Energy Storage and Distributed Energy Resources Phase 4 (ESDER 4) Draft Final Proposal

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 (ESDER 4) Draft Final Proposal*.[1]

DMM supports the ISO's overall direction to apply market power mitigation to battery resources. While there is not a significant amount of battery capacity participating in the ISO markets currently, batteries continue to be sited in areas that are frequently downstream from non-competitive constraints. As battery capacity increases on the system and continues to replace capacity in local areas, it will be increasingly important that these resources be subject to energy bid mitigation.

DMM believes there are several enhancements that could improve the ISO's proposed default energy bid (DEB) calculations. For example, the ISO's proposal will not allow battery DEBs to vary across the day. This approach necessitates the use of the highest possible cycling cost that may be incurred in the day for all hours. Further, this approach does not accommodate an opportunity cost component of the DEB that accounts for storage resources' capability to charge and discharge potentially multiple times over a day. This can lead to overstated opportunity costs in the DEB. If the ISO moves forward with its simplified approach to calculating DEBs, DMM encourages the ISO to closely monitor the impact of its proposed DEB calculations and seek to refine its methodologies over time to address any shortcomings.

In the Draft Final Proposal, the ISO has also proposed changes to the price estimation methods in two components of the DEB calculation. Specifically, the ISO revised its methodology for calculating expected prices for the charging energy component of the DEB used in the day-ahead market. The ISO now proposes to use prices from the LMPM market run, which do not reflect the impact of any bid mitigation that may be applied in the subsequent market run. This would allow DEBs used in the day-ahead market to be elevated by the exercise of local market power.

For the opportunity cost component of the day-ahead market DEB, the ISO retained its price estimation approach from its prior proposal. As constructed, this approach results in a value that cannot decrease when bilateral prices drop from the previous day. This may lead to significantly overstated opportunity costs when bilateral prices decrease significantly from the previous day.

[1] *Energy Storage and Distributed Energy Resources Phase 4 Draft Final Proposal*, California ISO, May 20, 2020: http://www.caiso.com/InitiativeDocuments/DraftFinalProposalEnergyStorage-DistributedEnergyResourcesPhase4.pdf

The ISO proposal also creates new resource master file parameters which will be used to calculate DEBs for battery resources. DMM requests that the ISO clarify what information will be used to derive the new "storage duration" parameter. DMM also stresses the importance of the ISO actively validating the master file parameters that will directly impact DEB calculations.

DMM supports the ISO's proposal to introduce a biddable end-of-hour state-of-charge (EOH SOC) parameter for storage resources. As indicated by stakeholders, this feature could be a more flexible way for battery resources to manage schedules in real-time versus self-scheduling. DMM appreciates the ISO's efforts to address potential changes in schedules between 15-minute and 5-minute markets, bid cost recovery rules (BCR), and using the end-of-hour state-of-charge feature to exceptionally dispatch storage resources.

While DMM believes the ISO's proposals to address these issues have improved significantly over time, the ISO should consider more refined methodologies for preventing large swings in schedules between 15 and 5-minute markets. Other approaches could help maintain flexibility of battery resources in real-time, especially when the end-of-hour state-of-charge constraint does not impact a resource's dispatch. The ISO could also refine BCR rules so that resources could remain eligible for BCR when the end-of-hour state-of-charge constraint does not impact a resource's dispatch. DMM also suggests that the ISO provide more detail on how storage resources subject to exceptional dispatch using an end-of-hour state-of-charge constraint will be settled, particularly for exceptional dispatches that may be considered non-competitive.

Lastly, DMM supports the ISO's efforts to more accurately determine demand response resources' contributions towards meeting resource adequacy requirements. DMM has observed that bidding patterns of demand response resources which are not subject to must-offer obligations have mirrored underlying load profiles. These resources' availability often do not align with the ISO's availability assessment hours, or hours where the ISO relies on resource adequacy capacity the most. To the extent that these demand response resources are counted towards meeting resource adequacy requirements, these resources' contributions to reliability in peak net load hours should accurately reflect curtailable load available in such hours.

DMM also supports the ISO's efforts to enhance demand response modeling by allowing resources to submit a maximum run time parameter. Stakeholders have indicated that this parameter would allow the ISO to better model the way many demand response programs are designed and called. It will be important for the ISO to monitor suppliers' use of the maximum run time parameter in conjunction with other master file parameters to ensure that resources which are counted for resource adequacy are not using master file constraints to limit resource availability below resource adequacy commitments.

More detailed comments on the ISO's draft final proposal are provided below:

I. Default Energy Bid for Energy Storage Resources

The Draft Final Proposal includes cycling costs and opportunity costs as two of three cost categories for energy storage resources. DMM supports the inclusion of each of these cost components in a DEB for energy storage resources.

A DEB that can change by hour could allow more accurate estimation of cycling costs

In earlier versions of the ESDER 4 proposal, the ISO sought to estimate the cost per MWh of cycling a storage resource, varying throughout the day based on resource operation over that day. While the approach was focused on cycling costs of lithium-ion batteries, the general approach appeared promising as an approach to accurately estimate costs of storage resources at a point in time. Key components of this general approach include tracking characteristics such as state-of-charge and number of cycles over the day, and allowing cycling costs reflected in DEBs to vary accordingly.

In the Second Revised Straw Proposal, the ISO proposed a static DEB value over the day. This approach is retained in the Draft Final Proposal. Because the DEB value will not be allowed to change throughout the day, the ISO proposes to use an estimate of cycling costs that will capture the highest-cost cycling scenario that a resource could face in the day. While such an approach may be necessary with a static DEB value for the day, this creates the potential to significantly overestimate costs in some hours and highlights the need for a DEB value that can change through the day.

The proposed approach also necessitates the use of a more blunt and conservative estimate of maintenance costs that may be varying with battery usage over the day. To more accurately capture the dynamic nature of energy storage resource costs, the approach could be refined to allow for different DEBs in different hours of the day and include better opportunity cost calculations.

Opportunity costs are dynamic and should reflect opportunities to recharge

DMM highlighted the role of opportunity costs for energy storage resources in earlier comments and appreciates that the ISO has included this cost in the proposed default energy bid methodology. Specifically, it is appropriate to include opportunity costs from foregone future profit opportunities. Such opportunity costs may be incurred if an energy storage resource charges or discharges at a time that is not profit maximizing over the day or other time period. Some examples are when a higher priced discharge opportunity is expected in future intervals, or when a lower cost charging opportunity is expected before reaching a high value discharge opportunity. Like the cycling costs considered by the ISO, these costs are also dynamic and change over the day. Opportunity costs will vary over the day with respect to expected prices in upcoming charging and discharging opportunities.

In an effort to capture the type of opportunity costs described above, the ISO proposes to estimate the next day's prices, construct a price duration curve of expected prices sorted in

descending order, and then calculate the strike price on that curve corresponding to the discharge duration capability of the storage resource at maximum output. This approach may be appropriate for resources that have no ability to recharge within a day once discharged, as resources subject to these limitations would face static opportunity costs at the highest valued discharge opportunities expected in the day.

However, this approach does not reflect the actual physical characteristics of energy storage resources that may be capable of charging and discharging multiple times over the course of a day. The use of a simple strike price approach for these resources could overstate the opportunity cost for all but the intervals where recharging is not physically possible before reaching the highest valued discharging opportunities.

DMM discussed this issue at length in earlier comments, illustrating through example how the ISO's simplified DEB approach can significantly overstate opportunity costs when a resource can cycle multiple times per day.[2] Additionally, DMM's comments on the ESDER 4 Straw Proposal outline a generalized approach that more fully accounts for opportunity and other costs at different points in the optimization period.[3] This general approach accounts for the dynamic nature of energy storage opportunity costs at different points over a day, and accounts for the ability to charge and discharge multiple times over a day to maximize profit.

Should the ISO elect to implement a simplified approach for energy storage DEBs rather than a more general approach like that presented in DMM's earlier comments, DMM encourages the ISO to closely monitor the impacts of this choice on calculated DEBs. DMM encourages the ISO to consider a future enhancement to estimated opportunity costs that accounts for the ability of energy storage resources to recharge throughout the day.

Estimated day-ahead charging costs may be influenced by market power when using LMPM run prices

The Draft Final Proposal contains a number of changes to proposed approaches for estimating prices used in the DEB calculation. While DMM appreciates that some of these changes are likely improvements to earlier proposals, the new proposal to estimate day-ahead charging cost using prices from the day-ahead LMPM run may warrant further consideration.

The ISO explicitly states that LMPM prices are not an appropriate choice to estimate opportunity costs because they may be influenced by market power. However, the ISO appears to make an assumption that because the charging costs are estimated using the lowest prices in

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[2] *Comments on ESDER 4 Second Revised Straw Proposal*, Department of Market Monitoring, March 27, 2020: http://www.caiso.com/InitiativeDocuments/DMMComments-EnergyStorage-DistributedEnergyResourcesPhase4-SecondRevisedStrawProposal.pdf

[3] *Comments on ESDER 4 Straw Proposal*, Department of Market Monitoring, May 21, 2019: http://www.caiso.com/InitiativeDocuments/DMM_Comments-EneryStorageandDistribuedEnergyResoucesPhase4-StrawProposal.pdf.

the day, they would not be influenced by market power and would be acceptable for estimating charging costs.

DMM notes that binding transmission constraints can lead to local market power in any hour of the day, even if those hours are the lowest prices of the day—the lowest prices of the day can still be relatively elevated at a given node when congestion is present. The use of the LMPM run prices in any part of the DEB calculation can lead to a DEB that is influenced by the exercise of market power. DMM encourages the ISO to reconsider the use of LMPM run prices in the day-ahead charging cost portion of the DEB calculation to ensure that the DEB calculation is not influenced by market power.

Price estimation methods for day-ahead opportunity cost calculations should allow for possibility of falling prices day-over-day

DMM appreciates the ISO revising its methodology for estimating prices used in the opportunity cost component of the real-time DEB calculation. The use of actual day-ahead prices as inputs to the real-time DEB calculation represents an improvement to the previous proposal which considered only the possibility of flat or increasing prices day-over-day which could overstate opportunity cost estimates on days where prices fall significantly over the previous day. However, because day-ahead prices cannot be used as an input to the day-ahead DEB calculation, and because LMPM run prices may be influenced by local market power, the ISO retains the earlier approach to price estimation for the calculation of the opportunity cost component of DEB in the day-ahead market.

The ISO's proposed approach to estimating day-ahead prices for use in the day-ahead DEB opportunity cost calculation uses the current day's prices scaled by a ratio of bilateral prices for the next day and current day. The approach does not allow for a ratio of less than one as would occur when prices are expected to fall. The use of a price estimation approach that does not allow for the possibility of prices falling on the next day could overstate costs reflected in the DEB on days when prices fall significantly from the previous day. The ISO may be able to improve its proposed price estimation approach by allowing for the possibility of both rising and falling prices across days when calculating the opportunity cost component of the day-ahead DEB.

Storage duration parameter

The ISO proposes to model a new master file parameter called *storage duration* in its calculation of opportunity costs for energy storage DEBs. The ISO indicates this parameter will represent "Time the resource is capable of discharging, given energy (MWh) capacity at full output".[4] In the Draft Final Proposal, the ISO states "The ISO also collects the maximum

[4] *Energy Storage and Distributed Energy Resources Initiative (ESDER4) Draft Final Proposal*, May 27, 2020, Slide 22: http://www.caiso.com/InitiativeDocuments/Presentation-EnergyStorage-DistributedEnergyResourcesPhase4-May27-2020.pdf

amount of storage capability (in MWh) for each storage resource, this value combined with the resource Pmax value, will inform the storage duration parameter above".[5]

DMM requests that the ISO clarify whether the storage duration parameter will consider the daily Max Charge Limit parameter which is a biddable parameter that sets a daily max state of charge for a battery resource. Max charge limits are submitted into SIBR and can vary by day. Additionally, the ISO explains that a resource's Pmax will factor into the storage duration calculation. DMM asks the ISO to clarify whether the duration parameter will consider potential Pmax de-rates submitted to the ISO's outage management system. If the ISO does not consider max charge limit values which may vary by day or Pmax de-rates in its calculation of storage duration, the ISO's DEB calculations may not accurately reflect resources' actual physical capabilities.

Cycling cost parameter

The ISO proposes to include an explicit $/MWh cycling cost value in battery DEB calculations (applied to resources' discharge range). In the Draft Final Proposal, the ISO describes the higher end of cycling costs will be used in DEBs based on resources operating beyond their "design specification". The ISO describes that, "[m]any of the batteries are being built to optimally perform one cycle per day, which includes charging the battery once for four hours and discharging the battery for four hours later in the day" [6] and, "[c]onversations with a variety of battery manufacturers have been informative as to the costs of storage resources operating beyond their design specification, which may be between 2 to 3 times larger than those costs when operating within them." [7]

DMM appreciates the ISO explaining that cycling cost values will be validated by the ISO based on supporting documentation before these values can be used in DEBs. However, DMM has some concerns about the ISO's plan to simply accept the higher cycling cost values associated with a resource operating beyond its "design specifications". The ISO could better ensure that suppliers' estimates of cycling costs reasonably reflect how resources are actually being operated.

DMM has observed that based on resource meter data, batteries in the CAISO market cycled, on average, 0.5 cycles per day between July 2019 and May 2020 (where a cycle is reached when a resource's cumulative dispatch equals the resources' maximum state-of-charge). Some batteries have cycled on average up to 1.2 cycles per day in a single month. DMM has also observed that the average discharge bids of CAISO battery resources in 2019 were below $50/MWh in the second and third quarters of 2019[8], a trend which continued through the end of 2019. Suppliers presumably already reflect cycling costs within energy bids. If the ISO allows

[5] *Draft Final Proposal*, p. 29.
[6] *Draft Final Proposal*, p. 23.
[7] *Draft Final Proposal*, p. 24.
[8] *Q3 Report on market issues and performance,* Department of Market Monitoring, December 5, 2019, pp. 89-90: http://www.caiso.com/Documents/2019ThirdQuarterReportonMarketIssuesandPerformance.pdf

cycling cost adders to reach $60 to $90/MWh (i.e. 2 to 3 times the $30/MWh value the ISO mentions in the Draft Final Proposal) and applies these values to static daily DEBs, DEBs may routinely be too high for extended periods of time based on how resources have actually been bid into the market and cycled.

DMM suggests that the ISO could, instead, require that suppliers submit information to the ISO which estimate cost adders that may be incurred for various levels of cycling. DMM assumes that the "one cycle per day" design specification is derived from an overarching level of total cycling over a resource's lifetime. The supplier could submit costs associated with a resource operating to its "design specification" and stepped cost adders to operate beyond these design specifications to the ISO. The ISO could either modify cycling cost adders over time based on resources' cumulative discharge observed in meter data as the resource approaches different levels of cycling, or the ISO could allow suppliers to routinely update cycling cost adders and use supporting information to justify suppliers' submissions to the ISO.

II. End-of-hour state-of-charge parameter

DMM supports the ISO's proposal to introduce a biddable end-of-hour state-of-charge (EOH SOC) parameter for storage resources. The ISO's proposal would allow scheduling coordinators to submit EOH SOC values as a minimum and maximum MWh range. As indicated by stakeholders, this feature could be a more flexible way for battery resources to manage schedules in real-time versus self-scheduling.

While DMM supports the general framework of the ISO's proposal, the ISO's proposal for managing potential schedule changes between 15 and 5-minute markets could be enhanced to better preserve the flexibility of battery resources in real-time, particularly when the EOH SOC constraint does not impact a resource's dispatch. The ISO could also refine BCR rules so that resources remain eligible for BCR when the EOH SOC constraint does not impact a resource's dispatch.

End-of-hour SOC interaction between 15 and 5-minute markets

DMM appreciates the ISO's consideration of impacts that the end-of-hour state-of-charge (EOH SOC) parameter could have between 15-minute and 5-minute markets, given the difference in look-ahead horizons.[9] To address potential swings in schedules between 15 and 5 minute markets, the ISO will apply an EOH SOC constraint to the end of 5-minute market horizons, "adjusted for a resource's charging activity for intervals beyond the RTED time horizon as determined by the latest RTUC advisory instructions for that time period."[10]

DMM believes the ISO's proposed solution is an improvement over its previous proposals to maintain alignment between 15 and 5-minute market schedules. The ISO's proposed solution

[9] *Comments on ESDER 4 Revised Straw Proposal*, Department of Market Monitoring, November 25, 2019, p. 7: http://www.caiso.com/InitiativeDocuments/DMMComments-EnergyStorage-DistributedEnergyResourcesPhase4-RevisedStrawProposal.pdf

[10] *Draft Final Proposal*, pp. 9-10.

would help prevent potentially large swings in generation between real-time market runs, and increase the likelihood that EOH SOC targets will remain feasible through the real-time market when the EOH SOC constraint impacts a resource's dispatch in the 15-minute market. However, the ISO's proposal may also limit resource flexibility in real-time, particularly when the EOH SOC constraint does not impact a resource's dispatch.

DMM suggests that the ISO consider whether "end-of-*horizon*" EOH SOC constraints should only be enforced in the 5-minute market if EOH SOC constraints are actually binding in 15-minute market runs. Understanding whether an EOH SOC constraint is binding (i.e. constraint exhibits a positive shadow price) could also be used to refine the ISO's proposed BCR eligibility rules when the EOH SOC feature is used.

Consider the ISO's example 1 on page 10 of the Draft Final Proposal. Suppose the EOH SOC constraint was set between 75% and 90% (between 30 and 36 MWh). In contrast to the ISO's example, suppose that advisory prices in the last two intervals of the RTUC horizon (09:30-09:45 and 09:45-10:00) were high, such that it would be optimal for RTUC to fully charge the resource to 100% by 9:35 so that the resource could capture high prices and discharge economically between 09:30-10:00. The resource could still meet the SOC target by hour ending 10, even though it would be discharging between 09:30-10:00.

Under the ISO's proposal, it is not clear whether the ISO would set the corresponding 5-minute market end of horizon SOC target (in the 8:30 RTED run) at 100%, given the resource's *discharge* predicted in RTUC advisory intervals between 09:30 and 10:00. If the ISO does plan to set the 5-minute market end of horizon constraint at 100%, the ISO's proposal would attempt to exactly mirror RTUC advisory schedules any time an EOH SOC constraint is used regardless of the constraint's impact on a resource's dispatch. If the constraint did not impact the resource's RTUC schedule, the ISO's proposal may limit resources' flexibility to meet changing conditions between the RTUC and RTED runs. On the other hand, if the ISO sets the end-of-horizon SOC constraint between 75% and 90% at the end of the 08:30 RTED horizon (as the resource had no *charging* activity in RTUC between 09:30 and 10:00), the ISO may inefficiently limit the resource's ability to charge above a 90% SOC and capture economic discharge opportunities between 09:30 and 10:00.

DMM suggests that the ISO consider whether it could identify whether an RTUC EOH SOC constraint is binding and only enforce RTED end-of-horizon SOC constraints in the 5-minute market if the EOH SOC constraint was actually binding in 15-minute market runs. Under the ISO's current proposal, the market software may restrict economic movement of battery resources in real-time when EOH SOC constraints may not otherwise have impacted resources' schedules. By only enforcing end-of-horizon SOC constraints in the 5-minute market if EOH SOC constraints are binding in the 15-mintue market, the ISO could better preserve flexibility on battery resources in real-time. This approach could also be used to enhance bid cost recovery rules when the EOH SOC constraint is used.

BCR and settlement issues

DMM appreciates the ISO's consideration of BCR eligibility rules when EOH SOC parameters or self-schedules are used to manage battery resource schedules in real-time. The ISO proposes to remove revenue *shortfalls* incurred in the hour with an EOH SOC and hour prior from the real-time BCR calculation. The ISO also proposes that revenue surpluses incurred in these two hours would not be removed from the real-time BCR calculation. The ISO's revised proposal would significantly limit potential gaming opportunities in hours preceding the hour with the EOH SOC constraint.

However, as mentioned in prior comments, the ISO's proposal could result in excluding hours from BCR calculations where the end-of-hour SOC constraint did not impact a resource's dispatch.[11] For example, suppose an EOH SOC is set in hour ending 10. A resource may be charged and discharged between 8:30 and 10:00 based on price spreads observed in the market horizon with no impact from the EOH SOC constraint. Suppose the resource is charged out of the money in hour ending 9, and discharged in hour ending 10. Under the ISO's proposal, net costs incurred in hour ending 9 would be excluded from BCR calculations while net revenues earned in hour 10 would count towards offsetting revenue shortfalls in other intervals of the day. In this type of scenario, net costs incurred in hour ending 9 should be included in the BCR calculation and eligible for cost recovery if the resource's dispatch was not impacted by the EOH SOC constraint.

In line with DMM's suggestion for managing resource schedules between 15 and 5-minute markets, the ISO could first determine whether EOH SOC constraints enforced in the 15-minute market were binding and exclude hours from the BCR settlement only if EOH SOC constraints were binding in the 15-minute market. Identifying whether EOH SOC constraints are actually binding and impacting resource dispatch could help improve the precision of BCR eligibility rules.

DMM supports the ISO's proposal to also apply BCR eligibility rules to the hour preceding a battery resource's self-schedule. Since the ISO proposes to define minimum SOC constraints in 5-minute market runs in order for resources to meet self-schedules, DMM suggests that the ISO could also identify whether these minimum SOC constraints needed to support self-schedules are binding or not, and use these distinctions to determine BCR eligibility when a self-schedule is in place.

[11] *DMM November 25 Comments on ESDER 4 Revised Straw Proposal*, pp. 7-8.

Interaction with resource adequacy

DMM previously suggested that the ISO consider whether a battery submitting a max EOH SOC less than a resource's 4-hour resource adequacy value in availability assessment hours (or at the start of the assessment hour window) should constitute a type of outage or de-rate.[12] Alternatively, since a resource may still be able to reach its resource adequacy value or Pmax for less than 4 hours, DMM suggested that the ISO could consider an ex-post settlement process for batteries that is linked to RAAIM.

The ISO clarifies in the draft final proposal that this issue will be taken up in its RA Enhancements Initiative, and that use of the EOH SOC parameters that fall below resources' contracted resource adequacy values could potentially impact resources UCAP values.

DMM maintains that it will become increasingly important to reflect the actual availability of battery resources in capacity values as batteries begin to comprise a greater portion of the resource adequacy fleet. DMM has already observed that use of the daily Max Charge Limit parameter has limited the 4-hour availability of some resource adequacy battery resources and suggests that the ISO also address the use of the Max Charge Limit parameter when assessing impacts to resource adequacy availability.

Exceptional dispatch of battery resources

DMM appreciates the ISO providing additional clarification on how the EOH SOC feature could be used to exceptionally dispatch storage resources.[13] DMM agrees that resources subject to exceptional dispatch using the EOH SOC feature should remain eligible for BCR in intervals potentially impacted by the EOH SOC constraint.

DMM suggests that the ISO provide additional detail on how settlements for battery resources subject to exceptional dispatch will work. This includes how DEBs developed under the ESDER 4 proposal will be used in the settlement of exceptional dispatches.

In contrast to settlements for exceptional dispatches of traditional resources, settlement rules for batteries would likely have to extend beyond the hour of the exceptional dispatch instruction. Similar to BCR rules for batteries using the EOH SOC constraint, the impact of an exceptional dispatch issued to a battery resource by using a target SOC constraint could extend beyond the hour the actual dispatch is needed. Battery resources may have to charge or discharge in prior intervals in order to meet an ISO exceptional dispatch instruction. If a resource's exceptional dispatch is deemed non-competitive, the ISO should clarify how DEBs may be used in place of bids in determining resource settlements.

[12] *Comments on ESDER 4 Revised Straw Proposal*, Department of Market Monitoring, November 25, 2019, pp. 6-7.
[13] *Draft Final Proposal*, p. 13.

III. Demand response

DMM supports the ISO's efforts to more accurately determine demand response resources' contributions towards meeting resource adequacy requirements. DMM has observed that bidding patterns of demand response resources which are not subject to must-offer obligations have mirrored underlying load profiles.[14] These resources' availability often do not align with the ISO's availability assessment hours, or hours where the ISO relies on resource adequacy capacity the most. To the extent that these demand response resources are counted towards meeting resource adequacy requirements, these resources' contributions to reliability in peak net load hours should reflect actual curtailable load available in such hours.

DMM also supports the ISO's efforts to enhance demand response modeling by allowing resources to submit a maximum run time parameter. Stakeholders have indicated that this parameter would better model how demand response programs are designed and called. The ISO should commit to monitoring suppliers' use of the maximum run time and other master file parameters to ensure that resources which are counted for resource adequacy are not limiting resources' availability through use of various master file constraints. For example, a supplier could use the maximum run time parameter and maximum starts per day parameter to significantly limit a resource's availability below its resource adequacy value.

[14] *2018 Annual Report on Market Issues and Performance*, DMM, May 2019, pp. 43-44: http://www.caiso.com/Documents/2018AnnualReportonMarketIssuesandPerformance.pdf