UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Electric Storage Participation in Regions with Organized Wholesale Electric Markets	**)** **)** **)**	**Docket No. RM16-23-000**

COMMENTS OF THE ENERGY STORAGE ASSOCIATION

The Energy Storage Association ("ESA") submits these Comments in response to the Notice of Proposed Rulemaking that was issued by the Federal Energy Regulatory Commission ("FERC") on November 17, 2016 pertaining to above-captioned docket. ESA is appreciative that FERC continues to recognize the importance of installing energy storage facilities on our nation's grid and, as detailed herein, is in general agreement with FERC's proposals that would direct organized wholesale market operators to create affirmative participation models for electric storage. A rule such as the one now under consideration is necessary for to ensure that all electric storage facilities can operate in organized wholesale markets. Thus, for the reasons detailed below, ESA respectfully requests that FERC issue a rule that directs regional transmission organizations ("RTOs") and independent system operators ("ISOs") to enable electric storage participation in all RTO/ISO markets, effective utilization of electric storage in RTO/ISO market operations, and participation of multiple storage configurations. ESA respectfully offers several modifications to FERC's proposals to best achieve these goals.

Additionally, ESA offers general support for FERC's parallel proposals on the participation of distributed energy resource ("DER") aggregations in organized wholesale markets. ESA supports a single order capturing storage and DER aggregation. However, should

FERC determine that the proposals on DER aggregations require further discussion and deliberation and that the proposals on storage do not, ESA respectfully requests FERC issue a separate order for the storage-related proposals, so as not to delay their implementation.

Ultimately, opening wholesale markets to competition from the fullest range of viable resources, including electric storage, is necessary to maximize economic efficiency, which ensures just and reasonable rates. Storage also enables more flexible grid operations, increasing the range of grid operational possibilities. Market access for electric storage is thus a necessary step forward to ensuring reliability and affordability of electric service.

I. COMMUNICATIONS

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II. ABOUT THE ENERGY STORAGE ASSOCIATION

Since its inception 27 years ago, 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 approximately 200 member companies have expertise in transmission- and distribution-level grid operations relevant to electric storage, as well as firsthand knowledge of the regulatory challenges to financing and operating commercial electric storage facilities to realize full system benefits. Additionally, many of ESA's members provide electric storage as a distributed energy resource and have expertise in the operations of customer-sited assets.

III. COMMENTS

A. ESA agrees with FERC that the proposed rule is critical to maximizing the competitiveness of organized wholesale markets, a necessary condition for just and reasonable rates.

In opening this NOPR, FERC recognized that "effective integration of electric storage resources into the organized wholesale electric markets would enhance competition and, in turn, help to ensure that these markets produce just and reasonable rates."[1] ESA agrees with FERC that enabling all electric storage[2] resources to participate in all services for which they are technically capable will ensure the fullest range of resource options compete to meet system needs economically. Conversely, when electric storage participation is prohibited or inhibited by discriminatory rules and market designs, the lack of competition results in increased system costs due to the narrower range and limited capabilities of resources available to provide services.

[1] NOPR at P 13.

[2] ESA specifically refers here to batteries, flywheels, and other newer forms of electric storage, rather than hydro pumped storage. These newer storage technologies lack a sufficient market participation model, whereas hydro pumped storage does not. In addition, the existing pumped storage participation models are inappropriate for newer electric storage resources. Pumped storage is often modeled separately as a load and as a generator, lacking ability to quickly transition back and forth between each mode. Models for pumped storage generally include minimum load operating points and startup, shutdown, and transition times and costs. Newer electric storage resources have greater flexibility to transition between charging and discharging and can be controlled to a higher degree of precision than hydro pumped storage resources. In particular, newer electric storage resources can move seamlessly and nearly instantaneously between positive and negative generation (discharging and charging) across their range, as they have little to no transition times. Newer electric storage resources do not have minimum load operating points or similar startup, shutdown, and transition times or costs.

The system benefits of electric storage resources have been well documented. For example, in both the PJM and in ISO-NE markets, the participation of electric storage resources has increased competition and reduced system costs.[3] From these results and other successes where electric storage has been installed worldwide, the flexibility that electric storage provides is an efficient solution to ensure system reliability, particularly as trends toward more variable generation and higher local and system load factors continue.

This point was affirmed most recently in a Massachusetts-commissioned study of large-scale electric storage deployment in ISO-NE. The study concluded that deploying electric storage resources on the grid results in significant benefits, including, but not limited to, avoided capacity payments, lower peak prices, reduced generator cycling, effective ramp management, avoidance of generator start-up and shut-down costs, and absorption of over-generation.[4] Similarly, a recent National Renewable 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.[5] In fact, rapidly deployed electric storage has been credited for mitigating the natural gas shortages on experience by CAISO.[6]

There is no question that FERC must remove barriers to allow electric storage

[3] PJM observed a 30% reduction in overall the Regulation reserve requirement as more fast-responding resources, including storage, cleared the market. See PJM's report *Performance Based Regulation: Year One Analysis*, submitted on October 16, 2013 in Docket No. ER12-1204. 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. See 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.

[4] See Massachusetts Department of Energy Resources, *State-of-Charge: Massachusetts Energy Storage Initiative Study*, Sep 2016, available at http://www.mass.gov/eea/docs/doer/state-of-charge-report.pdf

[5] 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.

[6] In California, multiple battery storage projects totaling over 70 MW were placed in service less than 6 months from contract approval to ensure system reliability after failure and shut down of the Aliso Canyon natural-gas storage facility. See https://www.greentechmedia.com/articles/read/aliso-canyon-emergency-batteries-officially-up-and-running-from-tesla-green

participation in wholesale markets. FERC is correct to direct RTOs/ISOs to establish participation models that consist of market rules that acknowledge the unique attributes of electric storage, and ESA agrees with many of FERC's proposals to this end. Nevertheless, ESA's recommendations in this comment focus primarily on the proposals that warrant modification to better assure fair and full market access of electric storage resources.[7]

B. ESA recommends modifications to FERC's proposed participation model for electric storage resources to better enable full participation of storage in wholesale markets.

To ensure that the proposed storage participation model[8] achieves its goals fully, ESA recommends that FERC's rule seeks to achieve three basic goals, namely to enable (1) electric storage participation in all RTO/ISO markets, (2) effective utilization of electric storage in RTO/ISO market operations, and (3) participation of different storage configurations. FERC's proposals would make significant progress toward achieving these goals, and ESA believes finalization of this rule will remove significant barriers to electric storage participation in wholesale markets.

In the spirit of helping FERC meet these goals most effectively and avoiding creating inadvertent barriers to storage, ESA recommends a series of modifications that include additional items to what FERC has proposed.

- Measures that enable participation in all markets:
    - *Ensure that storage can qualify in all markets*: The ability to participate in all markets (capacity, energy, and ancillary services), including clear rules for participation, is necessary to avoid discriminatory barriers. The storage resource

[7] Lack of mention of any proposals should not be considered lack of ESA support for them. Rather, ESA wishes to draw staff's limited attention to areas of divergence.

[8] ESA notes that while FERC defines a participation model as "a set of tariff provisions… ," models for participation in wholesale markets involve manuals/operating procedures and software systems in addition to tariff language.

should not be prohibited from participating in more than one market at a time, and clear rules for participation in energy and ancillary services concurrently should be developed. Storage resources should not be penalized for their "always on" nature.

- *Respect storage resources' energy limits*: FERC has acknowledged that an important characteristic of electric storage resources is their limited energy.[9] Modeling and dispatch that respects that constraint is essential. Thus, ESA respectfully requests that FERC's Rule enable storage resources to avoid must-offer obligations that would require them to offer/inject energy every hour or other mandates that could result in infeasible dispatches to the storage resource.

- Measures that effectively utilize electric storage in markets:

  - *Establish representation of electric storage as a single resource type*: The storage resource should register as and be modeled as one resource type within the ISO/RTOs systems so that it can be dispatched seamlessly from positive to negative.[10] It should not have to register as or be modeled as two separate resources types, i.e. generation and load. The single resource type should be able to both withdraw energy from and provide energy to the grid, as well as switch between states from one dispatch interval to the next.

  - *Establish appropriate bidding parameters and modeling*: Business rules for economic bidding should also be established so that the economic preferences and physical characteristics of the resource can be fully integrated into the market. Self-scheduling should always be an option. Storage operators should have the option to specify physical characteristics including charge limits, charge rates, and run times. In addition to utilizing appropriate bidding parameters and other operating parameters, RTOs/ISO should be required to offer the option for state-of-charge management. These parameters can then be used in the RTO/ISO's optimization and dispatch algorithms in the markets.

  - *Enable flexible dispatch of storage*: For full participation of storage, RTOs/ISO should be required to fully utilize the discharging and charging dispatch capabilities of electric storage resources, including allowing electric storage resources to participate as both seller and buyer, for both energy and ancillary services, and/or to switch between charging and discharging between dispatch intervals. Thus, the

[9] See *e.g.*, Order approving NYISO's LESR (127 FERC ¶ 61,135) and Order approving MISO's SER (129 FERC ¶ 61,303)

[10] *See, e.g.*, CAISO Non-Generator Resources (NGR), and PJM Energy Storage Resources (ESR) and Capacity Storage Resources (CSR).

new Rule would need to require RTOs/ISOs to establish a dispatch signal that moves fast enough to take advantage of the quick-response capabilities of storage resources.

- *Price energy used for charging appropriately*: FERC has correctly recognized the importance of energy used to charge electric storage for later discharge as a sale for resale, and that wholesale prices should be applied for charging energy. Additionally, ESA respectfully requests that FERC ensure efficiency losses be included in the definition of charging energy and that transmission charges not apply to charging energy. Additionally, the new Rule should not compel electric storage resources to purchase energy from the wholesale market, which will ensure storage co-located with generation resources is not discriminated against.

- Measures that enable different storage configurations to participate:

  - *Allow behind-the-meter storage to export to the grid*: FERC considers the participation of DERs valuable to wholesale market efficiency. While non-exporting behind-the-meter storage may use demand resource constructs, behind-the-meter storage should be enabled to export energy to the grid for purposes of wholesale market participation. The participation model must therefore include considerations of appropriate metering, telemetry, and/or accounting to differentiate wholesale and retail transactions, as well as ensure appropriate rate treatment.

  - *Allow storage to provide both wholesale and retail services:* FERC should enable multiple use storage and avoid rules that would restrict retail service provision by distributed electric storage. Additionally, separate bidding parameters are necessary for multiple-use storage from FERC's proposed required parameters.

  - *Set 100 kW as the largest minimum size for resource eligibility:* ESA agrees with FERC that the minimum size for projects to participate in wholesale markets should be 100 kW to reflect current RTO/ISO capabilities.

While there is not a single ideal storage participation model that exists in the U.S. today, many features of a complete storage participation model already exist somewhere in the range of RTO/ISO market designs. For example, CAISO's Non-Generator Resource (NGR) and PJM's Capacity Storage Resource (CSR) accommodate front-of-meter resources capable of both injection and withdrawal; NYISO's Behind-the-Meter Net Generation Resource (BTM:NG) accommodates certain behind-the-meter resources that export to the grid under certain

conditions; and CAISO's Proxy Demand Resource (PDR) accommodates non-exporting behind-the-meter resources. Yet, these constructs all have deficiencies that preclude full participation by all electric storage resources. However, the good news is that with some minor modifications, RTOs/ISOs can use these rules as a foundation to build on in their own markets to implement a complete storage participation model on the schedule FERC has proposed.

The level of prescriptive detail in FERC's NOPR and in ESA's comments is necessary to ensure a participation model is adequately defined. Lack of detail could result in falling back on existing models, which, as FERC has determined, are not sufficient to accommodate the physical and operational characteristics of all electric storage resources and enable their full participation in wholesale markets.

Again, ESA wishes to convey its general support for FERC's proposals. In consideration of FERC's limited attention, these comments do not explicitly point out each proposal with which it agrees, but rather focuses on modifications that will ensure FERC achieves its stated goals.

1. Measures that Ensure Access to All Market Products

a. Ensure that storage can qualify in all markets.

ESA agrees with FERC's proposal that storage be allowed to de-rate capacity to meet minimum run-time requirements in markets such as MISO's and NYISO's capacity markets, in order to allow market access to technically capable resources. ESA further recommends these RTOs/ISOs should assign a value of capacity to such storage consistent with the quantity of energy that can be sustained over the minimum run-time set by the RTO/ISO. In the instant docket, FERC proposes 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. However, some RTOs/ISOs explicitly exempt electric storage resources from a day-ahead energy market must-offer obligation, so under FERC's proposal there would not be a basis for determining a storage resource's capacity value. Further, establishing a day-ahead energy market must-off obligation without an accommodation of the limited energy nature of electric storage resources would create a barrier to storage insofar as requirement of an energy schedule in the day-ahead market is incompatible with energy limits (discussed further in Section 1.b). Rather, where a minimum run-time is explicit, such as in NYISO and MISO, an electric storage resource's capacity value should correspond to the energy deliveries it can commit to over that set duration.

In addition, ESA recommends that RTOs/ISOs with capacity performance markets (*i.e.*, PJM and ISO-NE) make market qualification and performance requirements clear and explicit. In PJM and ISO-NE, the process to determine the capacity value of an electric storage resource is not clear. Furthermore, even once a capacity value is assigned for an electric storage resource, it is not clear how that capacity value relates to the performance requirements. Uncertain qualification and assessment of storage resource performance in capacity markets limits participation, even though energy-limited storage can contribute to meeting peak demands and resource adequacy. Clear and concise capacity qualification and performance criteria for electric storage will at minimum remove the barrier of lack of transparency and create an opportunity for storage to participate in such markets.[11]

[11] Ultimately, electric storage resources will continue to face barriers to participation in capacity performance markets, given the significant liabilities posed by open-ended duration performance requirements for resources with energy limits. Yet, in times of energy scarcity, taking advantage of any available capacity benefits the entire electric grid. Electric storage resources offer flexibility during periods of peak load demand as an alternative to traditional peaking plants; in ESA's previous comments in Docket No. AD16-20, we demonstrate that significantly more than half of traditional capacity resources' operating periods could be met with electric storage of 4-hour duration. For this reason, ESA recommends the use of price differentiation in capacity performance markets, rather than making eligibility effectively depend on open-ended duration. Price differentiation could allow limited-duration resources to

Additionally, grid operators may not yet be fully educated about the physical and operating characteristics of all electric storage technologies. Current methods to assess technical capability and qualify resources for service may not be updated to consider energy storage and thus would be inappropriate for use. For example, technical requirements that resources be synchronized to qualify for certain services like spinning reserves were designed for traditional generation; but electric storage is inverter-based. Hence, the assessment criteria are not applicable to storage. Qualification of storage is thus unclear under this requirement, as determinations of technical capability are subject to interpretation. FERC recognizes this, and ESA agrees with FERC's statement that a market participant's eligibility to provide a particular reserve service should not be conditioned on the requirement to be online and synchronized to the grid to be eligible to provide ancillary services.[12]

Nevertheless, storage resources can provide a variety of services in diverse configurations, and this example portends other cases where the technical capabilities of a resource may not have precedent in the RTO/ISO registration process. Electric storage resources have diverse topologies and chemistries that result in a range of technical capabilities and may provide a variety of services. Therefore, it is imperative that RTOs/ISOs establish a process

provide value through relatively short duration injections (*e.g.*, several hours) to the system during RTO/ISO peak hours; such resources would be compensated, at a predefined, prorated rate, relative to the full price of firm open-ended capacity. ESA believes that using price differentiation for capacity markets would maximize economic efficiency and reduce system costs. Recognizing that capacity performance markets are presently the subject of FERC and court deliberation, ESA suggests FERC consider this issue once a path forward for capacity performance markets is clear.

[12] See NOPR at P 50. Regarding the NERC Glossary of Terms and associated Reliability Standards, ESA agrees with National Electric Manufacturers and Wellhead in Docket No. AD16-20 that NERC definitions of spinning reserve and non-spinning reserve do not clearly allow for market participation and should thus be changed (NOPR at P 52). The main component of the two NERC definitions that may pose a barrier for technologies like storage is the reference to the phrase "generation synchronized to the system." Storage resources are technically capable to provide immediate response to any ancillary service and can provide service equivalent to traditional generation resources. Storage resources today can fulfill requirements of reactive power, voltage ride through, and frequency response all with a highly controllable inverter-based configuration and with performance similar to or even better than traditional synchronized resources. This capability of storage resources should be reflected in the NERC definitions mentioned for improved clarification.

whereby asset owners can demonstrate its qualifications to provide a specific service. Allowing asset owners to work with the RTO/ISO through a transparent, predefined clarification process early in the effort of service qualification would create more certainty for new resources and ensure that all technologies that qualify for a particular market can provide the services sought by the RTO/ISOs. Conversely, RTOs/ISOs should allow storage owners an opportunity to respond to determinations of product ineligibility if there are unique qualities of unit performance insufficiently captured by qualification assessment methods.

b. Respect storage resources' energy limits.

As market rules accommodate ramp-rate limitations of conventional generators, non-dispatchability of variable generators, and indirect measurement of demand resources, ESA recommends RTO/ISO market rules make equitable accommodation of the energy-limited nature of electric storage resources. Rather than consider these accommodations as "special treatment," FERC should view ESA's recommendations as request for comparable treatment necessary to remove barriers to participation that will ultimately have positive impacts on market efficiency and system reliability.

ESA strongly supports FERC's proposal that RTOs/ISOs allow an electric storage resource to de-rate its capacity to meet explicit minimum run-time requirements to enabling participation in energy, ancillary services, and capacity markets.[13] By accommodating the energy limits of electric storage resources, capacity de-rating is an important step to removing a discriminatory barrier to market participation by otherwise technically capable resources.

To further accommodate the limited energy of electric storage resources, ESA respectfully requests that FERC direct all RTOs/ISOs to exempt all electric storage resources

[13] NOPR at P 49.

from, or otherwise allow all electric storage resources to manage, energy market must-offer requirements associated with providing capacity. This is necessary to avoid a discriminatory barrier to market participation by a technically capable resource. This is not without precedent: rules are in place today to accommodate the energy-limited nature of hydro pumped storage that allows such resources to participate successfully in capacity markets.[14] Similar rules can be extended to or created for all electric storage resources, better enabling participation in capacity markets, thus increasing competition.

ESA also argues that electric storage resources should not be required to have an energy schedule to participate in the ancillary service markets. Removing the requirement to provide energy allows a storage resource to provide effective ancillary services and limits the risk of a storage resource exceeding its energy limit. As an existing example, ESA notes the rules in several RTOs/ISOs where certain electric storage resources providing frequency regulation are exempt from providing an energy schedule.[15] In response to FERC's solicitation of comment on the subject, dispatch and pricing of energy and ancillary services will continue to be internally consistent even if an electric storage resource can provide ancillary services absent an energy schedule, as energy and ancillary services can still be co-optimized. Just as some resources currently provide energy and not ancillary services, having resources that provide ancillary services but not energy can be managed without detriment. Further, in the absence of an energy offer/schedule, a resource only providing ancillary services would generally not receive a lost opportunity cost calculation, which is the practice today in the RTOs/ISOs noted. Also, an electric storage resource's start-up time and ramp capability are generally represented in bidding

[14] See, for example, NYISO Procedures for Energy Limited Resources (ELR).
[15] See NYISO rules for Limited Energy Storage Resources (LESRs), MISO rules for Stored Energy Resources (SERs), and CAISO rules for Regulation Energy Management (REM) resources.

parameters and would adequately guarantee the resource's ability to provide other services absent energy market participation. Moreover, regular performance tests conducted by the RTOs/ISOs can determine the capability of storage resources to provide an ancillary service absent an energy schedule.

2. Measures that Effectively Utilize Electric Storage Operations in Markets

a. Establish representation of electric storage as a single resource type.

The storage resource should be able to register as, and be modeled as, one resource type within the ISO's/RTO's systems so that it can be utilized most flexibly, and thus most effectively. The storage resource should not have to register as, or be modeled as, two separate resources types, i.e. generation and load, as is currently done in some ISOs.[16] This dual representation limits the flexibility of scheduling and dispatching the storage resource in several ways. First, it generally only allows a resource to inject energy or to withdraw energy on a bidding interval (*i.e.*, hourly) basis (which may work for certain storage resources such as pumped hydro), rather than allowing switching between buying and selling energy on a dispatch interval (*i.e.*, five-minute) basis, which newer electric storage resources are capable of. Second, it generally includes transition time while switching from one mode of operation to another, which newer electric storage resources do not require. The single resource type should be able to both withdraw energy from and provide energy to the grid, as well as switch between states, from one (five-minute) dispatch interval to the next, so that it can be dispatched seamlessly across its full range, from positive to negative.

b. Establish appropriate bidding parameters and modeling of electric storage.

[16] See, for example, response of ISO-NE to inquiry in Docket No. AD16-20.

As FERC noted (in P 53 and P 66), RTOs/ISOs may fail to effectively utilize electric storage resources or even prevent them from participating if storage resources are required to use bidding parameters for traditional generators, rather than ones that optimize their unique operational capabilities. Electric storage resources have several unique physical and operational attributes: the ability to switch between charging and discharging very rapidly, even many times within one bidding interval (i.e. one hour) or dispatch interval (i.e. 5-minute period); short or instantaneous transition times between charging and discharging; and very fast or near-instantaneous ramp rates. Without bidding parameters to capture these attributes, electric storage will be under-utilized and may results in over-procurement of less efficient resources and higher system costs that are otherwise avoidable.

ESA supports FERC's proposal directing RTOs/ISOs to institute new storage-related bidding parameters.[17] For storage resources participating only in markets for wholesale generator services, these bidding parameters will increase utilization of storage. ESA notes, however, use cases of electric storage are diverse. For "multiple use" storage providing both retail and wholesale services, requiring the use of proposed bidding parameters can adversely impact retail service provision (see section I.A.3.b).

ESA also recommends that FERC's proposed state-of-charge[18] parameter be clarified and included as a discretionary, rather than required, parameter for bidding. FERC states that this parameter will allow "electric storage resources to identify their forecasted state of charge at the

[17] ESA supports establishing the parameters of upper charge limit, lower charge limit, maximum energy charge rate, and maximum energy discharge rate (NOPR at P 67), which provide an RTO/ISO with the necessary data to determine the quantity and rate of energy provision or withdrawal possible for a given storage resource over a specific period. Additionally, ESA agrees with FERC's inclusion of minimum charge time, maximum charge time, minimum run time, and maximum run time, as some storage resources may want to include these parameters for physical or economic reasons — such as for non-trivial startup times and costs that may need to be reflected in bids.
[18] State-of-charge should be reported in MWh.

end of a market interval"[19] and cites section 30.5.6 of the CAISO Tariff as a reference. Yet, this section of the CAISO tariff specifies that Non-Generator Resources may submit a *forecasted starting* state-of-charge value for the day-ahead market. ESA recommends RTOs/ISOs offer the option of a state-of-charge parameter both for real-time bids and for day-ahead bids. In particular, allowing an updated state-of-charge parameter to be included in real-time bids will give RTOs/ISOs a more accurate picture of a storage resource's limits and availability in the next bidding interval. Because an electric storage resource may not always be able to accurately predict its state of charge prior to day-ahead or real-time operation, or may participate in such a way and in such markets where state-of-charge is managed by the RTO/ISO,[20] ESA recommends that state of charge be a discretionary bidding parameter, along with the other optional parameters that FERC proposes.

ESA recommends FERC direct the RTOs/ISOs to institute a capability to continuously monitor a storage resource's state-of-charge during actual operation so that the information conveyed in the charge limit bidding parameters will actually translate into increased utilization, in line with FERC's intent.[21] Continuously monitoring state-of-charge will allow RTOs/ISOs to better optimize the storage resource scheduling and dispatch, such as by being able to compare the instantaneous state of charge with the resource's specified charge limits and identifying deviations from expected state of charge. Doing so will enable the RTO/ISO to make any necessary adjustments to dispatch and avoid issuing an infeasible dispatch command. This would be comparable to the way RTOs/ISOs continuously monitor output from currently-operating resources and use that information in dispatch decisions. And just as ESA requests that the state-

[19] NOPR at P 67.
[20] For example, as a regulation-only resource in an RTO/ISO market where the RTO/ISO actively manages the state of charge of regulation-only storage resources.
[21] Such as through telemetry.

of-charge bidding parameters be optional for the resource to submit, continuous monitoring of state-of-charge only needs to be "turned on" by the RTO/ISO when that optional bidding parameter has been submitted by the storage resource. ESA points out that several RTOs/ISOs have mechanisms today for relaying a storage resource's state-of-charge through telemetry, which demonstrates its viability.[22]

ESA reiterates its strong support for FERC's proposal that RTOs/ISOs allow electric storage resources to self-manage their state of charge at all times.[23] Self-management should be allowed in order for storage resources to retain operational flexibility and provide multiple services (including to both wholesale and non-wholesale customers) to the maximum extent possible. While not specified by FERC, ESA notes that self-management of state-of-charge must include the ability to adjust upper and lower operating limits and/or operating midpoints on a short-term basis, including from one dispatch interval to the next (*i.e.*, every 5 minutes). Simply adjusting bidding parameters on a bidding interval basis (*i.e.*, hourly) is not sufficient state-of-charge management for all electric storage resources, as it cannot adequately optimize the limited energy of the resource; this in turn limits the dispatch flexibility of the resource and thus the level of service that can be provided. Instead, effective state-of-charge management requires that a storage resource be permitted to adjust its limits and midpoints during real-time operation. FERC should provide for this ability in the final rule.

In response to FERC's solicitation of comment on the subject, ESA sees no conditions under which an RTO/ISO should not allow a storage resource to manage its own state of charge, as storage resource operators can ensure they can meet all dispatch commands from the

[22] Examples include CAISO's provision for state-of-charge management for Non-Generator Resources (NGR) that provide Regulation Energy Management (REM) and NYISO's state-of-charge management for its regulation-only Limited Energy Storage Resource (LESR).
[23] NOPR at P 69.

RTO/ISO. ESA recommends instead that existing penalties be used as appropriate to deter deviation from dispatch schedules for storage resources managing their own state of charge.

ESA also requests that RTOs/ISOs be required to provide optional, RTO/ISO-controlled state of charge management for electric storage resources.[24] This option will be the best way for some electric storage resources to be able to provide their full capabilities to the market in a continual manner. At a minimum, an active state of charge management mechanism should be available for electric storage providing services that require operational decisions faster than bidding intervals (e.g., frequency regulation) and where state of charge cannot be predicted or managed through bidding alone. In regions where RTOs/ISOs manage state of charge of short-duration (i.e., generally under one hour) storage resources for frequency regulation service, these resources are offered a way to continually provide service.[25]

c. Enable flexible dispatch of electric storage.

In addition to the bid parameters and modeling identified above, having optimized dispatch for all electric storage resources also requires RTOs/ISOs being able to dispatch storage resources as both supply and demand and having dispatch signals that respect and take full advantage of their other capabilities, including their very fast response and limited energy. These features are most important in the energy and frequency regulation markets.

In addition to the proposals in the NOPR, ESA requests that FERC direct RTOs/ISOs to permit electric storage resources to enter an energy bid curve with price/quantity pairs for

[24] NYISO, MISO, and CAISO offer RTO/ISO state-of-charge management for electric storage resources.
[25] ESA suggests that existing practices of RTO/ISO state of charge management should be expanded to all RTOs/ISOs and be available for resources of any duration, not just short-duration storage resources, as longer duration resources may benefit from this practice. For storage resources that are providing multiple services simultaneously — including, but not limited to, some combination of energy, reserves, and regulation — state of charge management should at least be available for the portion of resources' operating capacity that is providing regulation or similar products.

providing and withdrawing energy (bidding different quantities of positive or negative MW for different energy prices) in both day-ahead and real-time markets. By permitting resources to indicate their willingness to charge or discharge based on 5-minute pricing, RTOs/ISOs will be able to more fully utilize the unique capabilities of storage resources, which can respond nearly instantaneously to either provide energy or absorb energy in response to price signals and can thus both charge and discharge energy within a single bidding interval. This will help provide more dispatch flexibility to the system and can help lower system costs.

ESA also asks FERC to require RTOs/ISOs to enable electric storage resources to switch between charging and discharging over subsequent (five minute) dispatch intervals. By allowing storage resources to dispatch as either supply or demand within an (hour) bidding interval, RTOs/ISOs will benefit from the flexibility of electric storage technologies to switch states quickly to meet system needs. Dispatching all economically available electric storage resources as both sellers and buyers across dispatch intervals will enable the full use of storage resource capabilities and assure full benefits to the grid.

In addition to ESA's agreement with FERC's proposal that electric storage resources participate both as a wholesale buyer and wholesale seller of energy, ESA agrees with FERC that RTOs/ISOs must allow storage to participate as a self-scheduler.[26] ESA further recommends that FERC clarify that the option to self-schedule should apply to storage resources both as buyers and as sellers, and not just for "load resources" as mentioned in the NOPR, so as not to arbitrarily preclude this option for storage resources acting as sellers.

ESA notes that while some RTOs/ISOs do not have experience dispatching some electric storage technologies for services beyond frequency regulation, all RTOs/ISOs have experience

[26] NOPR at P 81.

dispatching other electric storage resources (such a hydro pumped storage) for energy and ancillary services, and can build on that experience to construct the dispatch pieces of a storage participation model.

In some RTOs/ISOs, the regulation dispatch signal moves very slowly relative to the ramping capability of new electric storage resources, which limits their ability to participate and provide service fully, and thus be compensated fairly.[27] In other RTOs/ISOs, the regulation dispatch signal is biased towards slow-ramping and energy-unlimited resources, by ramping slowly and holding in one direction for extended periods, thus unduly penalizing fast-ramping but energy-limited resources like electric storage.[28] ESA asks that FERC direct RTOs/ISOs to work with electric storage stakeholders to determine a regulation dispatch design that, as part of the storage participation model, would attempt to best utilize all storage resources so that RTOs/ISOs and other stakeholders can receive the full benefits from these fast and flexible resources.

d. Price energy used for charging appropriately.

ESA agrees with FERC's proposal that energy bought from the wholesale market that is used to charge electric storage for later resale into energy or ancillary services markets constitutes a sale for resale and should be settled at the locational marginal price ("LMP").[29] In addition, electric storage resources experience losses in the process of converting, storing, and

[27] One example is in MISO, where a slow Regulation dispatch signal has prompted stakeholders to ask for an AGC Enhancement project. See https://www.misoenergy.org/StakeholderCenter/CommitteesWorkGroupsTaskForces/IssuesTracking/Pages/IssueDetail.aspx?IssueID=129&MISOIssueID=MR027

[28] One example is in PJM, where stakeholders have complained the Regulation dispatch is excessively biased. See http://www.pjm.com/~/media/committees-groups/task-forces/rmistf/20161208/20161208-esa-proposal-executive-summary-draft.ashx

[29] NOPR at P 100.

re-converting electricity for delivery.[30] To ensure, that FERC's achieves its intent of pricing wholesale services appropriately, ESA recommends that the RTO/ISO should make clear that efficiency losses are included in the definition of charging energy, and thus settled using the LMP.

ESA also recommends FERC direct RTOs/ISOs to specify in their tariffs that energy converted and stored by an electric storage resource for re-delivery to the grid is not subject to transmission charges that apply to load. Withdrawals of electricity are necessary and integral to electric storage re-delivery of energy as wholesale services. Moreover, some withdrawals of electricity are in themselves wholesale service, such as frequency down-regulation, whose very purpose is to maintain stability of the grid. Therefore, transmission charges that apply to load should not apply to charging energy.

ESA also notes that some electric storage units may be co-located with generation that does not bid into wholesale markets. In this regard, charging energy should be a fuel source decision by electric storage resources. ESA recommends that FERC therefore clarify that RTOs/ISOs may not compel electric storage resources providing wholesale services to purchase their charging energy from wholesale markets. This is critical both to enable storage operators to make optimal fuel choices and to avoid inadvertent discrimination of energy resources in wholesale markets.

3. Make Rules Applicable to Different Storage Configurations To Maximize Competition and System Cost Reductions

a. Allow behind-the-meter storage to export to the grid.

[30] Additionally, some electric storage technologies having thermal management components that are internalized within the storage medium. Rather than be considered "station power," such systems are in fact integral to the storage medium and cannot be dissociated. ESA recommends that FERC consider such internalized components be counted as losses.

FERC's NOPR and ESA's preceding comments are focused on electric storage resources connected directly to the transmission or distribution system. Electric storage is also increasingly deployed behind a customer meter. FERC has previously determined that incorporating demand resources is critical to increase market competition and ensure just and reasonable rates.[31] When behind-the-meter ("BTM") electric storage resources are operated to modify customer loads (*i.e.*, not exporting energy to the grid) to provide wholesale services, they can use existing demand resource participation model provided by each RTO/ISO. However, when individual BTM electric storage resources export energy to the grid to provide wholesale services, there is not a participation model for doing so. FERC's NOPR and ESA's preceding comments do not effectively enable exporting BTM electric storage to participate. FERC has indicated that it is in the interest of organized markets enable participation of distributed energy resources generally to reduce congestion costs, reduce transmission investment costs, and rapidly respond to near-term generation or transmission contingencies.[32] ESA therefore respectfully recommends that FERC include provisions to remove barriers to market access for exporting BTM electric storage.

BTM electric storage resources should have similar ability to bid, be dispatched, and set prices as front-of-meter storage resources, which includes the ability to export to the grid while providing wholesale services. ESA notes that some RTOs/ISOs currently expressly prohibit net injections from BTM resources, while others do not have clear models to enable it.[33] The ability to export to the grid is essential for some BTM storage resources to fully participate and provide service to the electric grid, particularly if demand resources (i.e., including non-exporting BTM storage) cannot qualify for a given service. ESA recommends FERC enable net injections from

[31] See, for example, Order No. 719 (125 FERC ¶ 61,071) and Order No. 745 (134 FERC ¶ 61,187).
[32] NOPR at P 130.
[33] NOPR P 15.

BTM storage resources and that RTO/ISOs determine an acceptable and not unduly burdensome metering, telemetry, and/or accounting arrangement (i.e., equipment, method, or both) for conducting wholesale transactions.

Moreover, ESA recommends that exporting BTM storage resources using such a metering, telemetry, and/or accounting arrangement for wholesale transactions can sufficiently distinguish and separate retail transactions, enabling the provision of both wholesale and retail services by the same resource. ESA suggests that use of such a metering, telemetry, and/or accounting arrangement would avoid a single BTM storage resource receiving both wholesale and retail compensation for the same service delivered at the same time. Additionally, use of such a metering, telemetry, and/or accounting arrangement can allow the RTO/ISO to distinguish between wholesale and retail operations even when the storage resource is part of a heterogenous aggregation of behind-the-meter resources.

b. Allow storage to provide both wholesale and retail services.

ESA recommends FERC enable distributed[34] electric storage resources to provide both wholesale service and retail service to increase the market efficiency and flexibility of the electric grid. ESA suggests that various methods can be devised to facilitate multiple-use storage, in which services are provided to both the transmission and distribution systems. ESA cautions FERC to avoid rules that place restrictions on what resources in retail programs can provide to wholesale markets. Further, ESA suggests restrictions on participation of particular resources in retail programs imposed by the RTOs/ISOs needs to be justified by evidence that the participation of those resources would be harmful to the wholesale market. FERC has approved tariffs in recent years that specifically permit dual participation in wholesale and retail markets,

[34] ESA notes that "multiple-use" storage may be either front-of-meter or behind-the-meter.

and ESA respectfully requests FERC to issue a ruling in the instant docket that would not create unnecessary conflict or confusion.[35]

Additionally, ESA recommends that FERC consider different bidding parameters for multiple-use storage. As previously discussed, FERC's proposal to require certain bidding parameters, while effective for wholesale-only storage resources, would limit the ability of storage to provide retail services. Simpler bidding parameters that do not require a resource to specify its expected future energy limits might reduce utilization of distributed storage for wholesale service but would increase its utilization for retail service, such that on net the electric grid requires fewer resources to achieve the same reliability, increasing overall market efficiency.

c. Set 100 kW as the largest minimum size for resource eligibility, in line with proven RTO/ISO capability.

ESA agrees with FERC's proposal that RTOs/ISOs set 100 kW as the highest allowable minimum size for electric storage resources to be eligible to participate in markets. As noted in their responses to the inquiry in Docket AD16-20, all RTOs/ISOs allow at least some type of resource to participate at a size of 100 kW,[36] and PJM specifically allows electric storage resources to participate at a size of 100 kW. However, several RTOs/ISOs require storage resources to meet a requirement of up to 1 MW. At the same time, an increasing number of operational electric storage units are installed across the country, including at large commercial

[35] As NextEra Energy Resources notes in its comments on this NOPR, FERC previously approved CAISO tariff language that allows a distributed energy resource to participate in an aggregation that, in turn, participates in the CAISO market if it is also part of a net energy metering program does permit wholesale market participation. Similarly, Stem Inc noted that FERC's Order in Docket EL16-92-000 directly contravenes the blanket statement proposed in paragraph 134 of this NOPR, stating that the ISO has the burden of proof to justify any restrictions on multi-use.

[36] NOPR P 87.

& industrial customer sites installed where they may be less than 1 MW in size.[37] These storage resources can provide the same services as larger storage resources, and so can provide the same system benefits of flexibility, reliability, and cost reduction. Since PJM, the largest RTO/ISO by load served, has opened participation of storage resources of 100 kW into markets, ESA suggests barriers to doing so are not justified elsewhere and recommends that all RTOs/ISOs allow participation of electric storage at 100 kW.[38]

C. ESA generally supports participation of distributed energy resource aggregations in the organized wholesale electric markets. ESA specifically recommends FERC establish a Rule that enables smaller distributed resources, including electric storage, to participate effectively in such aggregations.

Electric storage resources are increasingly deployed as distributed energy resource ("DER") aggregations. ESA suggests that an ideal DER aggregation model will permit a heterogeneous set of distributed energy resources, including but not limited to individual or multiple electric storage resources, located in front of or behind the meter to provide and receive compensation for all products it is technically capable of providing: energy, ancillary services, and, where applicable, capacity. In general, rules for distributed energy resource aggregations should impose the minimum level of additional rules and restrictions necessary to enable market participation in order to keep barriers to entry as low as possible and maximize competition. In particular, ESA seeks to ensure that the three primary electric storage resource configurations — (1) front of meter, (2) BTM non-exporting, and (3) BTM exporting — are able to participate in such DER aggregations.

[37] The DOE Global Energy Storage Database includes over 230 electric storage resources, in operation or in development, located in the jurisdictional ISOs, under 1 MW (as of January 25, 2017).

[38] ESA also recommends FERC clarify offering and bidding increments should increase in 100 kW steps. This is necessary to allow a 200 kW storage resource to be able to participate in the same way as a 100 kW resource, rather than requiring a jump up to 1 MW as the next allowable level.

ESA also agrees with FERC's assertion that RTOs/ISOs should treat telemetry from DER aggregations in a similar manner as telemetry from generators and electric storage resources, as long as this telemetry permits DER aggregations to then provide similar products and services as traditional generators, including export onto the grid from behind the meter. ESA recommends that FERC only require that DER aggregations use the more granular telemetry that can be required for generators, such as six-second (or more frequent) communication with the RTO/ISO, when needed to provide a specific product that the aggregation wishes to provide.[39] ESA recommends that telemetry be required at the aggregation level, rather than at the level of individual resources. As many individual resources in a DER aggregation will be small, the cost of such additional telemetry equipment at smaller customer sites will be disproportionately large compared to project economics and presents a major barrier to distributed resource adoption.

To avoid arbitrary constraints on technically capable resources from participating in markets, ESA recommends that DER aggregations should not have upper limits on size or allowable MW, both per individual resource and per aggregation.[40] Additionally, although ESA agrees that a lower limit is necessary on aggregation sizes, ESA recommends that individual resources within an aggregation should have no lower size limits. Many BTM electric storage resources are relatively small (only a few kW in some cases), but in aggregate they can operate nearly identically to a single, much larger electric storage resource. As long as a DER

[39] ESA recommends additional submetering to be present if the aggregation plans to provide a service requiring near-real-time data, such as frequency regulation, or if resources in the aggregation will be exporting from behind the meter. Aggregations with storage resources can already provide simple load reduction to RTOs/ISOs without submetering each resource, and this should remain an option, so as to avoid unnecessary cost to the resource. Again, this should be at the discretion of the aggregator, which may wish to measure performance more accurately than retail metering alone can offer. For example, aggregations in CAISO benefit from being able to choose between retail metering and the meter generator output (MGO) methodology that directly meters the output of behind-the-meter resources.

[40] For example, ISO-NE rules for Alternative Technology Regulation Resources (ATRRs) limit individual resources in an aggregation to less than 1 MW.

aggregator can ensure its effective capacity exceeds the minimum size required by its participation model (i.e. 100 kW for an aggregation utilizing the storage participation model), RTOs/ISOs have no need to restrict the size of individual resources within the aggregations. Similarly, reliability rules for DER aggregations should not be applied to individual resources within the aggregation, as doing so would create additional barriers to entry and potentially discourage aggregators to include a diverse array of resource types.

D. FERC's proposals on storage participation should be pursued on a separate compliance and implementation timelines from proposals on DER aggregation participation.

1. ESA agrees that FERC's proposed schedule for implementation will allow sufficient time for storage proposals.

ESA recognizes that RTOs/ISOs will need time to determine what, if any changes would need to be to proscribed under the Rules that FERC is now evaluating, to their rules are necessary and prepare compliance filings after a final order is issued. ESA agrees with FERC's proposal for RTOs/ISOs to submit compliance filings six months from publication in the Federal Register, as this will provide the RTOs/ISOs, the storage industry, and other stakeholders an opportunity to work together to review existing rules and scope out any necessary changes in order to ensure the RTOs/ISOs' planned participation models will be compliant.

ESA raises a potential concern in that, while FERC has defined a participation model as "a set of tariff provisions…", a large part of what constitutes a participation model is the RTO's/ISO's modeling and dispatch software, of which a detailed description is generally not included in the higher-level language contained in the RTO's/ISO's tariff. Thus, it may be difficult for stakeholders and the Commission to determine if a proposed participation model fully complies with the final order simply from a tariff filing. It will be important for each RTO/ISO to engage with stakeholders prior to submitting compliance filings to explain the

details of their storage participation models so that stakeholders can be fully informed and able to submit comments on the compliance filings.

ESA agrees with FERC that up to twelve months from the date of the compliance filing is a reasonable time for implementation of the storage proposals, recognizing that implementation of the reforms proposed herein may require changes to some RTO's/ISO's modeling and dispatch software. ESA urges FERC to quickly rule on the compliance filings to give RTOs/ISOs certainty regarding the direction of market enhancements.

ESA notes that FERC's Rule, if based on the NOPR and ESA's comments, will ensure that the markets will be open for full storage participation. ESA supports a single order capturing storage and DER aggregation. However, should FERC determine that the proposals on DER aggregations require further discussion and deliberation and that the proposals on storage do not, ESA respectfully requests FERC issue a separate order for the storage-related proposals, so as not to delay their implementation.

E. Markets will realize the full benefit of electric storage when they are designed to compensate flexibility and performance.

Access to existing markets, while important, limits storage only to existing, priced services. Lack of price formation and market designs that do not compensate performance devalues the flexibility services provided by electric storage and other flexible resources.

A number of system services remain unpriced. For example, resources with fast-ramping capability are only compensated for ramping in CAISO Flexible Ramping product and MISO's Ramp Capability product; moreover, certain storage resource types are not currently eligible to participate in either ISO's ramping market. In addition, 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. Also, 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 service (in this case, energy) and thus more system value.

Ultimately, the major challenge of wholesale markets will be to increasingly provide system flexibility in a market-efficient manner. Ramping and over-generation will become larger concerns as the electric system evolves to include more variable, non-dispatchable generation. System peaks may become shorter but more unpredictable. A successful market approach to these challenges requires valuing the particular flexibility attributes of resources and all the capabilities they afford, rather than simply pricing energy or fixed capacity.

Fundamentally, the task of market creation and price formation is 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 compensate the performance provided by resources like storage. Outside of the instant docket, ESA urges FERC to pursue market designs that differentiate compensation by each resource's unique capabilities and constraints.

IV. CONCLUSION

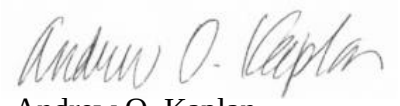
As discussed herein, ESA supports FERC's proposals to establish a participation model for electric storage resources. Organized wholesale markets only remain competitive and efficient when they update rules to enable viable technologies to offer their innovative capabilities. By enabling electric storage resources to participate fully in organized wholesale

markets, be utilized effectively in market operations, and participate in multiple configurations, FERC takes a significant step toward assuring that those markets have access to the widest range of competitive solutions, a necessary condition to ensure just and reasonable rates. Greater operational possibilities afforded by electric storage helps make the nation's electric grids adaptable to a range of future scenarios, and ESA encourages FERC to issue a final Rule in accordance with our recommendations that ensures that that the nation's electric system has all available tools to achieve reliable electric services at just and reasonable rates.

Respectfully submitted,

ENERGY STORAGE ASSOCIATION

By its attorney,



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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 13th day of February 2017.

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