



California ISO

Minimum State of Charge Extension

Final Proposal

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Market & Infrastructure Policy

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1 Introduction

Stakeholder initiatives prior to the proliferation of storage resources on the system recognized that there could be significant challenges in running a system with many use-limited storage resources. These challenges center around storage resources having insufficient state of charge in the real-time market going into periods when they will be critical. These challenges were evident during key periods of the high heat events in summer 2022. Storage capacity is projected to grow significantly, which will place increasing importance on reliably dispatching these resources.

At the start of 2023 the ISO system had more than 5,200 MW of storage resources; mostly 4-hour duration lithium-ion batteries. Almost all of this capacity was added within the last few years. Total overall storage development will continue to grow at a very rapid rate through summer 2024 and likely beyond.¹ This growth emphasizes the need to develop new market rules and tools to integrate these resources efficiently, including exceptional dispatch functionality and associated settlement rules.

To help manage storage resources during tight conditions, the minimum state of charge (MSOC) requirement was developed – as a temporary tool – to be in place for summer 2021 and summer 2022. This proposal extends the life of the minimum state of charge requirement to allow additional time for software development of new exceptional dispatch tools. The current minimum state of charge requirement is only used during much stressed system conditions, which only occur during the summer. Therefore, this policy proposes to request authority to extend the use of the minimum state of charge requirement through September 30, 2023, to allow for use of the tool through the summer months. Software development of the new features for exceptional dispatch within the energy storage enhancements policy is anticipated by fall 2023, and would be available for summer 2024. This proposal will not include scope for changing how the minimum state of charge requirement works.

¹ The California Public Utilities Commission, in their decision adopting a preferred system plan, calls for more than 10,000 MW of storage capacity by summer 2024, p. 90, Table 2:
<https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M451/K412/451412947.PDF>.

2 Background

Previous policies, including the energy storage and distributed energy resource 4 initiative and the resource adequacy enhancements initiatives, called out potential challenges to operating the grid with high amounts of use-limited resources and storage resources that may need to have state of charge to provide energy in hours later in the day.² Those policies also noted that the day-ahead market does a good job scheduling storage resources at optimal times. The day-ahead market understands when optimal (least cost) times are to charge storage resources and optimal (greatest cost reduction) times are to discharge the storage fleet. However, the real-time market is fundamentally different and does not internalize current or future dispatch decisions – outside of about 1 hour – for any resource type when determining dispatch during any specific intervals. Indeed, the real-time market is almost always dispatching storage resources based on energy bids and locational marginal prices for that resource.

The market enhancements for summer 2021 readiness policy developed the minimum state of charge requirement to address concerns about operating storage resources in the real-time market. Specifically, this policy sought to ensure that storage resources were able to meet day-ahead discharge schedules in the real-time market because they were either not sufficiently charged or they were prematurely discharged in the real-time market and unable to meet day-ahead schedules when they may be critically needed.

The minimum state of charge requirement had limited application. Use was restricted to resource adequacy resources on only the most constrained days, and it only applied to discharge awards during certain critical hours. It was intended to be in place for two years to allow time to develop a new, more permanent tool to ensure storage resource availability and optimal dispatch.

The requirement only applies under the following conditions:

1. The requirement only applies to resource adequacy resources
2. The requirement only applies on days when there is extreme need
3. The requirement only applies to charging during specific 'critical' hours

²² Energy Storage and Distributed Energy Resources:

<https://stakeholdercenter.caiso.com/StakeholderInitiatives/Energy-storage-and-distributed-energy-resources>;

Resource Adequacy Enhancements:

<https://stakeholdercenter.caiso.com/StakeholderInitiatives/Resource-adequacy-enhancements>.

4. The requirement charges resources immediately prior to critical hours
5. The requirement was initially only in place through summer 2022

First, the policy stated that the requirement would only apply to resource adequacy resources. The planning process to determine if reliability needs can be met are assessed through the resource adequacy program, which considers – on a monthly basis – all of the resource adequacy capacity that is shown by load serving entities. Therefore these resources should be sufficient to meet reliability needs, and these requirement should only apply to resource adequacy resources. This policy notes that all resources on the grid continue to be subject to typical exceptional dispatch instructions from operators.

Second, the market enhancements for summer 2021 readiness initiative considered that the minimum state of charge requirement should only apply on the most critical days. During typical days, even if some of the storage fleet does not have sufficient state of charge during critical hours, there are other resources available on which grid operators can call during critical hours. However, on extremely tight days, there may be conditions such that, if the storage fleet is unavailable, the only alternative is for grid operators to drop load. On such days, the policy acknowledged a minimum state of charge requirement is needed to maintain reliability. The policy identified that the minimum state of charge requirement would only be triggered on days when there were infeasibilities in the reliability unit commitment (RUC) process, i.e. there is insufficient supply to meet demand.

Third, the policy anticipated that storage resources may receive discharge instructions during non-critical hours, and that these dispatches should not be subject to the minimum state of charge requirement. For example, a storage resource may receive a schedule to discharge during the morning ramp, at hour ending 8. The policy noted that the requirement would not need to preserve state of charge outside of a pre-defined set of critical hours – typically during the evening hours when reliability threats exist. The policy specifically called out that state of charge would only be preserved in the real-time market for storage discharge awards during these critical hours.

Fourth, the policy considered that requirements on state of charge should apply to predefined critical hours and hours immediately prior to these critical hours. Again, because the objective of the minimum state of charge requirement is to be minimally invasive, the policy determined that the requirement would only hold state of charge for storage resources in the hours immediately preceding the critical hours.

Finally, the policy anticipated development of a replacement tool, which would include opportunity cost compensation for storage resources exceptionally dispatched and required to hold state of charge for use later. The opportunity cost arises from potentially missing higher priced dispatch opportunities in those intervening hours. This policy has been developed in the energy storage enhancements initiative, and includes tools that can replace the minimum state of charge requirement and continue to ensure reliable operation even on during days with the tightest conditions. However, because these new tools will not be implemented prior to summer 2023, this policy proposes to extend the existing minimum state of charge requirement until the new exceptional dispatch functionality is implemented.

Replacement Tools

The energy storage enhancements initiative developed policy to address operators' concerns about retirement of the existing minimum state of charge requirement.³ Specifically, this policy addressed the concept of utilizing exceptional dispatch to hold state of charge, compensation for lost opportunity costs, and new tools and automation for the operations team to visualize and issue these exceptional dispatches.⁴ Upon implementation of these new tools, as outlined in the energy storage enhancements policy, the minimum state of charge requirement would be retired. While the initial expectation was that these changes would be developed prior to summer 2023, the ISO technology team currently anticipates that development and complete implementation of these tools in fall 2023.

This policy proposes to extend the use of the existing minimum state of charge requirement until September 30, 2023. This will allow for sufficient time to complete development of the new exceptional dispatch tools. Software development is anticipated to be complete in fall 2023.

Potential Future Policy

During initial development of the minimum state of charge requirement, stakeholders advocated that a market-based solution would be a more efficient way to ensure reliable operations with deep penetrations of storage. Much of the discussion on this policy was focused on how to minimize use of out of market

³ Energy Storage Enhancements: <https://stakeholdercenter.caiso.com/StakeholderInitiatives/Energy-storage-enhancements>.

⁴ As with existing exceptional dispatch authority, these tools will only meant to be used in extreme circumstances when grid reality is threatened. These tools are not meant to be a typical day-to-day part of running the market.

actions and instead have storage resources incentivized and directed by market signals and instructions. Previous policy noted that storage resource scheduling coordinators would still have access to additional tools, outside of energy bids, such as the biddable end-of-hour state of charge, to manage resource state of charge in the real-time market.

Price signals can be an effective way to ensure that storage resources are available during the most critical times. For example, if energy shortage pricing was significantly higher than price caps in the day-ahead market, the potential or threat of buying back day-ahead schedules at very high real-time prices could be sufficient incentive to ensure that storage resources make themselves available in the real-time market. Another potential solution is to extend the real-time market to include a longer look-ahead horizon. These could be potential long-term solutions to address the availability and optimal use of limited duration storage resources to ensure reliability. These and other potential solutions may be discussed in the future price formation stakeholder initiative.

3 Minimum State of Charge Application

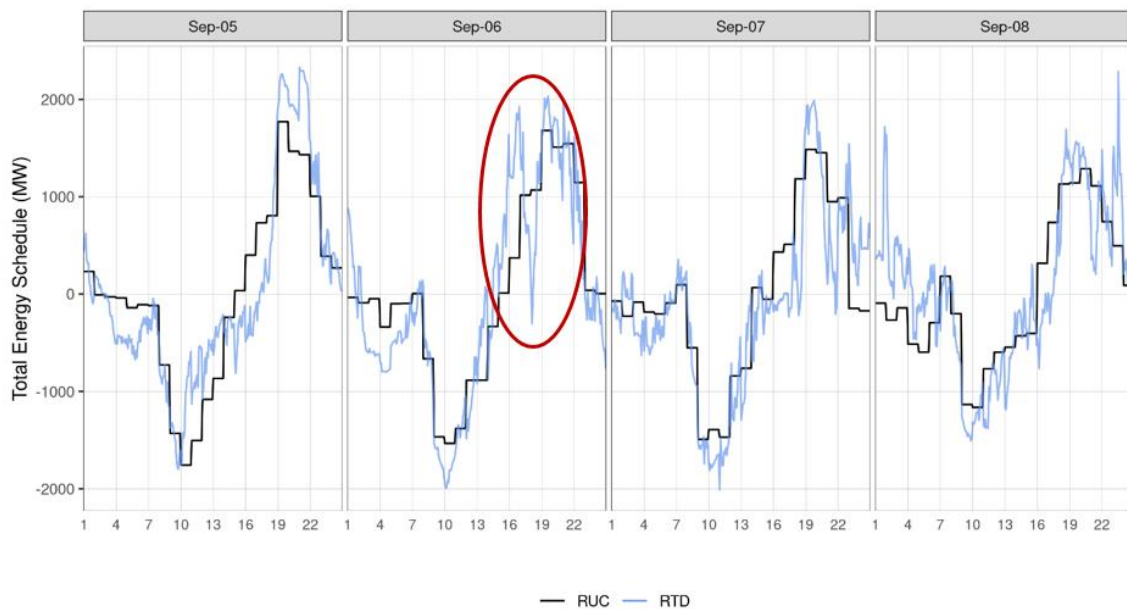
The minimum state of charge requirement is enforced only during critical hours when the reliability unit commitment process projects a supply shortfall, also known as power balance infeasibility. This shortfall condition is not a frequent occurrence and is typically observed during very tight supply conditions. In 2018 and 2019 there were no days with significant shortfalls in the reliability unit commitment process.⁵ In 2020 there were a total of 14 days, 6 days in 2021, and 14 days in 2022.

The minimum state of charge requirement was activated on nine days in September 2022, including the period of September 5 through September 8, when the system faced one of the most stressful conditions of recent history. The requirement was also used during three days in July 2021. In nearly all of the critical hours, the storage fleet carried state of charge at or in excess of quantities required from day-ahead schedules. This resulted in incremental energy above day-ahead awards provided in the real-time market during the critical hours. This was driven by high market prices that incentivized dispatch. This is illustrated in the market results from September 6, the record system peak load day.

⁵ Operators have the ability not to enforce the minimum state of charge requirements if they choose. They typically will not enforce the minimum state of charge when infeasibilities are particularly small. These figures reflect days when residual unit commitment infeasibilities were 500 MW or greater.

Figure 1 shows the aggregate dispatch for all storage resources on September 6. On this day, energy prices were high in the early afternoon, resulting in storage dispatch and aggregate state of charge at or below anticipated day-ahead levels. The minimum state of charge requirement effectively helped either prevent depletion and ensuring state of charge for the most critical hours of the day. To do this the minimum state of charge requirement prevented discharge or, in some cases, charged storage resources. If the minimum state of charge requirement had not been in place, storage resources would have been further depleted and required active manual intervention by operators to preserve the necessary state of charge for later in the day. This occurred during the time period circled in red in Figure 1.

Figure 1: Day-ahead and real-time energy schedules for storage



Overall, the minimum state of charge requirement worked as designed, ensuring storage resources with resource adequacy obligations maintained minimum state of charge during the critical hours. The constraint bound in the hours before and during the critical period, and storage resources providing resource adequacy received energy and ancillary service awards that allowed them to discharge during the critical hours.

4 Stakeholder Feedback

This policy received a significant amount of feedback from stakeholders, some of which was in support of the policy, and some which raised critical questions regarding the policy. Responses to this feedback are included here:

- *Multiple stakeholders suggested that the ability to extend the life of the minimum state of charge for two additional years was concerning and some suggested that the life of this tool should be limited to a single year.* In direct response to stakeholder feedback this final proposal specifies that the minimum state of charge requirement will not extend beyond September 30, 2023. This will ensure that operators have tools to reliably operate the grid this summer, and will allow time for development of the replacement tools in fall 2023.
- *Multiple stakeholders suggested that the ISO prioritize and/or fast-track software work on in the energy storage enhancements policy necessary for retirement of the minimum state of charge requirement prior to summer 2023.* The ISO technology team has prioritized work for the software development to be complete for summer 2023. At this time, the priority for software development includes, but is not limited to, initiatives already approved by the Board of Governors and the Western Energy Imbalance Market including energy storage enhancement, ancillary service state of charge, hybrid resources phase 2C, and transmission service and market scheduling priority. The ISO is also working to prioritize development to be completed for implementation in 2024 and beyond.
- *Multiple stakeholders commented that operators already have tools, outside of the minimum state of charge requirement, to manage storage resources on critical days.* While it is true the operations team has tariff authority to exceptionally dispatch storage resources, the available tools require a considerable amount of manual effort for grid operators. Specifically, replicating the functionality of the minimum state of charge tool requires that operators determine the current state of charge of a storage resource, determine the target state of charge to move the resource to, determine the amount of time to reach that target, enter an exceptional dispatch to charge the resource, and update the exceptional dispatch once the resource achieves the target state of charge to hold state of charge. The operators would have to perform this for each storage resource on the grid. The value of the minimum state of charge requirement is that it requires no manual work and automatically ensures these resources meet the state of charge requirements. The minimum state of charge requirement is only applied on extreme days, and these are the days when operators have little ability to spend time on manual processes to manage individual resources.
- *Some comments suggested that the minimum state of charge requirement may have been ineffective or was functioning in unintended ways when it*

was implemented during the heatwave in 2022 and at other times. This is inaccurate. The minimum state of charge requirement was a critical tool used by the operators during the heatwave in September 2022 and other stressed periods on the grid.⁶

- *Multiple stakeholders requested additional information on compensation for the minimum state of charge requirement, and if dispatch during these times would include opportunity cost compensation.* Currently the minimum state of charge requirement imposes constraints in the real-time market and does not issue exceptional dispatch instructions to storage resources. This requirement does not currently entitle recipients to opportunity cost compensation, and this policy does not propose that these dispatches be eligible for opportunity cost compensation.
- *Multiple parties requested that this policy include the ability to increase the storage default energy bid or reference levels during critical periods.* This is out of scope of this policy.
- *Vistra requested that the WEIM Governing Body have joint authority because of the impact to real-time markets.* This policy continues to maintain the Western Energy Imbalance Governing Body have the option to provide advisory input on this policy. This is consistent with the governance rules currently in place.

5 Proposal

Policy Summary

This policy proposes to extend the use of the minimum state of charge through September 30, 2023. This will allow time to develop the new exceptional dispatch functionality and associated settlement rules from the energy storage enhancements initiative. The following bullets summarize the policy:

- Extend the use of the minimum state of charge requirement until September 30, 2023
- Extension will not persist beyond development of the exceptional dispatch tools included in the energy storage enhancements initiative

⁶ Details regarding the use of the minimum state of charge requirement during the 2022 heatwave are included here:

<http://www.aiso.com/Documents/SummerMarketPerformanceReportforSeptember2022.pdf>.

Policy Description

The initial market enhancements for summer 2021 readiness initiative allowed for the use of the minimum state of charge requirement through summer 2022. This allowed time for energy storage enhancements that would replace the need for this functionality.

Although the ISO completed policy development work to replace the minimum state of charge requirement in the energy storage enhancements initiative, the software development for these improvements will not be implemented until fall 2023. Because these replacement features will not be in place before summer 2023, the ISO proposes to continue to apply the existing minimum state of charge requirement until September 30, 2023.

This policy will ensure that the minimum state of charge is available when it might be needed this summer and a replacement tool will not be in place, and will ensure that the requirement is not in place permanently.

6 Tariff Language

The ISO has included its proposed tariff revisions to extend the MSOC tool, below. Because these tariff revisions are short and straightforward, the ISO does not plan to stakeholder them separately. These tariff revisions likely will be temporary: Assuming the ISO implements its exceptional dispatch tools before September 30, 2023, the ISO will simply remove MSOC references from the tariff with its tariff filing to implement the exceptional dispatch tools and other energy storage enhancements. Nevertheless, the below revisions ensure the MSOC tool will sunset no later than September 30, 2023 regardless.

40.5 Minimum State of Charge Tool for Non-Generator

Resources Electing Limited Energy Storage Resource

Status that Provide RA Capacity

40.5.1 Operation of the MSOC Tool

Through ~~June 1, 2023~~the earlier of (a) September 30, 2023, or (b) the implementation of the CAISO's Exceptional Dispatch State of Charge enhancements, the CAISO enforces the MSOC Tool in the RTM on any

Non-Generator Resource that has selected a primary fuel type in Master File of “Limited Energy Storage Resource” and is an RA Resource for the day on which the MSOC is enforced.

7 WEIM Classification

This initiative proposes to extend the effective date of the minimum state of charge requirement. The WEIM Governing Body would have an advisory role with respect to this proposed amendment.

The Board and the WEIM Governing Body have joint authority over any “proposal to change or establish any ISO tariff rule(s) applicable to the EIM Entity balancing authority areas, EIM Entities, or other market participants within the EIM Entity balancing authority areas, in their capacity as participants in EIM. This scope excludes from joint authority, without limitation, any proposals to change or establish tariff rule(s) applicable only to the CAISO balancing authority area or to the CAISO-controlled grid.” Charter for EIM Governance § 2.2.1. The tariff changes to implement this initiative, however, would not be “applicable to EIM Entity balancing authority areas, EIM Entities, or other market participants within EIM Entity balancing authority areas, in their capacity as participants in EIM,” because the tariff rule that would be extended applies only to resources that are part of the California resource adequacy program. Accordingly, the proposed changes fall outside the scope of joint authority.

The WEIM “Governing Body may provide advisory input over proposals to change or establish tariff rules that would apply to the real-time market but are not within the scope of joint authority.” *Id.* Because this initiative includes certain changes to the rules of the real-time market, the WEIM Governing Body has the option of providing advisory input to the Board about those changes.