Capacity resource, to increase the Capacity value and to reduce chances of facing non-performance penalties. Such ability for storage resource to combine with other resources, especially intermittent renewable resources, should be defined and clarified in all ISO Capacity markets to improve system efficiency and maximize the value of resources to the grid. For variable renewable generation, class average capacity factors are often used to calculate Capacity market credit during the first several years of operation until resources have sufficient operating history. If electric storage is integrated into a renewable generation facility to a sufficient degree, average capacity factors could increase by a significant level. However, as of now there is no means by which renewable generators can capture this improved performance in Capacity market crediting.

2. Energy markets should make rules for participation of energy-limited storage clear.

Most ISOs do not make explicit a minimum duration requirement to offer Energy, but only explain they engage in hourly scheduling as part of their Energy scheduling process. This makes it difficult for storage resource owners to structure offers, as storage resource can dispatch flexibly on a sub-hourly basis. ISOs would improve the clarity of their rules by establishing clear qualification criteria for providing Energy, in terms of minimum duration requirement. Further, it should be made explicit that a limited-energy resource can derate its capacity to meet the product qualification criteria.

[38] Capacity Storage Resource, Demand Resources, Intermittent Resources, Energy Efficiency Resources and Environmentally-Limited Resources, see PJM Report pages 6-7.

3. Frequency Regulation markets should be operated as intended to correct for short-duration imbalances, taking full advantage of fast-responding resources and not structurally impeding them.

Frequency Regulation is designed "to follow the moment-by-moment changes in load,"[39] which electric storage is well-suited to do. The Commission acknowledged this when it approved ISO Regulation market designs that either instituted an energy-neutral[40] Regulation dispatch signal (in PJM and ISO-NE) or active state of charge management by the ISO (in MISO, NYISO, and CAISO).

a. *RTOs/ISO should utilize Frequency Regulation resources only to meet short-run imbalances and avoid anti-competitive structural impediments to energy-limited storage.*

However, in all ISOs, the Regulation dispatch is often biased in one direction for many tens of minutes. In PJM in particular, the energy-neutral Regulation dispatch signal ("RegD") has been trending less energy-neutral over time, based on a review of the signal data posted to PJM's website.[41] Further, PJM operators often manually peg the RegD signal in one direction for long periods (up to 60 minutes,[42] much greater than the nominal 15-minute time constant that is part of the signal design). As grid operators seek to correct such longer-run energy imbalances, Regulation resources are being called in a manner that better fits the requirements of Spinning Reserves. Doing so poses a structural impediment to the participation of energy-limited storage resources that entered such markets configured only to address short-term imbalances as expected in Regulation markets.

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[39] Open Access Transmission Tariff, Schedule 3, Regulation and Frequency Response Service.
[40] "Energy neutral" signals are those that net to zero over a given time interval. An electric storage resource on such a signal returns to its previous state of charge at the end of a given interval, making it equally available for the next interval.
[41] See PJM's website section on Ancillary Services at http://www.pjm.com/markets-and-operations/ancillary-services.aspx
[42] See PJM's presentation on Regulation Signal Saturation Analysis, June 1, 2016, available at http://www.pjm.com/~/media/committees-groups/task-forces/rmistf/20160601/20160601-item-02-regulation-signal-saturation-analysis.ashx

Rather, ISOs should call Spinning Reserves or other ancillary services to meet longer-run imbalances.

b. RTOs/ISOs should enable dispatch of Regulation resources by ramp-rate to better meet Regulation needs and enable full market participation of storage.

Some ISOs do not dispatch their Regulation fleets to take full advantage of the fast-response capabilities of storage resources. For example, while MISO utilizes five dispatch priority groups for Regulation, in which resources are ranked based on available ramp, [43] the Regulation dispatch signal is extremely slow and subdued relative to the capabilities of storage resources, as the signal was designed for thermal generation resources. Advanced storage resources can ramp much faster and can provide much more movement than the current MISO Regulation dispatch signal can provide. This means the market does not fully take advantage of the capabilities of storage resources.[44] Also, while SPP has the ability to utilize multiple Regulation dispatch priority group sorted by effective ramp rate of the resources, it does not actually utilize its priority groups and has chosen to randomly deploy Regulation resources.[45] This dispatch method does not enable the benefit of the response capabilities of the resource fleet to be realized and would significantly underutilize the speed and flexibility of storage resources.

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[43] MISO Business Practice Manual No. 002 - Energy and Operating Reserve Markets, section 8.2.4 Regulating Reserve Deployment.

[44] While MISO has been considering an Automatic Generation Control Enhancement project that was developed with input from the storage industry in 2014, the enhancement is still in the very early "planned" phase, despite clear and significant benefits of this enhancement for MISO. See MISO Market Roadmap - Project Statuses and Fact Sheets - May 2016, available at https://www.misoenergy.org/_layouts/MISO/ECM/Redirect.aspx?ID=214446. See also MISO AGC Enhancement presentation to Market Subcommittee, October 28, 2014, available at https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/MSC/2014/20141028/20141028%20MSC%20Item%2005b%20AGC%20Enhancement%20for%20Fast%20Ramping%20Resources.pdf

[45] "When the first two criteria are both set to 'off' and the third criterion is greater than 1, Resources are randomly assigned to a priority group for an Intra-Day RUC interval. The current configuration is (1) off, (2) off, (3) = 6." SPP Protocols, section 4.4.3.3 Regulation Deployment.

4. Spinning Reserves and Ramping should have appropriate offer obligations for storage.

Providing Energy should not be a requirement to provide Spinning Reserves and Ramping. Electric storage resources are capable of ramping nearly instantaneously, which is fast enough to provide Spinning Reserve and Ramping service without having an Energy schedule. Additionally, inverter-based resources like grid-connected electric storage should not be prohibited from providing synchronized reserves due to outdated qualification criteria and performance requirements for generators, as what is deemed to be "synchronized" is inapplicable to storage.[46]

D. Distributed storage resources on both sides of the customer meter face barriers to market participation due to both eligibility rules and qualification / performance requirements. Accordingly, ESA respectfully requests FERC to direct ISOs/RTOs to eliminate barriers to market participation by applying the same principles above to distributed storage resources.

ESA wishes to distinguish between storage directly connected to a distribution system without a customer meter ("front-of-meter," or "FOM") and storage connected to the distribution system from behind a customer meter ("behind-the-meter," or "BTM"). While FOM storage can participate in RTO/ISO markets in a manner similar to transmission-connected storage, it faces uncertainty and barriers associated with rate treatment.

On the other hand, BTM distributed storage has limited participation in RTO/ISO markets. As a load-modifying resource, BTM storage can participate in markets as a demand response resource so long as minimum resource size and other requirements are met. However, demand response resource qualification and market operations can be inappropriate for BTM storage. Market participation rules are often designed around

[46] As mentioned in the NYISO Report on page 3, footnote 4, and page 7, footnote 16. Because the qualification criteria is based on Northeast Power Coordinating Council (NPCC) rules, such a prohibition would affect storage resources in ISO-NE as well.

individual sites as a resource, rather than the capabilities of an aggregated set of sites, presenting barriers to aggregation—which is of particular concern when wholesale markets require relatively large minimum project sizes. Measurement of demand response resource deliveries are based on derived counterfactual baselines with inherent margins of error, even though load-modifying storage can be directly metered; as a result, BTM storage is often needlessly overbuilt to meet a given qualified level of deliveries.

Wholesale market demand response constructs can prohibit BTM storage from offering other services that it is capable of. For example, the CAISO Proxy Demand Resource (PDR) resource type is prohibited from providing frequency regulation, even though it is technically capable of doing so as a purely load-modifying resource. [47] In their Reports, ISO-NE and NYISO describe how NPCC rules prohibit the provision of Spinning / Synchronized Reserve with local generators, including BTM storage.[48] Wholesale market rules also limit the ability of BTM storage to offer uses to both wholesale markets and to either the distribution system or to end-users, creating uncertainty for market participants who wish to fully realize the multiple services storage can provide. For example, in its comments the NYISO states that "Generally speaking, the NYISO's tariffs do not permit a Supplier (including ELRs and LESRs), except certain demand side resources, that sell Energy, Capacity or Ancillary Services to the NYISO's wholesale markets to simultaneously provide a service (from the same supplier) to a distribution utility." Not only is this statement unclear as to application, it is inconsistent with ongoing state goals and objectives. CAISO's recent ESDER Initiative begins to address this barrier and represents an important first step

[47] See CAISO's *Energy Storage and Distributed Energy Resources (ESDER) Stakeholder Initiative Phase 2: Issue Paper*, issued March 22, 2016, available at http://www.caiso.com/Documents/IssuePaper-EnergyStorageandDistributedEnergyResourcesPhase2.pdf

[48] ISO-NE Report page 11; NYISO Report page 9 footnote 20.

that other RTOs/ISOs may learn from.[49] For markets to realize the greatest system benefits and enhance competition necessary for just and reasonable rates, RTO/ISO rules should seek to enable multiple value streams and uses. ESA refers the Commission to the filing of the California Energy Storage Alliance in the instant docket for greater detail on these issues and agrees with the barriers and solutions identified therein.

Minimum project sizes can be prohibitive to FOM and BTM storage and are inconsistent across regions. MISO, ISO-NE, and NYISO all limit resource sizes to a minimum of 1 MW, [50] even though resources as small as 0.1 MW in PJM, CAISO, and SPP are allowed to provide service. Additionally, metering and telemetry requirements and interconnection processes can pose prohibitively high transaction costs for the small project sizes that characterize BTM storage, creating undue burdens on BTM storage participation in most RTOs/ISOs. Similarly, the ability to bid aggregated distributed resources into wholesale markets is not possible in some RTOs/ISOs and is unclear in others. For example, while ISO-NE allows distributed resources to aggregate to meet the 1 MW minimum resource size for an ATRR, NYISO does not allow aggregations to meet the 1 MW size for an LESR.[51]

Further, no RTO/ISO at present allows BTM storage to net inject power to provide wholesale generator services, although NYISO recently filed and received conditional approval for its Behind The Meter Net Generator (BTM:NG) enhancement.[52] NYISO did not

[49] See CAISO's Energy Storage and Distributed Energy Resources Initiative at http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_AggregatedDistributedEnergyResources.aspx

[50] NYISO Demand Side Ancillary Service Program (DSASP) minimum resource size is 1 MW, while Special Case Resource (SCR) and Emergency Demand Response Program (EDRP) allow 100 kW.

[51] ISO-NE Report, page 26, and NYISO Report, page 13.

[52] Order Accepting Proposed Tariff Revisions Subject to Condition, issued May 17, 2016, in Docket No. ER16-1213.

include electric storage functionality, like state of charge management, in its BTM:NG design, and the construct still effectively excludes participation of storage resources.

As with other resources located on electric distribution systems, distribution-connected storage resources should be enabled to participate in wholesale markets to enhance market competition necessary for just and reasonable rates, including as an aggregation across multiple storage assets and sites. CAISO's new and proposed tariff language on distributed energy resource providers, including energy storage, is one of the more advanced among RTOs/ISOs.[53] ESA recommends that the Commission consider how it might extend best practices learned in CAISO across all wholesale markets, as well as consider addressing common barriers in metering, telemetry, and resource eligibility across markets.

Additionally, the *Energy Vault* case before the Commission has made the rate treatment of distribution-connected storage less certain, as it is unclear if and to what extent wholesale distribution charges will be applied to charging activities that are otherwise a part of wholesale service.[54] The result is that storage projects' rate treatment can remain uncertain prior to commissioning, creating a barrier to investment and market entry.

E. While the ISOs report they have stakeholder efforts underway to improve participation for storage, these efforts do not address all of the barriers that exist to storage participation and are moving slowly and have no guarantee of implementing beneficial changes. Accordingly, ESA respectfully requests FERC to direct the RTOs/ISOs to develop rules using the parameters set forth in our comments so as to avoid having tariffs proposed that will, on their face, be discriminatory against storage resources or a barrier to participation in market products.

[53] Order Accepting Proposed Tariff Revisions Subject to Condition, issued June 2, 2016, in Docket No. ER16-1085.
[54] *PJM Interconnection, L.L.C.*, et al., 151 FERC ¶ 61,231 (2015) ("June 18th Order").

While most RTOs/ISOs report undertaking potential modifications to market rules and procedures specifically addressing electric storage, for the most part these efforts are incremental and do not address a number of significant barriers described above. Additionally, the timeline for many of these efforts is particularly long, and so is out of step with the rapid maturation of electric storage technologies. For example, while MISO's Market Subcommittee has discussed work plans for electric storage issues, some issues of fundamental concern to the storage industry are now either assigned for discussion at an indeterminate point in the future or absent from consideration.[55] Similarly, while SPP's Market Working Group has recently taken up discussion of a storage resource type multiple months have passed without significant progress on the issues. Moreover, even if an RTO/ISO agrees upon changes during a months- or years-long process, required software changes can push implementation out further still. For example, in the NYISO current storage roadmap process, related tariff changes that involve software changes cannot actually be implemented before 2018-2019.

ESA would like to acknowledge CAISO for several recent and current initiatives that address multiple significant barriers to the market participation of storage resources identified above. Much of CAISO's forward-leaning efforts are due to the storage procurement target that the California Public Utilities Commission (CPUC) has implemented, and the joint exercises between the CPUC and CAISO in bringing together market participants for storage roadmapping and follow-on technical workshops are to be commended for appropriately taking on issues of fundamental importance to storage market participation.

[55] See ESA's comments to MISO MSC at http://energystorage.org/system/files/resources/miso_comment_2016-1-22.pdf and at http://energystorage.org/system/files/resources/esa_comment_on_miso_energy_storage_proposed_workplan_2016-3-18_002.pdf

For these reasons, it is essential that as part of this docket, FERC direct the ISOs/RTOs to implement tariff changes consistent with the non-discriminatory policies outlined in these Comments.

F. In addition to the critical areas identified in the Commission's request, ESA respectfully wishes to briefly identify several related issues that effectively determine market access for storage: interconnection, price formation, and access to transmission service.

Tariff language that provides access to markets for generator services is a necessary but not sufficient condition for storage participation. ESA wishes to briefly identify several related issues that effectively determine market access for storage.

1. Resolving challenges with interconnection is necessary for market access of storage resources.

Interconnection provides physical access to markets and is a necessary precondition for market participation. Electric storage faces specific interconnection barriers. In general, interconnection studies for storage may not match the highly controllable operations that are being requested by market participants. In particular, co-locating storage with existing generation assets behind a point of interconnection faces burdens to prove reliability out of proportion with the risk that such a controllable resource represents. An approach similar to MISO's "net zero" policy would be preferable. [56] Related to this, the modeling of storage as a load is inappropriate, since charging is controllable and potentially a direct market service; CAISO's "negative generation" construct is a better approach.

ESA acknowledges FERC for examining these barriers in Docket RM16-12 and looks forward to working with the Commission to develop solutions that adequately address RTO/ISO reliability concerns.

[56] MISO Attachment X - Generator Interconnection Procedures (GIP), section 3.2.3 Net Zero Interconnection Service.

2. Price formation and market creation are critical to ensure services from storage and other flexible resources can be valued and compensated.

Access to markets, while important, limits storage only to existing, priced services. Lack of price formation and use of out-of-market compensation fundamentally devalues flexibility services provided by electric storage and other resources. A number of system services remain unpriced. Resources are not compensated for frequency response capability in any RTO/ISO. Resources with ramping capability are only compensated in CAISO and MISO, and certain storage resource types are not eligible to participate in either ISO's Ramping market currently. Generator unit start-up and shut-down costs and not incorporated into wholesale prices, and uplift payments to generators are out-of-market settlements. No product yet exists for "positive" demand response, in which highly controllable load, such as storage charging, could balance unexpected and sudden reductions in system load or manage over-generation. Some services that depend on cost allocation, such as voltage and local reliability commitments, could instead use price signals for more market-efficient service provision. Moreover, existing products other than frequency regulation lack differentiation of price based on resource performance; for example, Spinning Reserve compensates a resource with 5-second response the same as a resource with 5-minute response, even if the former can provide more system value.

ESA acknowledges FERC for examining out-of-market settlements for uplift in AD14-14. ESA also acknowledges FERC for inquiring into frequency response service compensation as part of RM16-6. Fundamentally, the task of market creation and price formation is much larger than the narrower interests of electric storage resource owners. Nevertheless, reducing barriers to market participation will realize greater system benefits when markets for flexibility exist and value the performance provided by resources like storage.

3. Since storage is uniquely capable of providing transmission service as well as competitive market services, enabling storage resource to do both will optimize the efficient use of grid assets.

Continuing barriers to energy storage as a transmission asset merit redress. The *Western Grid* case[57] provides a baseline for classifying storage as a transmission asset eligible for cost allocation. Nevertheless, storage is not considered as a part of ISOs' regular transmission planning processes or procurement.

Also, FERC declared in *Western Grid* that storage assets acting as transmission are ineligible to participate in markets for wholesale generator services.[58] Storage is technically capable of providing both transmission and generator services over a given period—for example, by reserving a proportion of capacity for transmission while using remaining capacity for generator services, or by switching to generator services when transmission services are unneeded. Enabling storage resources to flexibly shift service to meet the highest-value system needs at any given time, not just among generation services but also between transmission and generation services, enables full utilization of storage resources, which in turn will optimize utilization of other grid assets and bring overall system benefits.

While ESA respects the reasons that provision of transmission service and generator service have been separated, ESA requests that FERC consider implementation of a regulatory framework that enables technically-capable electric storage to provide both services and realize greater optimization of system assets. For example, if electric storage projects proposed during transmission planning were allowed to offer into wholesale markets only as price takers, then anticipated market revenues could be subtracted from the total project costs to derive a lower net cost to the RTO/ISO and mitigate any strategic behavior designed for windfall profits. An alternative approach to would be to allow battery

[57] *Western Grid Development, LLC*, 130 FERC ¶ 61,056
[58] *Western Grid Development, LLC*, 133 FERC ¶ 61,029 at P 16-17

and other storage projects selected as a non-transmission alternative in the transmission planning process to offer into energy, ancillary services or capacity markets as price takers, similar to how the Commission has directed reliability must run units to offer into the RTO/ISO markets. In the transmission planning process, storage developers could subtract anticipated market revenues from the total project costs to derive a net cost to the RTO/ISO of selecting its project as a non-transmission alternative. Such resources would be constrained operationally to be available for dispatch by the RTO/ISO to resolve the identified system need for which it was selected in the transmission planning process.

V. CONCLUSION

There are nearly 300 MW of advanced electric storage currently operating in PJM, while there is 0 MW of advanced electric storage operating in ISO-NE, MISO, and SPP. This is because market rules are a critical determinant to the participation of electric storage in wholesale markets. When technically-capable storage has affirmative market access, is modeled appropriately, qualifies for service through performance standards that treat it equitably, and accesses markets designed to reward performance, then it will increase competition and provide system benefits.

In summary, ESA respectfully requests the Commission to consider a slate of actions on different timescales to enable storage participation in wholesale markets. In the near-term, FERC can direct RTOs/ISOs to affirmatively state the eligibility of storage to participate in existing resource types and adjust tariffs appropriately, and FERC can also direct RTOs/ISOs to initiate development of a resource type that models storage appropriately and enables it to participate in all wholesale market products, if not already done. Additionally, FERC can direct RTOs/ISOs to make available aforementioned dispatch data and, where appropriate, offer market participants walkthroughs of how their software

treats storage assets. Furthermore, FERC can direct appropriate RTOs/ISOs in the near term to clarify the ability of storage to derate to provide Capacity, as well as clarify offer obligations for Capacity. FERC can also clarify that RTOs/ISOs should use Regulation to address short-term imbalances as intended and begin projects to enable faster dispatch, if not already done. Finally, FERC can direct RTOs/ISOs to exempt storage from must-offer obligations in Spinning Reserve and in Ramping.

In the medium-term, FERC can direct RTOs/ISOs to establish clear rules regarding combination of storage with other resources to provide Capacity, as well as to consider a a channel for participation in open-ended duration Capacity markets, such as through price differentiation for defined duration resources. FERC can also address common barriers to distributed storage across RTOs/ISOs, particularly with respect to metering, telemetry, and aggregation. In line with the establishment of appropriate storage resource types, FERC can direct RTOs/ISOs to review qualification criteria and performance requirements to ensure storage can participate fully, as well as revisions to ancillary services market designs to take advantage of the flexibility and performance of storage resources.

In the longer-term, FERC can direct RTOs/ISOs to establish methods for enabling distribution-connected storage to participate simultaneously in wholesale services and distribution or end-user services, both as load-modifying resource and as a net injection resource. FERC can also take that opportunity to review and provide guidance for the application of wholesale distribution charges for distribution-connected storage providing wholesale service. FERC can consider investigating methods to enable storage to provide both wholesale generator services and transmission services. Finally, FERC can direct RTOs/ISOs to more generally establish markets for flexible services.

By enabling electric storage resources to participate fully in organized wholesale markets, FERC can ultimately ensure that those markets have access to the widest range

of solutions and the capability to capture their full system benefits. That competition is critical to ensuring that markets remain competitive and efficient. A number of the proposals in this comment, moreover, would apply to resources other than storage, as they are premised on valuing resource flexibility in wholesale markets. Greater operational possibilities are the surest way to manage uncertainty, and ESA hopes that the Commission will agree that creating those possibilities will ensure our electric system remains reliable and affordable.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I, Anne O'Hanlon, hereby certify that the foregoing Comments were served via electronic mail to the service list.

Dated in Boston, MA this 6th day of June 2016.

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