

March 28, 2023

The Honorable Kimberly D. Bose  
Secretary  
Federal Energy Regulatory Commission  
888 First Street, NE  
Washington, D.C. 20246

**Re: California Independent System Operator Corporation**  
**Tariff Revisions to Extend**  
**Minimum State of Charge Requirement**

**Docket No. ER23-\_\_\_\_-000**

Dear Secretary Bose:

The California Independent System Operator Corporation (“CAISO”) submits this discrete tariff amendment to extend the minimum state of charge (“MSOC”) requirement for resource adequacy storage resources until the earlier of (a) September 30, 2023, or (b) the implementation of the CAISO’s planned exceptional dispatch state of charge enhancements.<sup>1</sup> As the Commission found in 2021, the MSOC requirement is “a reasonable measure that will allow CAISO under specified circumstances to ensure that resource adequacy energy storage resources have sufficient charge to support their day-ahead market awards on days when tight supply conditions are expected.”<sup>2</sup> Without this short extension, the MSOC requirement would sunset on June 1, 2023 potentially leaving the CAISO without the necessary tools to ensure reliable operations this summer. The CAISO originally included the sunset date to convey that it would develop enhancements that would obviate the MSOC requirement. The CAISO has developed these enhancements and the CAISO Board of Governors has approved them, but the CAISO currently does not know whether it can finalize the software, simulate it with market participants, and put it into production before this

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<sup>1</sup> The CAISO submits this filing pursuant to section 205 of the Federal Power Act (“FPA”), 16 U.S.C. § 824d. Capitalized terms not otherwise defined herein have the meanings set forth in the CAISO tariff, and references to specific sections, articles, and appendices are references to sections, articles, and appendices in the current CAISO tariff and as revised or proposed in this filing, unless otherwise indicated.

The CAISO proposes an effective date of May 28, 2023, 61 days from today.

See CAISO Final Proposal on this topic, *available at* <https://stakeholdercenter.caiso.com/StakeholderInitiatives/Minimum-state-of-charge-extension>.

<sup>2</sup> *California Independent System Operator Corp.*, 175 FERC ¶ 61,168 at P 31 (2021).

summer's peak load conditions. Out of an abundance of caution, the CAISO therefore proposes to extend the MSOC requirement to the end of this summer or when the CAISO implements the replacement enhancements, whichever is sooner. Although the CAISO aspired to replace the MSOC requirement before this summer, it requires more time to do so. Preserving the MSOC requirement will help protect the reliability of the grid, which must take precedence.

## I. Background

### A. MSOC Requirement

The CAISO implemented the MSOC in 2021 as part of its resource adequacy enhancements.<sup>3</sup> As the Commission summarized in approving the MSOC requirement:

[T]he need for storage to charge before discharging energy onto the grid, combined with the real-time market's horizon being too short to manage the typical charge/discharge cycle, poses challenges for CAISO operations. . . . [T]he day-ahead market optimizes over 24-hours and can thus account for the charge/discharge cycle, but notes that the time horizon for the real-time market makes it difficult for CAISO to optimize the charge/discharge cycle to derive the greatest reliability benefits from resource adequacy storage resources.<sup>4</sup>

To address these challenges, CAISO proposes an interim mechanism that will constrain real-time market awards to storage resources, under specified conditions, in order to ensure that a resource adequacy storage resource will have sufficient charge to meet its discharge awards from the day-ahead market. CAISO proposes that this mechanism will only be triggered if there is an hour of the day for which its Residual Unit Commitment ("RUC") process<sup>5</sup> initially cannot find a feasible solution without adjusting the original constraints and will only do so for the most critical hours of that day. CAISO proposes to notify market participants approximately at the time day-ahead market results are posted of any

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<sup>3</sup> *Id.*

<sup>4</sup> "For example, real-time prices during what are typically the lowest-priced hours of the day may be higher than prices in the day-ahead market, resulting in no charging of storage resources. Also, if high prices occur before peak net-load hours, the real-time market may discharge the limited energy available from the storage resource before the period of greatest need." *Id.* at P 15 n. 16.

<sup>5</sup> "The RUC process is conducted by CAISO in the day-ahead market after the economic Integrated Forward Market has been executed to ensure sufficient supply is committed to meet the CAISO's forecast of its demand." *Id.* at P 16 n. 17 (citing "Residual Unit Commitment," Appendix A to the CAISO tariff).

RUC infeasibilities and which hours' day-ahead schedules are subject to the minimum state of charge tool.<sup>6</sup>

The CAISO Department of Market Monitoring (“DMM”) and other stakeholders supported the MSOC requirement as an interim measure to maintain reliability. Although some commenters protested aspects of the MSOC requirement, the Commission approved the MSOC requirement as just and reasonable and not unduly discriminatory.<sup>7</sup> The Commission found the MSOC requirement

serves as an enhanced optimization of the real-time market on days with tight supply to take into account the inability of that market to optimize across an entire trading day. While it may be preferable for CAISO’s real-time market to optimally dispatch resource adequacy storage resources such that this additional constraint was unnecessary, we find that CAISO’s proposal represents a just and reasonable solution to address a specific, defined reliability need. This solution will address the approximately 1,800 MW of energy storage resources anticipated to be available this summer, and the likelihood that CAISO will need to rely on those resources during tight summer conditions.<sup>8</sup>

The Commission also noted that the “CAISO has taken steps to limit the impact of its proposal. Specifically, CAISO will only trigger the tool on days when the RUC process is infeasible in some hours,” namely “when there is not enough supply available in the day-ahead timeframe to meet CAISO’s forecast load and, therefore, the capacity from all resources, including resource adequacy storage resources, is crucial to meet demand at net peak load.”<sup>9</sup>

## **B. MSOC Requirement in Practice**

The CAISO storage fleet has grown significantly since 2021. The CAISO now has over 4,500 MW of battery storage capacity.<sup>10</sup> Storage clearly represents a critical technology to meet demand. As intended, the MSOC requirement has worked well to address the large and growing storage fleet. The MSOC requirement is a surgical, effective measure to help ensure reliability during the few days each year where the CAISO faces capacity shortfalls. In 2021 and 2022, the CAISO faced RUC

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<sup>6</sup> *Id.* at PP 15-16.

<sup>7</sup> *Id.* at P 31 *et seq.*

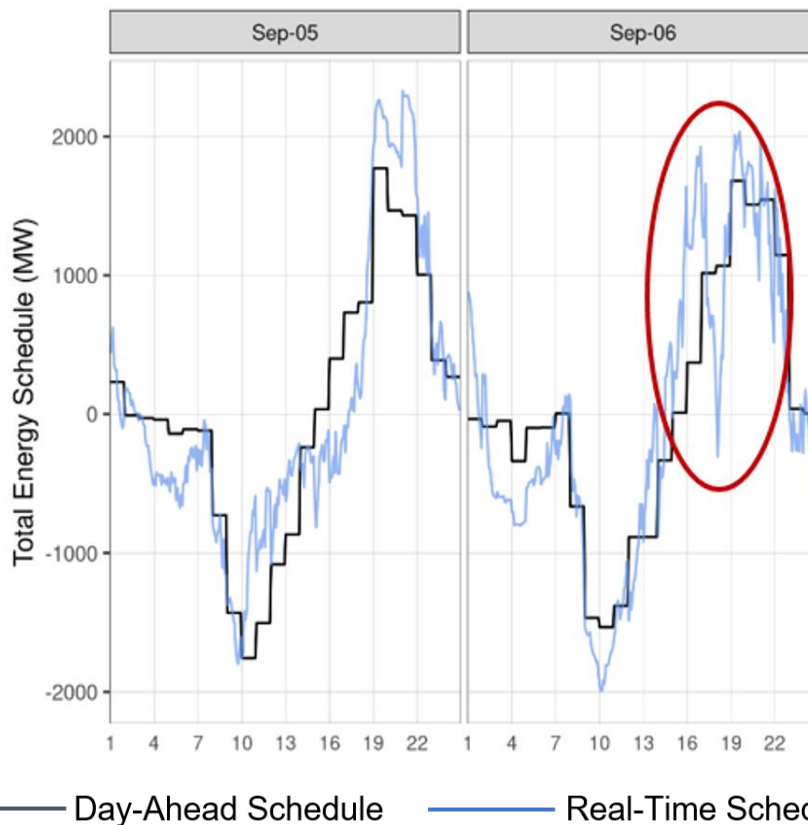
<sup>8</sup> *Id.* at P 33.

<sup>9</sup> *Id.* at P 32.

<sup>10</sup> See CAISO Key Statistics February 2023, <http://www.caiso.com/Documents/Key-Statistics-Feb-2023.pdf>.

infeasibilities on 6 and 14 days, respectively. The CAISO only utilized the MSOC requirement on 12 of these 20 days: on 3 days in 2021 and 9 days in 2022.<sup>11</sup> The slight uptick between 2021 and 2022 was largely due to the historic demand during September 2022. Nevertheless, the CAISO used the MSOC requirement sparingly: in nearly all of the critical hours, the storage fleet carried state of charge at or beyond quantities required from day-ahead schedules. This allowed storage resources to provide incremental energy above day-ahead awards in the real-time market during the critical hours. The market results from September 6, when the CAISO faced what would become its record peak demand, illustrate this:

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



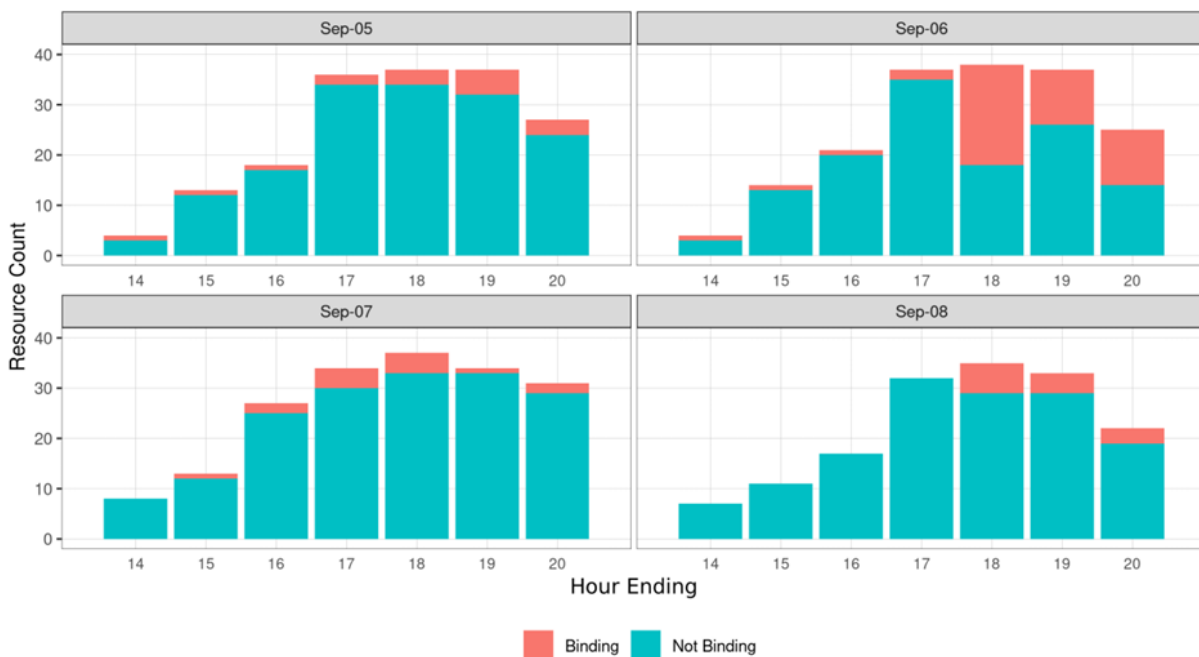
Overall, the minimum state of charge requirement worked as designed, ensuring storage resources with resource adequacy obligations maintained minimum state of

<sup>11</sup> Although CAISO operators use their engineering judgment based on holistic system conditions, generally CAISO operators use the MSOC requirement when RUC infeasibilities are substantial, typically over 500 MW, and otherwise have successfully avoided using it.

charge during the critical hours.<sup>12</sup> The constraint bound in the hours before and during the critical period to ensure storage resources had sufficient state of charge to provide energy and ancillary service awards during the critical hours.<sup>13</sup>

This means the MSOC requirement worked as intended to provide some level of comfort that storage resources would have sufficient state of charge to meet demand, but without inhibiting the majority of storage resources from taking advantage of real-time price signals to provide additional energy where possible and in nearly every hour. Figure 2 shows the four-day period from September 5 through September 8, when the CAISO faced extremely high temperatures and system loads, including the all-time record peak load.

**Figure 2: Enforced Real-Time MSOC Requirement**



The CAISO used the MSOC requirement all four days, to all of the storage resources with day-ahead discharge schedules during the critical evening hours. This figure shows that although the constraints were enforced during these hours of this four-day period, they bound and impacted dispatch instructions relatively infrequently. The

<sup>12</sup> Detailed data on the storage fleet’s performance during September 2022 is included in the CAISO’s Summer Market Performance Report for September 2022, available at <http://www.caiso.com/Documents/SummerMarketPerformanceReportforSeptember2022.pdf>.

<sup>13</sup> For most of the storage resources, economic bids kept them above the minimum state of charge imposed by the MSOC requirement and, in many hours, the real-time pricing did not warrant dispatch at the day-ahead schedules for the full hour.

majority of the periods when the constraints bound occurred on September 6 during the early evening hours, when real-time prices were very high, but it was important to save state of charge for future critical hours later in the day.

Although the CAISO issued exceptional dispatches to five storage resources to hold their state of charge in anticipation of a historic net demand peak on September 6—which materialized—the MSOC requirement avoided the need for the CAISO to issue exceptional dispatches broadly across the entire storage fleet.<sup>14</sup> This allowed CAISO operators to focus on other critical system issues and mitigation measures to maintain reliability.

### **C. Energy Storage Enhancements Stakeholder Initiative**

The CAISO's energy storage enhancements stakeholder initiative began in May 2021, shortly after the CAISO submitted the MSOC requirement for Commission approval.<sup>15</sup> The initiative concluded in December 2022 when the CAISO Board of Governors and Western Energy Imbalance Market Governing Body approved new enhancements for storage and hybrid resources, including enhancements that would allow for retirement of the MSOC. The CAISO plans to submit these enhancements for Commission review later this year, depending on the development of the related software. These enhancements will include new tools for CAISO operators to monitor and manage storage resources' state of charge, and new tools for CAISO operators to issue exceptional dispatches for storage resources to change to or hold at a specific state of charge.<sup>16</sup> Today these are slow, cumbersome processes for CAISO operators, effectively requiring them to call each storage resource's scheduling coordinator and communicate what the CAISO needs for reliability. The new enhancements will help automate and streamline this process. Altogether these enhancements will give CAISO operators the tools they need to be comfortable with the retirement of the MSOC requirement. Unfortunately, the CAISO cannot develop, test, and implement the software for these enhancements before the expiration of the MSOC requirement, and it may not be able to do so before peak demand conditions occur.

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<sup>14</sup> See *id.* at p. 152. The CAISO issued exceptional dispatches to four storage resources in hour-ending 17, three in hour-ending 18, and one in hour-ending 21. Some resources received exceptional dispatches in more than one hour, and the CAISO clarifies that five storage resources in total received exceptional dispatches. Without the MSOC requirement, the number would have been much higher.

<sup>15</sup> All stakeholder materials are available on the CAISO website: <https://stakeholdercenter.caiso.com/StakeholderInitiatives/Energy-storage-enhancements>.

<sup>16</sup> They also include new settlement enhancements to ensure storage resources dispatched to hold a state of charge receive adequate compensation for their opportunity costs. These enhancements are not directly related to the need for the MSOC requirement, but they will be included with the reliability enhancements.

## II. Proposed Tariff Revisions

To ensure reliability this summer during peak demand conditions, the CAISO proposes to delay the sunset of the MSOC requirement. The MSOC requirement has worked as intended, and the CAISO's replacement enhancements may not be ready before this summer. Out of an abundance of caution, the CAISO proposes to include simple tariff provisions changing the sunset date from June 1, 2023 to "the earlier of (a) September 30, 2023, or (b) the implementation of the CAISO's Exceptional Dispatch State of Charge enhancements."<sup>17</sup> This will make the MSOC requirement available to CAISO operators through this summer unless the CAISO implements its new energy storage enhancements. If the latter occurs, the CAISO will submit new tariff revisions removing the MSOC requirement from the tariff altogether.

The Commission should approve the instant tariff revisions as just and reasonable. They simply take an existing, Commission-approved policy, and extend it one additional summer to help ensure reliability. The MSOC requirement has worked as intended: the CAISO has used it sparingly, and only in extreme circumstances, and storage resources still have had ample opportunity to avail themselves of market opportunities. Storage is proliferating at a rapid rate, and the Commission must recognize that it is a brand-new technology in the CAISO's markets with limited energy (MWh) availability. Storage is now such a critical part of the CAISO's supply fleet as the CAISO sets new demand records, that some level of caution is warranted. Although the sunset date was included as part of the CAISO's rate filing to implement the MSOC requirement, it was not—and is not—determinative to whether retaining the MSOC requirement for a limited extension period is just and reasonable. Nor was the sunset a key condition of the Commission's acceptance, as the CAISO itself proposed the sunset.<sup>18</sup> The same reasons the Commission approved the MSOC in the first instance support its extension for a very limited period of time to ensure reliability. The CAISO included the sunset, and extends it here, for the assurance of stakeholders and to make it clear that the CAISO has every intention to retire the MSOC requirement soon.

## III. Effective Date

The CAISO requests an effective date of May 28, 2023, 61 days from today.

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<sup>17</sup> Proposed Section 40.5.1 of the CAISO tariff.

<sup>18</sup> In contrast to an express sunset ordered on compliance or pursuant to settlement rules.



#### **IV. Communications**

Please address communications regarding this filing to these individuals, whose names the CAISO requests the Commission place on the official service list established regarding this submittal:

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\*Individuals designated for service under Rule 203(b)(3).<sup>19</sup>

#### **V. Service**

The CAISO has served copies of this transmittal letter, and all attachments, on the California Public Utilities Commission, the California Energy Commission, and parties with effective scheduling coordinator service agreements under the CAISO tariff. In addition, the CAISO is posting this transmittal letter and all attachments on the CAISO Web site.

#### **VI. Materials Provided In This Filing**

The following documents, in addition to this transmittal letter, support this filing:

Attachment A	Clean tariff sheets incorporating the revisions described in this filing
Attachment B	Redline sheets showing the changes to the currently effective tariff described in this filing

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<sup>19</sup> 18 C.F.R. § 385.203(b)(3).



Attachment C: Memorandum to CAISO Board of Governors

Attachment D: Final proposal

## **VII. Conclusion**

For the reasons described above, the CAISO respectfully requests that the Commission accept the CAISO's proposed tariff revisions.

Respectfully submitted,

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Counsel for the California Independent  
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**Attachment A – Clean Tariff**

**Tariff Amendment – Minimum State of Charge Extension**

**California Independent System Operator Corporation**

**March 28, 2023**

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#### **40.5.1 Operation of the MSOC Tool**

Through 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. The MSOC Tool limits RTM awards to any covered resource in the market intervals preceding any Trading Hour that meets the requirements specified in Section 40.5.2 such that, based on its registered operating parameters, the resource will have sufficient charge to meet its discharge awards from its Day-Ahead Schedule for any Trading Hour that meets the requirements specified in Section 40.5.2. The MSOC tool does not increase the charge on a resource beyond what is necessary to ensure it can meet a discharge award from a Day-Ahead Schedule.

When reviewing market and system conditions on the Operating Day, the CAISO may choose not to apply the MSOC Tool for particular Trading Hours if its assessment of projected conditions reflects that the MSOC Tool is not necessary for system reliability in those Trading Hours.

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**Attachment B – Marked Tariff**

**Tariff Amendment – Minimum State of Charge Extension**

**California Independent System Operator Corporation**

**March 28, 2023**

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#### **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. The MSOC Tool limits RTM awards to any covered resource in the market intervals preceding any Trading Hour that meets the requirements specified in Section 40.5.2 such that, based on its registered operating parameters, the resource will have sufficient charge to meet its discharge awards from its Day-Ahead Schedule for any Trading Hour that meets the requirements specified in Section 40.5.2. The MSOC tool does not increase the charge on a resource beyond what is necessary to ensure it can meet a discharge award from a Day-Ahead Schedule.

When reviewing market and system conditions on the Operating Day, the CAISO may choose not to apply the MSOC Tool for particular Trading Hours if its assessment of projected conditions reflects that the MSOC Tool is not necessary for system reliability in those Trading Hours.

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**Attachment C – Final Proposal**  
**Tariff Amendment – Minimum State of Charge Extension**  
**California Independent System Operator Corporation**  
**March 28, 2023**



California ISO

# Minimum State of Charge Extension

Final Proposal

March 6, 2023

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.<sup>1</sup> 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.

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<sup>1</sup> 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.<sup>2</sup> 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

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<sup>22</sup> 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.<sup>3</sup> 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.<sup>4</sup> 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

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

<sup>4</sup> 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.<sup>5</sup> In 2020 there were a total of 14 days, 6 days in 2021, and 14 days in 2022.

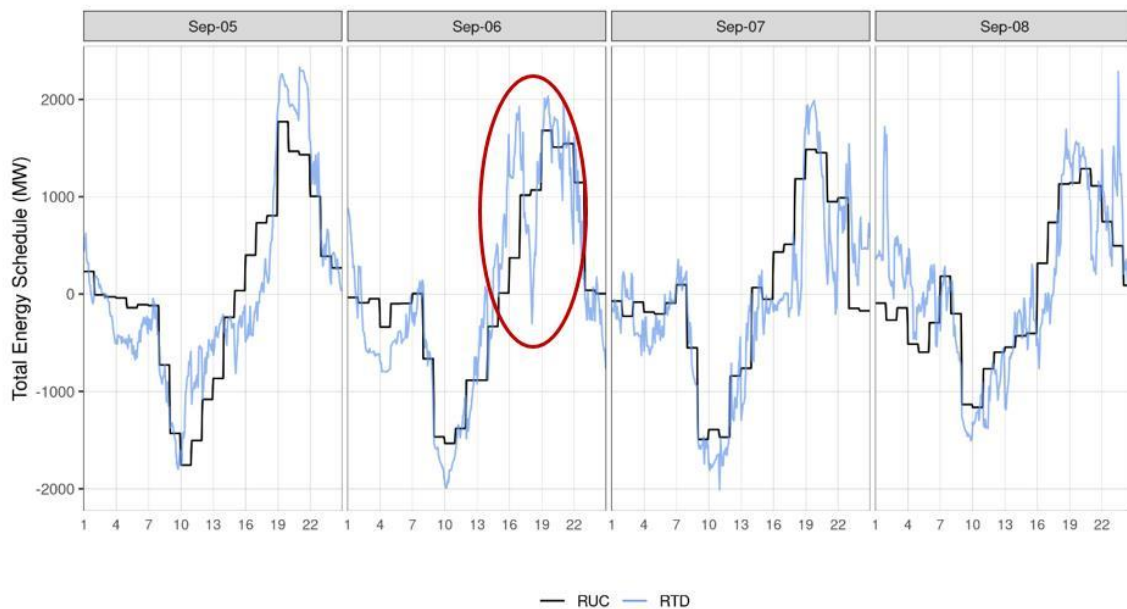
The minimum state of charge requirement was activated on nine days in September 2022, including the period of September 5 through September 8, when the system faced one of the most stressful conditions of recent history. The requirement was also used during three days in July 2021. In nearly all of the 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.

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<sup>5</sup> 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.<sup>6</sup>

- *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

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<sup>6</sup> 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.

**Attachment D – Board Memoranda**

**Tariff Amendment – Minimum State of Charge Extension**

**California Independent System Operator Corporation**

**March 28, 2023**

# Memorandum

**To:** ISO Board of Governors  
**From:** Anna McKenna, Vice President of Market Design and Analysis  
**Date:** March 15, 2023  
**Re:** **Decision on minimum state of charge extension**

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*This memorandum requires ISO Board of Governors.*

## EXECUTIVE SUMMARY

Management proposes to extend the minimum state of charge constraint that was developed as part of the enhancements for summer 2021 readiness initiative. The proposal extends the effective date of the minimum state of charge until the software developments associated with the replacement tools developed in the energy storage enhancements initiative are implemented, currently expected fall 2023.

The minimum state of charge constraint was developed and approved by the Board of Governors in April 2021 as an interim solution to address the challenge of operating storage resources in the real-time market during tight system conditions. The constraint was developed to ensure that storage resources remain sufficiently charged during critical conditions, and do not discharge prematurely when needed later in the day, such as during net load peak hours. The constraint was triggered on a limited number of days during very tight supply conditions and has worked as intended.

The goal is to no longer have to use the minimum state of charge constraint because it will be replaced by a more comprehensive set of tools to ensure storage resource availability that were approved by the ISO Board of Governors and WEIM Governing Body in December 2022. These more comprehensive set of tools, when implemented, will provide ISO operators with enhanced state of charge visibility and control via exceptional dispatch functionality. These enhancements also provide opportunity cost compensation for resources that are exceptionally dispatched to hold state of charge.

To address stakeholder concerns and ensure the minimum state of charge tool expires even in the event of implementation delays, Management proposes to sunset the minimum state of charge constraint no later than September 30, 2023.

This proposal falls under the WEIM Governing Body's advisory role authority which they will be considering at its March 21, 2023 meeting.

***Moved, that the ISO Board of Governors approve Management's proposal pertaining to the minimum state of charge extension as described in the memorandum dated March 15, 2023; and***

***Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement these changes, including any filings that implement the overarching initiative policy but contain discrete revisions to incorporate Commission guidance in any initial ruling on the proposed tariff amendment.***

## **BACKGROUND and PROPOSAL**

The minimum state of charge constraint was developed as part of the initial market enhancements for summer 2021 readiness initiative. It was designed to help manage storage resources during tight conditions and address concerns with operating storage resources in the real-time market. Specifically, the constraint mitigates the risk storage resources may be unable to meet day-ahead discharge schedules in the real-time market because they were either insufficiently charged or discharged prematurely, leaving them unable to meet their day-ahead schedules for later hours when their energy may be essential to maintain reliability. These challenges were evident during summer 2022, including during the September 2022 heatwave event, when the minimum state of charge constraint was used to help manage reliability. Because storage capacity has will continue to grow significantly, this constraint or its replacement will play an increasingly critical role in maintaining reliability.

Because the minimum state of charge constraint helps manage the way resources operate and is not a market based mechanism, the constraint was developed to be used only under very limited circumstances. The ISO enforces the minimum state of charge constraint only during critical hours when the reliability unit commitment process projects a supply shortfall. These conditions occurred on only 14 days in 2020, 6 days in 2021, and 14 days in 2022. The minimum state of charge requirement is limited by design in that it: 1) only applies to resource adequacy resources, 2) is only applied on the most constrained days, and 3) is only applied to discharge awards during critical hours.

When used, the minimum state of charge constraint ensures state of charge for storage resources during the most critical hours of the day. If the minimum state of charge constraint had not been in place during recent summer heatwave events, storage resources would have been further depleted and required considerable manual effort by operators to preserve the necessary state of charge for later in the day. Though operators took manual actions when the constraint was enforced, the constraint obviated the need to take other significant manual actions, including determining the current state of charge, the target state of charge, and the amount of time needed to



reach the target state of charge for each storage resource, followed by entering an exceptional dispatch to charge the resource and updating the exceptional dispatch once the storage resource achieves the target state of charge. Overall, the minimum state of charge constraint worked as designed, ensuring that storage resources with resource adequacy obligations maintain state of charge during critical hours, and operators did not have to issue even more manual dispatches than necessary with the requirement.

The minimum state of charge constraint was developed as a temporary measure to be in place for summer 2021 and 2022, which would allow time for the development and implementation of energy storage enhancements that would replace the need for the minimum state of charge constraint. The replacement tools provide operators with greater state of charge visibility and increased abilities to issue exceptional dispatches rapidly and efficiently. It also includes opportunity cost compensation for storage resources exceptionally dispatched and required to hold state of charge for use later. These tools can replace the minimum state of charge constraint and continue to ensure reliable operation on days with the tightest conditions.

Although the policy development work to replace the minimum state of charge constraint was completed in the energy storage enhancements initiative, the software development for these improvements will not be fully implemented until fall 2023. Because these replacement features will not be in place before summer 2023, Management proposes to continue to apply the existing minimum state of charge constraint under limited specified conditions until development and implementation of the new tool and market rules is complete, but no later than September 30, 2023.

## **STAKEHOLDER POSITIONS**

Several stakeholders expressed support for the extension of the minimum state of charge constraint provided the ISO minimizes the duration of the extension. Other stakeholders—primarily storage operators and generation representatives—generally opposed the extension of the minimum state of charge constraint. These stakeholders requested the ISO develop the replacement tools prior to summer 2023, asserting that the minimum state of charge constraint disadvantages storage resources, and the ISO already expressly committed to retire the requirement after two years of use.

In response to stakeholder feedback, Management updated the proposed sunset date from September 30, 2024 to September 30, 2023 in the final proposal. The ISO is committed to developing and implementing the replacement tools as expeditiously as possible, and has prioritized the software development for these tools. Management originally proposed the September 30, 2024 sunset date to ensure continuity in the event of unanticipated delays in the software development process. However, given stakeholder concerns and the ISO's focus on prioritizing the development of the replacement tools, the 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.

## **CONCLUSION**

Management requests the ISO Board of Governors approve Management's minimum state of charge extension proposal described in this memorandum. This proposal will extend the use of the minimum state of charge constraint until September 30, 2023, allowing time for the implementation of new exceptional dispatch functionality and associated settlement rules from the energy storage enhancements initiative.