

**UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION**

**Electric Storage Participation in Regions)
with Wholesale Electric Markets)**

Docket No. AD16-20-000

COMMENTS OF NATIONAL HYDROPOWER ASSOCIATION

The National Hydropower Association (NHA) appreciates this opportunity to provide input to the Federal Energy Regulatory Commission (FERC or Commission) Office of Energy Policy & Innovation in response to Docket No. AD16-20-000 - Electric Storage Participation in Regions with Organized Wholesale Electric Markets. NHA is providing comments to the specific questions raised in the request for comments, and has provided references to additional information sources that FERC may find useful when evaluating various responses.

NHA is the hydropower industry's national association and is dedicated to advancing the interests of conventional hydropower, pumped storage, conduit power and marine energy technologies. NHA's 220⁺ members include utilities, independent power producers, project developers, equipment manufacturers and service providers. Our responses below include comments from NHA's Development Council, which works to address the regulatory and business needs for new development to support increasing renewable energy goals and maintain a robust and reliable grid.

Question I - The Eligibility of Electric Storage Resources to be Market Participants

NHA assumes individual ISOs provided comments that show tariffs allowing generators and non-generators to participate in markets. The primary markets provided to energy storage

providers are the same as traditional generators – Reserves (spinning reserves and cold stand by reserves), AGC (frequency regulation), Ramping (ramp up and ramp down load following) and Black Start. NHA also observed that various ISOs filed comments indicating that many of the capacity services they use are needed to comply with NERC Balancing requirements.

Additionally, energy storage providers may participate in demand response programs. While energy storage projects are eligible to participate in some markets, there are several attributes of energy storage and specifically pumped storage units that are not currently addressed by these tariffs. Pumped-storage plants can offer significantly more benefits to the electric system than those commonly recognized by ISOs and included in the comments previously received by the ISO commenters. Specifically pumped storage plants can offer real time system inertia [see FERC 755 reference to flywheel effect], generator droop setting that can respond to system conditions instantaneously, and Automatic Voltage Regulation Control (AVR) that can adjust rotor field strength in real time. All three of these services can be provided by traditional hydropower generators as well and pumped storage plants. These three services are critical services that allow instantaneous response to grid conditions that keep the voltage and frequency stable as other services like AGC respond in the ultrafast 1-4 second time frame. Markets are not currently available to compensate for these services.

Additionally, energy storage devices are able to provide grid services that offset the need for new transmission and or distribution infrastructure. Under the current regulatory environment, energy storage plants are classified as a generation resource and are not currently eligible for to get a transmission rate of return for these services.

Another example of how conventional hydropower can be used as a storage facility can be observed in Denmark and Norway. [For further information, see (<http://spectrum.ieee.org/green-tech/wind/norway-wants-to-be-europes-battery>) Spectrum article “Norway Wants to be Europe’s Battery” October 2014.] If this approach were adopted in the U.S., then large hydropower plants with significant storage could be operated in coordination with wind and Solar PV. Also see HydroVision 2015 paper by Manitoba Hydro on using existing hydro storage in a similar manner as Denmark and Norway.

Question II - Qualification Criteria and Performance Requirements

As noted in the response to question 1 above there are additional technical services provided by generation that is located within an area that needs post transient services to ensure voltage stability, often referred to as Locational Effectiveness Factor (LEF) that pumped-storage units can provide to the electric system and are not included in the market services recognized by the ISO’s. These services include: automatic voltage regulation (AVR), power system stability (PSS), Generator Droop settings and the inherent inertia provided by a rotating mass connected to the electric system. Because LEF type services are not represented by the market pricing, location and need for this type of service is difficult to price and locate. As new non-traditional sources of generation are increasingly interconnected to the electric system these services are becoming more important to planners and operators. Many of these services are required by NERC balancing standards, but because there is no compensation paid to facilities that provide these services, pumped storage plants are at a significant disadvantage in the delivery of these services in regards to revenue recognition.

Other services unique to energy storage plants are the ability to defer or offset transmission and distribution infrastructure improvements. Currently, generators that provide additional load following resources (LFR) are not compensated by markets but provide services that are increasingly valuable and needed to insure grid security and effectiveness. There is currently no mechanism for energy storage plants to get a tariff rate or return similar to transmission assets for either the locational effectiveness or the deferment of T&D upgrades.

Question III - Bid Parameters for Electric Storage Resources

Pumped storage generators can currently participate in markets for reserves, AGC, Reactive Power, Black Start and capacity services so long as they meet the requirements for each service as defined by each ISO tariff. Not included in any of the bid parameters in the tariffs is the ability to respond to transients with AVR's, PSS and generator droop settings. These services are often required by NERC standards and provide the basis for locational effectiveness to support the grid, but they are not included in any bid evaluation parameter for these services. These essential services should be included to better differentiate the ability of a specific generator, energy storage system or type of generation to provide effective service to the grid. The impact of renewables such as wind and solar PV and retirement of large steam powered units on overall system inertia is also a major driver for advanced technology developments in units, as well as other energy storage technologies. For reference see NERC Essential Reliability Services Task Force Measures Framework Report; December 2015 Appendix A – Frequency Support - Inertial Response pages 25- 61.

(<http://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/ERSTF%20Framework%20Report%20-%20Final.pdf>)

Question IV - Distribution-Connected and Aggregated Electric Storage Resources

Both distributed and aggregated energy storage projects can participate in organized markets in most of not all ISOs. The missing piece here is again the lack of value for the locational effectiveness and enhanced bid parameters that value the services actually provided to the grid operator.

Question V - When Electric Storage Resources are Receiving Electricity

Pumped-storage projects can currently participate in markets as a load and in some cases sell ancillary services while pumping.¹ What is missing here is the benefits from a pumped storage project's ability to more effectively regulate variable resources locally and the benefit these projects provide to the overall transmission grid. This is specifically highlighted in advanced technology projects using adjustable speed pump turbines that are capable of providing frequency regulation, ramping and load following in pump mode. There are several current examples of projects providing the services in Europe and Japan. If there were markets available in the U.S. that recognized these additional benefits, it would be more likely that new projects would be constructed to provide these benefits to the grid.

In addition, energy storage projects are regarded as either a generator or a load and these underestimates the value of energy storage and the efficiency provided to the grid and grid operators. Because the clarification of value have not yet been included in tariffs or FERC regulation, pumped-storage projects are unable to gain access to the full value of services

¹ See ISO New England response to AD16-20-000 Section II-A-1 page 5 footnote 9; Dispatchable Asset Related Demand in Section I.2.2 of the Tariff. See also Tariff Section III.1.10.6, which specifies that these resources must self-schedule or submit a demand bid in the Energy Market.

provided. The net result is that no new major plants have been built for over 30 years in the United States.

A potential concept for FERC to consider is a Reverse Demand Response, which would create a tariff when adding pumping load for grid stabilization if required by ISOs and RTOs to meet NERC balancing requirements. This would be the converse of the current Demand Response (DR) tool for peak demand reduction. This tariff would acknowledge the value of storage in adding load whenever needed, on demand, to address over-generation by renewables or to resolve transmission constraints. DR has traditionally been focused only on dispatchable demand reductions. Correspondingly, future market products could be considered where dispatchable demand additions could be bid into day-ahead and real-time markets as part of grid-level renewable integration.

For more information on adjustable speed hydropower related to fast power and fast speed control (i.e. flywheel effect) , see Section 4 of a recent paper titled “Variable Speed Plants” authored by R. Guillaume, T. Kuntz and A. Schwery (Alstom) presented at HydroVision conference in Portland Oregon.

(<http://s36.a2zinc.net/clients/pennwell/HVI2015/Public/SessionDetails.aspx?FromPage=Calendar.aspx&SessionID=11937#>)

In the paper the authors describe a two part control process. The first part is for conversion of kinetic energy from the spinning rotor mass to real power by electronic means in the sub 5 second range, and the second part is water flow regulated by governor and wicket gate controls.

In a plant employing a doubly fed induction machine (DFIM), with the stator field locked (synchronized) to system frequency, there are two controllable variables, gate position and rotor field speed. The time constant of the rotor field [converter – inverter] including motor/generator time constant is less than the time constant of the turbine governor including water column time constant. Therefore it is possible to change the rotor field speed faster via electronic controls than it is to change the mechanical speed of the pump/turbine water wheel and wicket gates.

Once again, NHA appreciates the opportunity to provide these comments to FERC on this important issue. Please contact me should you have questions regarding this response or would like additional information.

Respectfully submitted,



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National Hydropower Association