Memorandum

To: ISO Board of Governors

From: Benjamin F. Hobbs, Chair, ISO Market Surveillance Committee

Date: July 17, 2019

Re: **Briefing on MSC activities from May 8, 2019 to July 15, 2019**

This memorandum does not require Board action.

During the period covered by this memorandum, the MSC held a general session meeting in Folsom on June 7, 2019.[1] The presentations and discussions are briefly summarized below. The next general session meeting of the MSC will be held on August 19, 2019; tentative topics of discussion include resource adequacy enhancements, day-ahead market enhancements, and mechanisms to mitigate potential system-wide market power.

General Session Meeting of June 7, 2019

There were three major items on the agenda of the June 7 general session meeting. One reviewed the ISO's on-going analysis of the ISO's market's competitiveness at a system level. The other two concerned two ISO initiatives: the day-ahead market enhancements initiative, with the discussion focusing on possible implementations of a reliability capacity product; and the energy storage distributed energy resources Phase 4 initiative, with the discussion emphasizing the calculation of default energy bids for storage. For each agenda item, ISO staff made a formal presentation followed by discussion among stakeholders, ISO staff, and MSC members.

Day-ahead market enhancements discussion. The first agenda item was day-ahead market enhancements. Ms. Megan Poage, Senior Market Design Policy Developer at the ISO, and Dr. George Angelidis, Principal of Power Systems Technology Development at the ISO, made a joint presentation. First, Ms. Poage outlined the basic operational needs for a reliability capacity product:

- to meet steep ramps in net load between real-time intervals that are overlooked in the day-ahead market with hourly granularity;
- to meet changes in the net load forecast between the day-ahead and real-time markets; and
- to ensure that the product is deliverable, recognizing transmission constraints.

[1]All presentations and recordings of the meeting can be found at http://www.caiso.com/informed/Pages/BoardCommittees/MarketSurveillanceCommittee/Default.aspx

Regarding the first need, discussions among the committee, ISO staff, and stakeholders addressed potential magnitude of cost savings and reductions in exceptional dispatch that will result and the economic efficiency of meeting these needs through the market. They also discussed whether changes in system conditions between day-ahead and real-time might mean that reliability capacity scheduled day-ahead might be unavailable to meet the real-time ramps. Regarding the second need, one MSC member suggested that consideration should be given in the longer term to the creation of formal intra-day markets between day-ahead and real-time, as now exist in Europe. This would allow schedule adjustments to be made by the market when more is known about the evolution of net load over the day, but far enough before real-time such that there are more options to change commitments.

Dr. Angelidis then outlined two alternative formulations of the market software to schedule generation for energy and reliability capacity. The first formulation optimizes energy and reliability capacity with energy being scheduled based on demand bids as it is today. Based on a separate requirement, reliability capacity would be scheduled to provide additional upward and downward dispatch capability. Then in a sequential process, similar to today's day-ahead market process, where energy is scheduled by one market run with an hourly granularity, and then a separate post-market optimization ensures that adequate capacity is available to meet fifteen-minute ramping needs.

The second formulation is an integrated energy-reliability capacity market process, in which resource owners would provide offers for both energy and reliability capacity. There would be two types of schedules, one representing resources with physical ramping capability, which would clear based on the ISO's demand forecast, and the other representing other resources, which would clear based on demand bids. Dr. Angelidis then presented the formulation of transmission limitations designed to ensure deliverability of reliability capacity from one market to another.

Several issues were discussed extensively. One was the proposal that day-ahead reliability capacity would "expire" in real-time, rather than be maintained as real-time flexible ramp product and be subject to imbalance settlements if the reliability capacity differed from the amount of ramp product. Concerns were raised by a stakeholder about whether the same capacity could receive forward flexible resource adequacy payments, day-ahead capacity reliability payments, and real-time flexible capacity payments. Another issue was whether physical capacity alone or physical plus net virtual capacity should be the basis of determining day-ahead reliability capacity needs. A third issue mentioned by a stakeholder was whether the mathematics of the second proposal might result in over-procurement.

Structural system-level competitiveness analysis discussion. Two presentations were made during this agenda item. The first was by ISO staff, and was prepared by Perry Servedio (Lead Market Design Policy Developer), Dr. Guillermo Bautista Alderete (Director, Market Analysis & Forecasting), and Dr. Jiankang Wang (Engineering Specialist Lead). The second was by Dr. Amelia Blanke, Manager, Monitoring & Reporting in the ISO's Department of Market Monitoring. The first presentation summarized an ISO study of system-wide structural competitiveness, as gauged by the residual supply index. That index is the ratio of

available supply (subtracting out the supply controlled by the particular schedule coordinator(s) of interest) divided by demand in a given hour. If less than 1, this indicates that the coordinator(s) of interest are pivotal, and conditions are deemed uncompetitive. The index was calculated for all hours in 2018 for combinations of three schedule coordinators (the "three-supplier" index).

The presentation indicated that many assumptions need to be made in such an analysis. A key assumption is the treatment of virtual supply, which lead to discussion of the extent to which such supply represents real supply that could ultimately provide energy. Under the assumptions made in the staff study, including the inclusion of virtual supply in the numerator of the index, 55 hours out of the year exhibited uncompetitive conditions. Mr. Servedio outlined the characteristics of those hours, when tended to be during periods of high demand and high gas prices.

Mr. Servedio then summarized several possible policy implications. Among these issues are how imports and fixed price energy contracts can be counted towards resource adequacy requirements, and the design and implementation of system-level market power mitigation processes. A stakeholder made the argument that contracting for imported resource adequacy is presently hindered by what that stakeholder perceives to be a complicated and inflexible process for allocating import capability on the interties. The particular inflexibility highlighted was the monthly import capability reallocation process; it was argued that a seasonal or annual process would make it easier to make commitments to import capacity and thus provide more supply to the ISO market.

Dr. Blanke's presentation summarized several Department of Market Monitoring analyses. One set of analyses calculate the pivotal supply indices for 2018 under several alternative assumptions concerning treatment of virtual supply as well as ancillary service bid segments that do not overlap with energy bids. The Department found that the virtual supply analyses made a significant difference in the results, and Dr. Blanke reported that under their recommended assumption (that virtual supply not be included in the numerator), 272 hours would be identified as exhibiting uncompetitive conditions under a 3 supplier index. Dr. Blanke also reported the results of comparisons of hypothetical competitive baseline energy prices (all resources bid their default energy bids) and market outcomes (calculated with actual bids) for all hours in 2017 and 2018, which were reported in the annual State of the Market report.[2] Those analyses found a greater amount of system-wide mark-up in evening ramp hours than at other times. Dr. Blanke concluded with several recommendations. These include recommendations that the ISO begin considering implementation of system-wide market power mitigation, and that issues of must-offer enforcement, resource adequacy requirements and counting rules, and monitoring be addressed.

Energy storage and distributed energy resources initiative Phase 4 discussion. Mr. Gabe Murtaugh, Sr. Infrastructure & Regulatory Policy Developer at the ISO, presented an overview of the ISO's proposal for defining default energy bids for distributed storage for use

[2] *2018 Annual Report on Market Issues and Performance*, Sections 2.4 and 7, CAISO Department of Market Monitoring, May 2019, http://www.caiso.com/Documents/2018AnnualReportonMarketIssuesandPerformance.pdf.

in local market power mitigation. Because storage will often be installed to manage local congestion problems, if a significant amount of storage is owned by one entity, it could be in a position to exercise local market power.

Default energy bids require estimates of costs of providing energy, which include the cost of charging and any opportunity costs of using the energy at one particular time versus another; internal energy losses; and cycling costs in which deep charge/discharge cycles tend to shorten battery life more than shallow cycles. An MSC member pointed out that consideration of the latter can lead to very different operation of batteries, according to simulations of optimal battery use in the ISO-New England system; there are ways to consider cycling costs within a linear dispatch or opportunity cost calculation model.[3] Another complication is warranty requirements (which might limit cycles to one a day); there is disagreement over whether such contractual (as opposed to physical) limits should be considered in calculating opportunity costs or not.

Mr. Murtaugh then outlined three alternative methods to calculate default energy bids. The ISO is recommending that a method based on an approximate opportunity cost calculation that examines the revenue that could be earned later in the day (based on forecast prices) from half of the energy stored in storage facility. This approximate method would, in essence, assume no more than one cycle per day (discharging half of its capacity) and would, in essence, be viewing energy charging, cycling, and losses as sunk costs. This approximate method is easily implemented; in the future, the ISO may want to consider more accurate but elaborate methods for calculating storage opportunity costs that are presently in the research stage.[4]

Mr. Servedio then made a short presentation on allowing a schedule coordinator to submit a state-of-charge constraint for the end of the hour or day for a storage facility that the ISO scheduling software would have to comply with. The ISO proposes that if compliance with the state-of-charge constraint results in uneconomic operation, then the resource would not be eligible for bid cost recovery. Two alternative proposals for implementing that restriction were included in the presentation. One issue of concern is whether manipulation of the state-of-charge constraint could result in exercise of local market power, and if so, whether a market power mitigation procedure could detect and mitigation that possibility.

[3] Xu, B., Zhao, J., Zheng, T., Litvinov, E. and Kirschen, D.S., 2017. Factoring the cycle aging cost of batteries participating in electricity markets. *IEEE Transactions on Power Systems*, *33*(2), pp. 2248-2259.

[4] Xu, B., Botterud, A., Korpas, M., and O'Sullivan, F., "Unlocking the Market Value of Energy Storage via Improved Economic Dispatch and Storage Control", Presentation, Technical Conference regarding Increasing Real-Time and Day-Ahead Market Efficiency and Planning Efficiency and Enhancing Resilience through Improved Software, Docket No. AD10-12-010, Washington, DC, http://www.ferc.gov/CalendarFiles/20190626080941-4%20-%20XU_FERC_06262019.pdf