Stakeholder Comments Template

Energy Storage and Distributed Energy Resources (ESDER) Phase 4

This template has been created for submission of stakeholder comments on the Revised Straw Proposal for ESDER Phase 4. The paper, stakeholder meeting presentation, and all information related to this initiative is located on the initiative webpage.

Upon completion of this template, please submit it to initiativecomments@caiso.com. Submissions are requested by close of business **November 12, 2019.**

Submitted by	Organization	Date Submitted
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Please provide your organization's general comments on the following issues and answers to specific requests.

Beacon Power, LLC manufactures flywheel energy storage systems for grid service and industrial applications. It developed 20 MW flywheel energy storage facilities for NYISO in 2011 and for PJM in 2013, both serving the frequency regulation market. Beacon works with utilities and developers to provide flywheel systems for grid application.

Beacon is pleased that the CAISO is developing the market for energy storage technologies. Beacon is commenting to help CAISO develop a level playing field for all storage technologies.

1. **End-of hour state-of-charge proposal**
    a. This whitepaper explains the PJM regulation market conditional neutrality signals. https://www.pjm.com/~/media/committees-groups/task-forces/rmistf/postings/regulation-market-whitepaper.ashx. This is an alternative approach to bidding the end of hour SOC.

2. **Discussion of end-of-day state-of-charge**
    a. See whitepaper in #1

3. **Market power mitigation for storage resources**

a. Losses in Default Energy Bids (DEB): Two categories of losses are identified for inclusion in DEB, round trip efficiency losses and parasitic losses. Parasitic losses are made up of two components, so there are actually three types of losses for energy storage resources. Flywheels have standby losses which are relatively constant plus idling losses which are a function of SOC (rotor speed). Therefore, parasitic losses should be modeled as two separate losses. As with the degradation marginal cost adder for batteries, the idling losses need to be modeled appropriately.
b. Degradation: The marginal cost adder to adjust for the depth of discharge may be appropriate for DEB but shouldn't be an adjustment for dispatch purposes. Beacon flywheels have no degradation with any depth or charge or discharge, so will not receive any marginal cost adder. Consider 3 FRR's, a battery FRR with an accepted bid, a flywheel FRR with an accepted bid, and no degradation, and a flywheel FRR with a higher not accepted bid, and no degradation. The bidder needs to consider the possibility of deep discharges or be able to specify the range for its bid. Otherwise, an award can be made on a low bid price to the battery FRR with the DEB degradation adjustment on dispatch raising the bid above the FRR with the higher not accepted bid. This would be distorting the market.
c. In addition, consider the same 3 FRR's, a battery FRR with an accepted bid, a flywheel FRR with an accepted bid, but no degradation, and a flywheel FRR with a higher not accepted bid. With the degradation adjustment in dispatch, it would tend to shift the deeper cycling away from the battery FRR and to flywheel FRR which would only be fair if the flywheel FRR receives additional compensation for that extra service—like the PJM Frequency Response Mileage or NYISO Movement calculation.

4. **Variable output demand response**

5. **Parameters to reflect demand response operational characteristics**

6. **Removing consideration of non-24x7 settlement of behind the meter resources under DER aggregation model**

7. **Additional comments**

Please offer any other feedback your organization would like to provide from the topics discussed during the working group meeting.

   a. The proposal seems to be based solely on battery FRR. It doesn't seem that the capabilities of other technologies, such as flywheel energy storage were considered in developing this proposal.
   b. Characteristics of Beacon Power flywheels include:
      i. 120 kW @ 15 minutes

ii. 170 kW @ 10 minutes

iii. 300 kW @ 4 minutes

iv. Response time <1 millisecond

v. Ramp Rate >1,000 MW/min at any SOC and symmetrically for charging or discharging

vi. Reactive power is provided in all four quadrants

vii. No degradation from frequent cycling

viii. No degradation from charging or discharging to full rated MW

ix. No degradation with age (design life 25 years)

x. Because the energy stored in the flywheel is related to the speed of the rotor, the current SOC is known precisely at all times.

c. Two flywheel frequency regulation plants have been operating for years:

i. Stephentown: Stephentown plant is a 20 MW frequency regulation facility in Stephentown, NY, commissioned in 2011 and serving NYISO. It combines 200 flywheel units rated at 100 kW. NYISO sends a regulation signal every 6 seconds. The Stephentown plant responds to PJM signals in <1 millisecond. The Stephentown plant has a ramp rate in excess of 10,000 MW/min, going from idle to rated output in less than 4 cycles. The Stephentown plant responds quickly and receives compensation for amount of movement and the measured performance factor for its response.

ii. Hazle: The Hazle plant is a 20 MW frequency regulation facility in Hazle, PA, commissioned in 2013 and serving PJM. It combines 200 flywheel units rated at 100 kW. PJM sends a regulation signal every 2 seconds. RegD signals are for fast response resources, including flywheels. The Hazle plant responds to PJM signals in <1 millisecond. The Hazle plant has a ramp rate in excess of 10,000 MW/min, going from idle to rated output in less than 4 cycles. PJM aggregates regulation performance on 5 minute intervals. The Hazle plant responds quickly and receives more compensation for both the mileage travelled and the accuracy of the response.

d. The present Phase 4 proposal for Energy Storage seems to be based entirely on batteries. This sets the expectation that batteries are entitled to operate the Frequency Response market. The End of Hour SOC (EOH SOC) and End of Day SOC (EOD SOC) concepts are perplexing. Either the EMS will cycle the Frequency Response resources (FRR's) up and down each period to maintain the capability for the resource to move up or down, or the EMS hampers its ability to control frequency. The way it is drafted also presumes that the FRR has 30 or 60 minutes of energy and will be made whole for recharging independent of the regulation market. The EOH SOC makes the EMS dependent upon the FRR to bid itself into an SOC range so that it can provide control up and down.

e. The present proposal seems to be based upon the battery FRR's having one or more hours of energy, which allows them to ramp relatively slowly in the same direction for multiple periods. If the EMS was making the system frequency cross the 60 Hz line in every period (NERC CPS1 measurement), no FRR would move in the same direction for multiple periods.

f. Isn't it possible to state unequivocally that the sum of regulation up and regulation down should always be equal for each period based on how the EMS operates? (The EMS has other resources to dispatch so that FRR don't have to be responsible for ramp periods, just the minute to minute or second to second deviations from 60 Hz.) That would mean that the average start of period SOC for all FRR for that period should be equal to the average SOC at the End of Period. The only reasons each FRR would not be at its starting SOC at the end of each hour would be 1) EMS didn't dispatch them all the same way or 2) some FRR respond like steam generation with hysteresis when changing direction and don't consistently provide as much regulation as other FRR.

g. Flywheels do not have hysteresis or delay in responding to FR commands from the EMS. The Beacon flywheels respond in <1 millisecond to a command to change charge or discharge level including changing direction. The flywheels each have a ramp rate >1,000 MW/min, moving from idling to either full rated charging or to full rated generation in less than 4 cycles at any SOC.

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