Energy Storage and Distributed Energy Resources Phase 4 (ESDER 4) Issue Paper and Stakeholder Working Group Meeting

Comments by Department of Market Monitoring
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Summary

DMM appreciates the opportunity to comment on the ISO's Energy Storage and Distributed Energy Resources Phase 4 (ESDER4) Working Group Meeting held on March 18, 2019.

DMM supports moving forward with various issues identified within the scope of the ESDER4 initiative, including making energy storage resources subject to local market power mitigation and developing an approach for calculating default energy bids (DEBs) for energy storage resources. DMM also supports the ISO exploring changes to qualifying capacity (QC) methodologies for weather-sensitive demand response resources in coordination with the CPUC and local regulatory authorities (LRAs). In general, DMM is supportive of design enhancements that will allow scheduling coordinators (SCs) to more efficiently and accurately reflect costs and physical capabilities of energy storage and demand response resources in the market.

In these comments, DMM identifies several issues regarding other aspects of the ISO's proposal which merit further consideration and discussion.

First, DMM believes a clear delineation of appropriate costs to include in DEB calculations should be established. In particular, DMM maintains that contractual provisions and performance guarantees that are economic in nature are not appropriate bases for establishing resource reference costs.

In addition, DMM provides feedback on the energy storage DEB methodology presented in the Working Group Meeting. DMM believes that the simplified approach presented may not consistently represent marginal costs of energy storage resources and outlines additional considerations and potential alternative approaches.

Lastly, DMM recommends the ISO consider potential Bid Cost Recovery (BCR) and gaming issues that may arise if NGR resources are able to submit end-of-hour state-of-charge (SOC) values.

I. Bidding requirements for Energy Storage Resources

DMM supports the ISO's proposal to make energy storage resources subject to local market power mitigation. DMM also supports the ISO's efforts to create a default energy bid (DEB) approach that appropriately reflects costs of energy storage resources. However, DMM believes that the simplified approaches discussed in the Working Group Meeting may not consistently represent marginal costs of energy storage resources, and that a more precise

approach may be more appropriate. DMM plans to outline the details of such an approach for consideration in future stakeholder comments.

Default energy bids for energy storage resources

As recognized in the Working Group Meeting, the purpose of a default energy bid is to create a close approximation of a resource's marginal cost of energy production. For energy storage resources, the marginal cost of energy production may include charging cost analogous to fuel cost for a thermal generator, as well as any variable O&M costs that are a function of incremental energy production.

Marginal cost for many energy storage resources also includes opportunity costs associated with foregone profit opportunities. An energy storage resource may forgo expected profits if it operates in a manner that departs from expected profit maximizing operation for a day or operating period. This opportunity cost component at a given time is dynamic, and depends upon expected future prices over the operating period, the discharge duration capability of the storage resource, the available time for and physical ability of the resource to recharge following a discharge, and the resource's current state-of-charge.

The problem of determining expected maximum energy arbitrage profit and the associated marginal opportunity cost at a given point in time is complex. In the context of a default energy bid, the problem may be further complicated by potential software limitations and the need for a standardized DEB approach that is highly transparent and applicable to resources with a wide range of characteristics. However, to ensure efficient dispatch of energy storage resources when mitigated, the ISO should seek to construct any estimate of marginal opportunity cost as precisely and accurately as practicable for both the charging and discharging range of an energy storage resource.

In the Working Group Meeting, the ISO shared some early thinking on possible approaches to calculating DEBs for energy storage resources. One potential approach presented by the ISO would calculate a DEB for the entire charging and discharging range of a storage resource from the average of expected prices in peak hours in a given day. While DMM appreciates the ISO's early recognition that opportunity cost can play a significant role in the marginal cost of storage resources, the potential approach presented in the Working Group Meeting is likely too simple and may not accurately reflect the opportunity cost of storage resources.

An initial issue is that the approach presented by the ISO does not appear to consider the ability of many storage resources to recharge within the day if discharging occurs earlier than expected. This can lead to overstated opportunity cost, depending on the state-of-charge, charging speed or discharge duration of the resource.

Additionally, the use of average peak prices over a period length equal to the discharge duration may at times substantially understate the opportunity cost of the resource. This will be the case when the positioning of the resource is such that intervals of extreme prices are the

accurate representation of opportunity cost, but averaging with other peak period prices mutes the value of these extreme prices.

In addition to the potential approach presented at the Working Group meeting, the ISO has also recognized work on this topic completed in other markets. Specifically, the ISO made note of an approach adopted by Southwest Power Pool (SPP) where a DEB for storage resources amounts to an expected price in the next hour, adjusted for roundtrip efficiency losses.[1] The ISO indicated that it may consider a similar approach. This approach has merit in its dynamic nature, considering changing opportunity costs and charging costs (where applicable) throughout the operating day, and its explicit consideration of differences in cost on the charging and discharging output range of a resource.[2] The approach has additional merit in its simplicity of implementation.

DMM supports these attributes, but notes that SPP's approach is best suited for storage resources that can completely charge or discharge within one hour. The approach may stand as a reasonable approximation of opportunity cost for short duration resources that exceed one hour of discharge capability by some amount, or for longer duration resources when assuming a certain state-of-charge. However, the ISO can improve precision of opportunity cost estimates and the resulting DEBs for longer duration resources (e.g., four-hour resources) by considering a more general problem as an extension of SPP's approach. DMM plans to outline the details of such an approach for consideration in future stakeholder comments.

Response to stakeholder questions on the urgency of designing default energy bids for battery storage devices

In the Working Group meeting, stakeholders questioned the urgency of addressing mitigation of battery resources at this time and suggested that the ISO should delay designing battery default energy bids until there is more evidence of battery resources exercising market power. DMM strongly supports the ISO's attempts to design default energy bids for batteries in the ESDER 4 initiative.

DMM has not yet observed battery operators economically withholding battery charging or discharging to an extent that would warrant immediate implementation of battery energy bid mitigation. However, DMM's analysis indicates that many of these battery resources are located in areas that are frequently downstream of congested, non-competitive constraints. Therefore, it is extremely likely that these resources will be subject to energy bid mitigation within the next few years, regardless of whether or not stakeholders want to prioritize designing default energy bids at this time.

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[1] Supporting documentation for SPP's approach: "Dynamic Opportunity Cost Mitigated Energy Offer Framework for Electric Storage Resources", A. Swadley, Southwest Power Pool - Market Monitoring Unit. August 24, 2018. https://www.spp.org/documents/58525/dynamic%20opp%20cost%20esr%20mitigated%20offer%20framework 20180824.pdf

[2] The roundtrip efficiency loss adjustment differs for the charging and discharging operating ranges.

Designing default energy bids that accurately reflect the way battery costs vary with incremental energy production or withdrawal could be complicated and time consuming. DMM recommends that the ISO and the battery storage community work together to define these costs now. Working on the design now will reduce the risk of implementing hastily and potentially poorly designed default energy bids when it becomes urgent to address market power that could be exercised by battery resources. The likelihood that batteries will be subject to bid mitigation within the next few years also increases the importance of improving the non-generator resource (NGR) model to consider how some battery usage patterns may cause significant maintenance costs that cannot be accurately modeled as a cost of incremental energy production or withdrawal.

DMM understands that CAISO's current structures for modeling battery resources cannot accurately reflect the ways in which operating a battery accelerates the need for the battery owner to incur significant, lumpy maintenance costs such as augmenting battery cells. For example, operating characteristics like the frequency that a battery cycles, or the depth of its charge or discharge, may significantly impact how often a battery resource requires cell augmentation to maintain its stated capacity. Stakeholders have expressed a need to reflect these costs in order to avoid market dispatches that result in excessive cycling of battery resources.

Stakeholders have explained that battery owners may agree to less expensive tolling contracts with CAISO market participants if the contract or negotiated warranty includes provisions that limit how the battery can operate in CAISO's markets. For example, a battery resource owner may guarantee the physical performance of the battery at a stated capacity for a set number of years if the counterparty agrees to a limit on cycling frequency. Arrangements with more restrictive cycling limits may be available at lower cost. Such agreements are based on the premise that more frequent cycling and operation of battery resources increases the need for maintenance and the associated cost required to maintain the resource's capacity. However, managing potential maintenance costs through contractual limitations or negotiated warranties could result in inefficient utilization of battery resources in wholesale electricity markets. Furthermore, when CAISO begins mitigating battery resource energy bids, market participants may not be able to control whether or not CAISO dispatches battery resources in violation of contractual arrangements with third parties.

The CAISO does not currently mitigate the energy bids of battery resources. As a result, market participants can rely on energy bids to operate the resource in ways that minimize the wear and tear on the battery and avoid violating contractual limitations. When CAISO begins to mitigate energy bids of batteries, the cost-based default energy bids will sometimes be used in place of energy bids submitted by scheduling coordinators. Therefore, market participants will no longer be able to rely on their submitted energy bids to control how the battery operates.

The cost-based default energy bids to which batteries may be mitigated would include incremental energy costs associated with incremental energy production or withdrawal. Inflating default energy bids with costs caused by other operational characteristics such as cycling frequency or depth of charge would result in inefficient dispatch. CAISO also recently

reaffirmed that "CAISO maintains its longstanding position that economic limitations such as those originating from contracts, such as power purchase or tolling agreements, are not acceptable limitations for establishing an opportunity cost".[3] The CAISO should clarify that market participants should not rely on being able to use contractual limitations to justify increasing the opportunity costs in a battery's default energy bids.

Moreover, CAISO does not permit market participants to constrain resource parameters below the resource's actual physical operating characteristics in order to manage contractual limitations or to limit costs, such as major maintenance costs.[4] This could lead to inefficient market outcomes if a battery resource dispatch that may be part of a least cost market solution does not occur because the resource is constrained by a physical-type parameter set below the battery's actual physical characteristics.

Therefore, DMM continues to strongly recommend that the ISO and the battery community work closely together as part of the ESDER 4 initiative to identify and model how some kinds of battery usage, such as increased cycling frequency and deep charging or discharging, accelerates the need to incur significant maintenance costs. This will allow the CAISO optimization to accurately consider these lumpy costs when determining the efficient dispatch. Accurately modeling the actual operational drivers of these costs will allow market participants to efficiently limit the kinds of battery operations that cause significant maintenance costs.

II. Non-generator resource enhancements

State of charge management

The ISO proposes to allow NGR resources to submit an end-of-hour state of charge (SOC) parameter. The ISO described two potential use cases for this type of constraint in the Working Group: (1) to allow NGR resources to reach a target SOC at a given time to support Multi-Use-Applications (MUA) provisions, and (2) to ensure an NGR resource can meet an ISO dispatch for reliability purposes as envisioned under the Storage as a Transmission Asset (SATA) initiative.

DMM encourages the ISO to fully consider bid cost recovery (BCR) implications and gaming issues under this proposed feature. Under the ISO's proposal, if a SC submits an end-of-hour SOC value, the market would ramp an NGR resource in preceding intervals to meet a submitted target SOC at any cost. As a result, a resource could be dispatched out of economic merit in intervals leading up to the end of hour.

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[3] *Filing to Implement Commitment Cost Enhancements Phase 3 Initiative, Request for Timely Commission Order, and Request for Waiver of Notice Requirement*, March 23, 2018, p. 24-25: http://www.caiso.com/Documents/Mar23_2018_TariffAmendment-CommitmentCostEnhancementsPhase3_ER18-1169.pdf.

[4] *California ISO Market Notice: Outage Reporting for Energy Storage Resources with Physical Limitations*, May 11, 2017: http://www.caiso.com/Documents/OutageReporting-EnergyStorageResources-PhysicalLimitations.html.

If a resource must be discharged in preceding intervals to meet a target SOC, it could be dispatched to generate when bid costs exceed LMP. Or, if a resource must be charged in preceding intervals to meet a target SOC, it could be instructed to charge at LMPs that exceed the bid price at which it is willing to consume. In either scenario the resource would be operating uneconomically and LMPs would be insufficient to cover bid costs in certain intervals. Because the SC would have control over its bids and end of hour SOC submissions, potential BCR gaming issues arise.

For example, a resource could submit an end of hour SOC of 100%, but schedule itself such that it is fully depleted in preceding intervals. The market will honor the end of hour SOC constraint and charge the resource at any cost in the intervals leading up to the end of hour. The resource could submit very low bids in preceding intervals while being instructed to charge at LMPs that far exceed its bids. If eligible for BCR, the resource could accrue a windfall BCR as it responds to the ISO's charging instruction.

The ISO should consider potential gaming strategies and necessary mitigation provisions if SCs are allowed to submit end-of-hour SOC constraints. The ISO could consider making resources ineligible for BCR in intervals where a NGR resource's dispatch is impacted by the end of hour SOC constraint.

In addition to allowing SCs to submit end-of-hour SOC values, the ISO will also consider using end-of-hour SOC constraints to ensure NGR or SATA resources will meet an ISO reliability dispatch instruction. DMM believes this type of use would be analogous to an exceptional dispatch by the ISO that should be subject to bid mitigation. Because a resource must reach a certain SOC to honor ISO reliability purposes, DMM believes it is reasonable for costs incurred by the resource to meet the ISO instruction that are not covered by LMP to be recovered through BCR. However, exceptional dispatch bid mitigation provisions should also apply to NGR bids in these instances to prevent resources from submitting bid costs that would allow them to accrue excessive BCR payments.

III. Demand response resources

Weather-sensitive DR

DMM supports the ISO working with the CPUC and other LRAs to consider new methodologies for establishing qualifying capacity (QC) values for weather-sensitive DR resources. DMM supports developing RA counting methodologies that more accurately reflect expected resource availability to the market.

Additionally, using forecasts to reflect the availability of weather-sensitive DR resources could allow these resources to better reflect actual physical capabilities in the market on any given day. Today, weather-sensitive DR resources may not be able to provide the full contracted amount of RA capacity to the ISO in most operating hours, but scheduling coordinators cannot partially de-rate resources to reflect actual capability under current ISO rules.

DMM reiterates that resources are expected to represent actual physical operating capabilities and costs to the market. Weather-sensitive DR should not represent that their full contracted capacity is available in the market if these resources are not physically capable of providing their full RA value. On the other hand, without the capability to partially de-rate a DR resource, SCs could also face unnecessary RA substitution costs when the substitution obligation covers the resource's full RA value but the resource actually is partially available.

Reflecting weather-sensitive DR availability based on a forecast (much like variable energy resources) could therefore be a more efficient and accurate means for SCs to reflect actual availability of weather-sensitive DR resources in the market.