



California Independent
System Operator Corporation

September 19, 2022

The Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

**Re: California Independent System Operator Corporation
Docket No. ER22- ____-000**

**Tariff Amendment to Prevent Unwarranted Bid Cost Recovery
Payments to Storage Resources, and
Request for Effective Date One Day After Filing**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) submits this tariff amendment to address a market design issue identified by the Department of Market Monitoring (DMM) that affects energy storage resources. Over the past year, storage resources have become a critical and growing part of the fleet the CAISO relies on for reliable operations. Most recently, during the historic heatwave, storage resources played a critical role in supporting reliable operations during the net load peak. Prior to the heatwave, the CAISO worked with DMM to address a market design issue that under specific conditions affects the bid cost recovery of storage resources awarded ancillary services. Now that the CAISO has returned to normal operations, the CAISO is submitting this filing to establish a market rule change that removes the potential for adverse market outcomes while the CAISO works with stakeholders to explore any other potential solutions in addition to this proposed change.

The CAISO's proposed tariff amendment would prevent energy storage resources providing ancillary services from receiving unwarranted real-time

market bid cost recovery payments in a narrowly-defined scenario.¹ The CAISO's market optimization enforces a constraint (the Ancillary Service State of Charge Constraint) to ensure storage resources have sufficient state of charge to meet the requirements of their ancillary services awards. The CAISO proposes to prevent storage resources from receiving real-time bid cost recovery for real-time market intervals in which the Ancillary Service State of Charge Constraint requires a storage resource to charge or discharge.

This amendment remedies unintended market outcomes producing unwarranted bid cost recovery payments during these intervals. To address this issue immediately and prevent the payments in these cases, the CAISO respectfully requests that the Commission waive its notice requirement to allow the tariff revisions contained in this filing to go into effect one day after the date of this filing, September 20, 2022. The CAISO will implement these changes on recalculation settlement statements as part of its normal settlements process. For this reason, the CAISO does not request a shortened comment period or an expedited Commission order accepting this amendment. The CAISO also is immediately initiating a process to discuss with stakeholders what, if any, other longer-term enhancements might be made to the tariff to address this issue. The CAISO will submit any tariff revisions resulting from the stakeholder process for Commission acceptance.

I. Executive Summary

Storage resources are an important and growing part of the resource mix in the CAISO's markets. Only in the past year have large quantities of storage resources begun participating in the CAISO markets in a meaningful way, having become a critical component of the fleet the CAISO relies on for reliable operations. During the recent historic heatwave, storage resources played a critical role in supporting reliable operations during the CAISO's net load peak. Because of their recent growth, the CAISO and interested stakeholders are learning how storage resources impact the CAISO's market design.

Storage resources can provide both energy and ancillary services. Under the CAISO tariff, all resources providing ancillary services must be dispatchable to provide the procured level of ancillary service on a continuous basis for at least 30 minutes in the real-time market. This requirement helps ensure that resources with ancillary service awards can provide those services. Storage resources are especially vulnerable to not meeting this requirement because

¹ The CAISO submits this filing pursuant to section 205 of the Federal Power Act, 16 U.S.C. § 824d. Capitalized terms not otherwise defined herein have the meanings set forth in the CAISO tariff. References to numbered sections are references to sections of the CAISO tariff unless otherwise indicated.

their ability to meet an award at a particular point in time depends on their state of charge, which depends on preceding dispatches. To address this risk and ensure that storage resources are positioned to comply with the 30-minute ancillary service rule, the CAISO's software enforces the Ancillary Service State of Charge Constraint to ensure those storage resources that have elected to provide ancillary services have a sufficient state of charge to actually provide them in real-time for at least 30 minutes.

Earlier this year, DMM discovered undue market outcomes resulting from regulation down awards to or self-provisions by storage resources for long periods when paired with high energy bids from those resources. In these circumstances, storage resources receive unusually large and unwarranted bid cost recovery payments. DMM has informed the CAISO these relatively high bid cost recovery payments have resulted from conduct that does not appear designed to exploit or manipulate existing rules. Nevertheless, DMM and the CAISO agree the bid cost recovery payments are unwarranted.

Bid cost recovery under the CAISO tariff is designed to provide "uplift payments" to a resource when revenues from the sale of energy and ancillary services do not cover the resource's start-up, minimum load, and energy bid costs over the course of a day. Without the prospect of these uplift payments, resources would have an incentive to add a risk premium to their market offers to cover the possibility of not recovering these costs. This could lead to inefficient market outcomes, with higher overall costs for energy. To avoid that outcome, the CAISO provides bid cost recovery payments. Storage resources, however have neither start-up costs nor minimum load costs and generally have fast ramp rates. Although they may have other opportunity costs, they lack the conventional drivers for bid cost recovery.

Based on its analysis, DMM identified the cause of the high bid cost recovery payments to storage resources. When a storage resource bids or self-schedules to provide regulation down, and then receives multiple schedules with regulation down awards, the resource may charge repeatedly to meet the regulation down schedules, resulting in a high state of charge. To comply with a subsequent 30-minute-performance requirement, however, the storage resource providing regulation down must hold headroom below its maximum state of charge to ensure its ability to provide the ancillary service. When the resource is charged above the headroom needed to comply with the tariff, a constraint in the optimization software will dispatch the resource to discharge energy so a sufficient amount of headroom can be maintained to meet this requirement.²

² The reverse could also occur—charging to create headroom to meet regulation up schedules—but has not been observed frequently, and would be unlikely to result in high bid cost recovery.

This is the Ancillary Services State of Charge Constraint.

DMM observed situations where discharge instructions resulting from this constraint were uneconomic because the prevailing LMPs were below the storage resource's energy bids. As a result, the storage resources were eligible to receive bid cost recovery uplift payments because of the difference between their bids and the prevailing prices during the interval when the resource was issued instructions to discharge. Because the storage resources' bids were at or near the bid cap, the bid cost recovery payments were abnormally high. Both DMM and the CAISO have concluded that these excess bid cost recovery payments under these conditions cannot be justified by the principles underlying bid cost recovery. In these circumstances, the storage resources' high bids reflect a market strategy, namely, avoiding energy dispatches in certain intervals. They do not represent the resources' actual bid costs. Further, the absence of bid cost recovery payments would not create incentives for these resources to bid in ways that would undermine the market's efficiency. If anything, the opportunity to receive bid cost recovery payments drives the incentive for high bids that undermines market efficiency.

These excessive bid cost recovery payments cause customers to bear significant and unjustified uplift costs. Individual storage resources received bid cost recovery payments ranging from \$100,000 to \$240,000 in just a single day in March 2022. And high bid cost recovery payments have continued since then. These circumstances have accounted for about \$7 million in uplift payments, and more than half of all real-time market bid cost recovery payments to storage resources in 2022 so far.

The CAISO proposes to address these unintended consequences and unwarranted uplift payments by eliminating specific bid cost recovery payments to storage resources providing ancillary services during real-time market intervals when the constraint moves the resource to ensure it has sufficient state-of-charge to satisfy the tariff's ancillary service requirements. This change only applies in limited circumstances. The CAISO's proposal will not affect the availability of bid cost recovery payments to storage resources during any other intervals.

The CAISO also proposes to describe the constraint as expressly as possible in the tariff so all storage resources and scheduling coordinators are aware of it in the future. Scheduling coordinators and resources that have received these bid cost recovery payments understand the constraint, and it is currently documented in a business practice manual as an additional implementation detail for ensuring compliance with the tariff's requirement to provide ancillary service on a continuous basis for 30 minutes. Nevertheless, the CAISO believes the circumstances discussed in this filing show why it is now appropriate to include the constraint as expressly as possible in the tariff.

This filing effectively explains to market participants how storage resources can pair ancillary service bids with high energy bids to inflate bid cost recovery uplift payments inappropriately. For this reason, the CAISO respectfully submits good cause exists to allow this tariff amendment to take effect as soon as possible, one day after the date of this filing. Due to the immediate need to remedy the issues described above, the CAISO did not undertake a stakeholder process prior to this filing.³ The CAISO is initiating a stakeholder process to discuss the circumstances justifying this tariff amendment and explore possible additional market rule enhancements to address these issues.

II. Background

A. The Bid Cost Recovery Mechanism

Scheduling coordinators for resources submit three-part bids, which include start-up, minimum load, and energy bid costs. The CAISO's market optimization considers the start-up and minimum load costs in optimizing for the least-cost commitment or dispatch of all resources. Only the energy bid cost, however, is used in setting the LMP for a given market interval. This creates a risk that the rents from the difference between the LMP and the resource's energy bid costs will provide insufficient revenue to compensate its start-up and minimum load costs. Also, because of inter-temporal constraints such as ramping rates, minimum run times, and minimum up times, a resource's energy or ancillary services bid may set the price in one interval in which the CAISO commits the resource, but that resource may not be marginal—its energy bid price is above the market clearing price—in other intervals when it also must run to meet those inter-temporal constraints.⁴ Bid cost recovery uplift payments address these risks.

Absent bid cost recovery, resources likely would seek to avoid unrecovered costs by internalizing these risks in their energy bids: They would add a risk premium to their energy bids. This reaction, while rational from the scheduling coordinator's perspective, would impact the efficiency of the CAISO market solution because the LMP no longer would reflect the marginal cost of providing energy on the CAISO system. Bid cost recovery helps avoid this outcome. The CAISO recovers the costs of bid cost recovery payments through

³ Doing so would have notified market participants of a bidding strategy to obtain excessive bid cost recovery payments.

⁴ *Cal. Indep. Sys. Op. Corp.*, 135 FERC ¶ 61,110 at PP 7 *et seq.* (2011).

uplift payments allocated out to a combination of measured demand and virtual bidders.⁵

B. Storage Resources in the CAISO Markets

Storage resources differ from other types of resources because they do not produce energy, but store it and release it onto the grid at a later time. Simply put, they charge energy and discharge it later. Storage resources participating in the CAISO markets generally use the CAISO's non-generator resource model, which tracks each resource's state of charge.⁶ The CAISO introduced the non-generator resource model in 2012, and since then the CAISO has added several parameters to help optimize storage resources. Most recently, in 2021, the CAISO filed for Commission acceptance of tariff revisions to help optimize the performance of storage resources and improve the CAISO markets. The revisions included making storage resources ineligible for bid cost recovery of real-time market revenue shortfalls in the hour the resource submits an end-of-hour state of charge bid parameter, the hour preceding an end-of-hour state of charge bid, and the hour preceding a self-schedule.⁷ The Commission accepted the tariff revisions, stating in relevant part that while it "accept[ed] CAISO's proposal to make energy storage resources ineligible for bid cost recovery of real-time market revenue shortfalls in" the timeframes specified in the revisions, "we nonetheless encourage CAISO to monitor and gauge the impacts of the bid cost recovery provisions to energy storage resource settlements."⁸

The CAISO administers day-ahead and real-time wholesale electricity markets. Storage resources can participate in those markets by bidding or self-providing energy or ancillary services.⁹ The CAISO does not require any resource to provide ancillary services. The ancillary services a storage resource

⁵ See existing tariff section 11.8.6.

⁶ See existing tariff section 30.5.6.1. The tariff defines state of charge to mean the energy available to CAISO markets from a non-generator resource or storage device. CAISO tariff appendix A, existing definition of "State of Charge." For the sake of clarity, this transmittal letter distinguishes between existing tariff provisions (*i.e.*, provisions in the current CAISO tariff), revised tariff provisions (*i.e.*, existing tariff provisions that the CAISO proposes to revise in this filing), and new tariff provisions (*i.e.*, tariff provisions that the CAISO proposes to add in this filing).

⁷ See transmittal letter for Energy Storage and Distributed Energy Resources Phase 4 – Tariff Revisions, Docket No. ER21-2779-000, at 3-5 (Aug. 27, 2021).

⁸ *Cal. Indep. Sys. Operator Corp.*, 177 FERC ¶ 61,051 at P 28 (2021).

⁹ A storage resource must have a rated capacity of 100 kilowatts or more to be eligible to participate in the CAISO markets. Existing tariff section 4.6.3.2; tariff appendix A, existing definition of "Participating Generator."

can elect to provide include regulation, which can be either regulation up or regulation down. Where a conventional generator would ramp up or down to provide regulation, a storage resource providing regulation up would discharge energy, and a storage resource providing regulation down would charge. Unlike conventional generators, storage resources generally can move almost instantaneously to any point in their operating ranges. Charging or discharging pursuant to CAISO ancillary service dispatches helps balance load and supply to regulate the system frequency at 60 Hz.¹⁰ Storage resources also can elect to provide spinning reserve¹¹ and non-spinning reserve.¹²

The CAISO tariff requires a facility participating in the markets to provide data identifying each of its resources, including storage. The CAISO maintains its master file as an electronic repository for such data.¹³ The information a supply resource can provide to the master file (through its scheduling coordinator) includes physical operating limitations such as the minimum state of charge and the maximum state of charge for a storage resource, expressed in megawatts (MW) for the storage resource's capacity limits and in megawatt-hours (MWh) for the storage resource's energy limits.¹⁴ The CAISO uses those master file values as the minimum state of charge and the maximum state of charge available for the storage resource in the day-ahead market.

The tariff also requires that all storage and other resources providing ancillary services must be dispatchable to provide the procured level of ancillary service on a continuous basis for at least 30 minutes in the real-time market.¹⁵

¹⁰ Specifically, the CAISO uses regulation up and regulation down to control the operating level of a resource within a prescribed area in response to a change in system frequency, tie line loading, or the relation of these to each other so as to maintain the target system frequency and/or the established interchange with other balancing authority areas within predetermined regulation limits, consistent with reliability standards. Tariff appendix A, existing definition of "Regulation."

¹¹ Spinning reserve is the portion of unloaded synchronized resource capacity that is immediately responsive to system frequency, is capable of being loaded in 10 minutes, and is capable of running for at least 30 minutes from the time it reaches its award capacity. Tariff appendix A, existing definition of "Spinning Reserve."

¹² Non-spinning reserve is the portion of resource capacity that is capable of being synchronized and ramping to a specified load in 10 minutes (or that is capable of being interrupted in 10 minutes) and is capable of running (or being interrupted) for at least 30 minutes from the time it reaches its award capacity. Tariff appendix A, existing definition of "Non-Spinning Reserve."

¹³ Existing tariff sections 4.6.4 and 4.6.11; tariff appendix A, existing definition of "Master File."

¹⁴ Existing tariff section 27.9.

¹⁵ The 30-minute requirement applies to regulation (existing tariff section 8.4.1.1(g) and

This requirement means, for example, that a storage resource must hold a state of charge at a level that enables the storage resource to respond to automatic generation control (AGC) signals for regulation at the awarded level for those 30 minutes.¹⁶ For example, if a storage resource receives an award for 10 MW of regulation down in the real-time market, it is required to hold a real-time state of charge of 5 MWh (10 MW multiplied by 0.5 hour) below the maximum state of charge listed for the resource in the master file, to ensure the resource's ability to deliver the regulation down for the entire 30-minute period.¹⁷ In simple terms, the storage resource must have sufficient "headroom" so it can continue to charge to absorb energy, thereby helping to balance load and supply to maintain the system frequency. If it is fully charged, it cannot continue to provide regulation down, and it must discharge to create headroom to meet its next regulation down schedule.

To ensure compliance with the 30-minute tariff requirement, the CAISO enforces the Ancillary Service State of Charge Constraint in the real-time market to hold a storage resource's real-time minimum and maximum states of charge. This constraint is documented in the BPM for market operations.¹⁸ But for the Ancillary Service State of Charge Constraint, the AGC signals could result in a storage resource becoming fully discharged in the case of regulation up or fully charged in the case of regulation down, thereby preventing the storage resource from complying with the 30-minute requirement for subsequent intervals when

tariff appendix K, existing section A 1.1.4) and to spinning and non-spinning reserve (existing tariff section 8.4.3 and tariff appendix K, existing sections B 1.4 and C 1.2).

¹⁶ Storage resources that provide regulation up and regulation down are subject to four-second signals from the AGC anywhere within the range of regulation the storage resources are providing.

¹⁷ Business practice manual for market operations, section 2.5.9 (BPM for market operations). Conversely, if the storage resource receives an award for 10 MW of regulation up in the real-time market, it is required to hold a minimum of at least 5 MWh (*i.e.*, 10 MW multiplied by 0.5 hour) of state of charge. *Id.* The BPM for market operations is available on the CAISO website at <https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Market%20Operations>.

¹⁸ BPM for market operations, section 7.8.2.5. Prior to this filing, the CAISO determined it was appropriate to include the Ancillary Service State of Charge Constraint in a BPM. The Commission has explained that "[d]ecisions regarding whether an item should be placed in a tariff or in a business practice manual are guided by the Commission's rule of reason policy, under which provisions that significantly affect rates, terms, and conditions of service, are readily susceptible of specification, and are not generally understood in a contractual agreement must be included in a tariff, while items better classified as implementation details may be included only in the business practice manual." *Midcontinent Indep. Sys. Operator, Inc.*, 169 FERC ¶ 61,137 at P 252 (2019) (internal quotation marks omitted). With regard to the CAISO, the Commission has explained that "[t]he Business Practice Manuals exist to provide additional implementation details and transparency about the CAISO's operations to market participants." *Cal. Indep. Sys. Operator Corp.*, 122 FERC ¶ 61,271 at P 84 (2008).

that resource has an ancillary service award or self-provision. If a resource suddenly cannot meet its ancillary service schedule, the real-time market and CAISO operators must procure that capability elsewhere, or system reliability is at risk.

C. Excessively High Bid Cost Recovery Payments to Storage Resources This Year

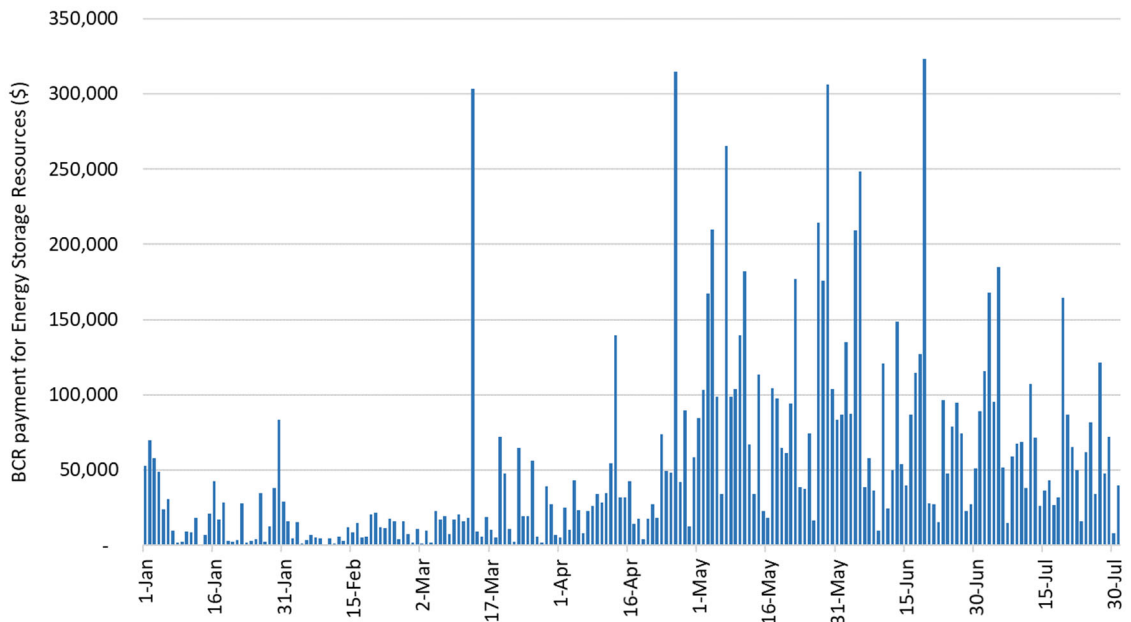
DMM is the internal market monitor for the CAISO and routinely reviews bid cost recovery payments, its recipients, and the underlying drivers of those payments. DMM's review includes bid cost recovery payments made to storage resources, which have greatly increased their participation in the CAISO markets over the past several years.¹⁹ High or frequent bid cost recovery payments can indicate inefficient market outcomes and storage resources, especially, would not be expected to receive significant real-time bid cost recovery payments. They do not have start-up or minimum load costs and generally can ramp quickly. Although they may require bid cost recovery in some instances, storage resources generally are unlikely to face the inter-temporal constraints that cause a resource to be infra-marginal in one interval and supra-marginal in a closely related interval.²⁰

In March 2022, DMM identified unusually high real-time bid cost recovery payments made on a few specific days to some storage resources. On certain days in subsequent months, some storage resources also received comparable abnormally high bid cost recovery payments.²¹ These spikes in real-time bid cost recovery payments to storage resources are depicted in the following chart:

¹⁹ See *Cal. Indep. Sys. Operator Corp.*, 175 FERC ¶ 61,168 at P 15 (2021) ("CAISO states that it is experiencing significant growth in the number of storage resources on its grid, growing from approximately 200 MW in summer 2020 to an anticipated 1,800 MW available for dispatch by summer 2021."); *Cal. Indep. Sys. Operator Corp.*, 177 FERC ¶ 61,051 at P 9 (stating that the CAISO "has over 1,000 MW of energy storage resources in its markets and anticipates close to 2,000 MW by the end of the year.").

²⁰ I.e., below the marginal price of energy and then at or above the marginal price of energy.

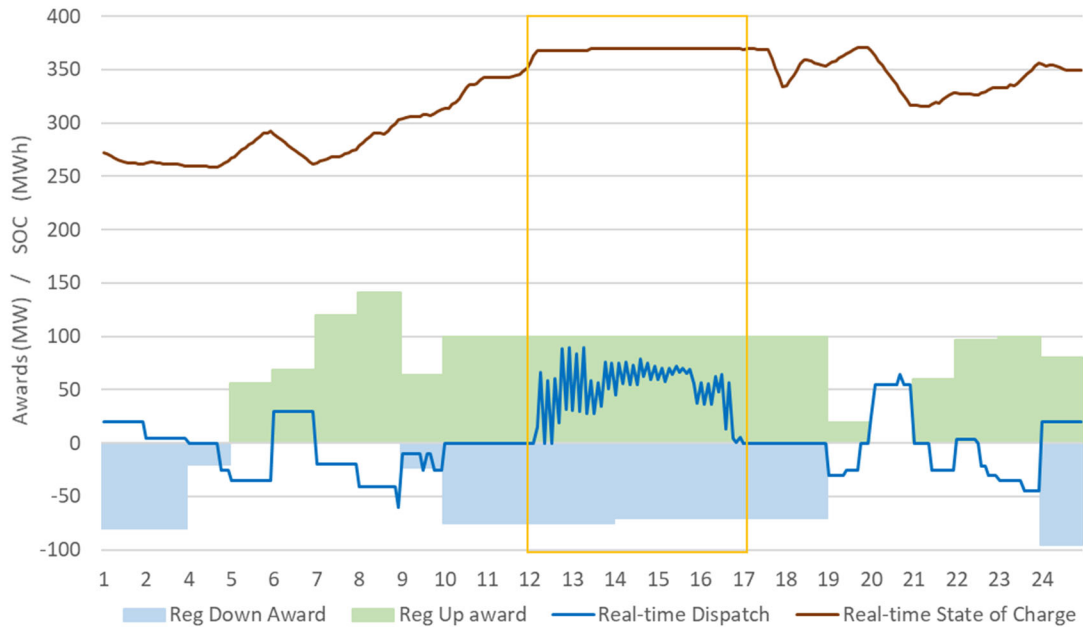
²¹ DMM addressed this issue on pages 5-6 and 12 of comments it submitted on August 4, 2022 in an ongoing CAISO stakeholder process regarding energy storage enhancements (DMM Comments). <https://stakeholdercenter.caiso.com/StakeholderInitiatives/Energy-storage-enhancements>.



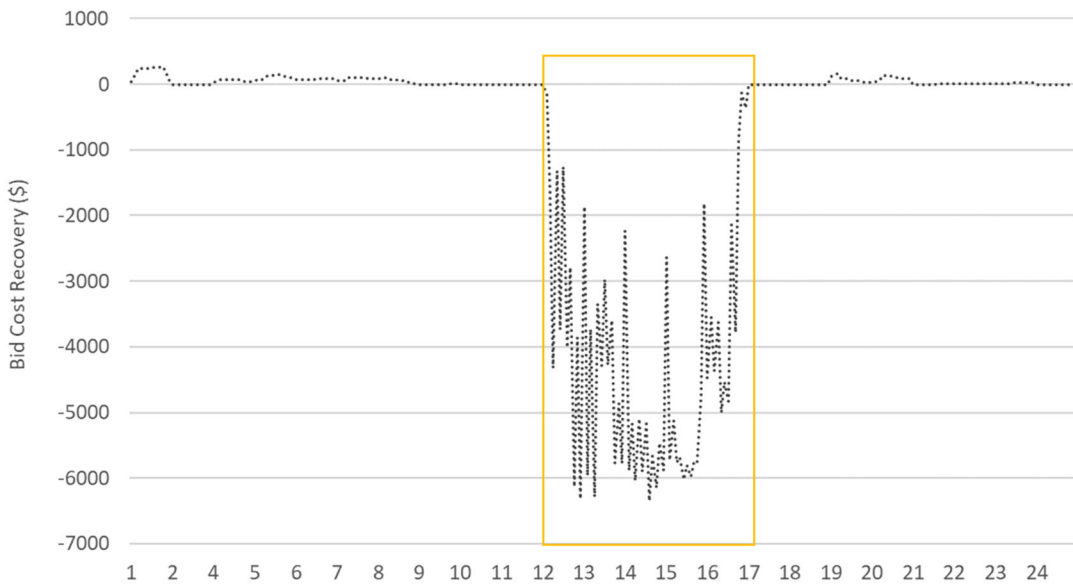
The chart shows the aggregate real-time bid cost recovery payments to storage resources on the days depicted. During 2022, individual storage resources have received as much \$240,000 in bid cost recovery payments in a single day.

DMM determined these unusually high bid cost recovery payments to storage resources resulted from a combination of ancillary service awards or self-provisions in the real-time market, particularly for regulation down, coupled with relatively high energy bids.²² Specifically, some storage resources received multiple consecutive hours of regulation down awards, which resulted in charging the storage resources. Over the real-time market intervals the storage resources provided regulation down, the state of charge for each such storage resource increased and eventually hit the 30-minute real-time requirement. The Ancillary Service State of Charge Constraint enforces headroom from the maximum state of charge set forth in the master file to allow storage resources to continue to meet the 30-minute requirement in the tariff. Once this threshold was reached in real-time on the days depicted in the chart, the CAISO market optimization software dispatched these storage resources to discharge energy to meet the lower maximum state of charge constraint in future intervals. The following chart illustrates this dynamic for the part of the day within the area in yellow where the state of charge (line in red) reached a level in which the market dispatched the resource for energy (line in blue) while it had a regulation down award (area in green). The second chart with the dotted line in grey shows the bid cost recovery accrued during that period.

²² *i.e.*, to discharge energy.



Because the discharge instructions appeared uneconomic—prevailing LMPs were below the resources' energy bids—the storage resources were eligible to receive bid cost recovery payments for the difference between the bids and the prevailing LMPs during the interval when the storage resource was issued instructions to discharge.



Because these storage resources' energy bids were at or near the bid cap, their bid cost recovery payments were abnormally high. Rather than submitting energy bids based on the actual costs of providing energy, storage resource scheduling coordinators may submit energy bids based on opportunity costs or merely the desire to avoid being dispatched to provide energy. Deep or frequent charge and discharge cycles can degrade batteries over time, which is why many storage resources elect to provide capacity and ancillary services as much as possible rather than conventional energy. These bidding strategies are not *per se* illegitimate, but they do not warrant the extreme bid cost recovery payments certain storage resources received on top of the revenues they received for discharging energy.²³

The CAISO believes this is an inefficient market outcome causing storage resources to receive excessive and unwarranted bid cost recovery payments in certain circumstances, requiring customers to pay for these inappropriate uplift payments. Absent tariff changes, if a storage resource must charge or discharge in order to meet requirements to provide certain ancillary services in real-time, it could pair regulation bids or self-schedules with high energy bids to inflate bid cost recovery payments and overall collected revenue, without changing actual operating patterns.²⁴ Although this issue may simply be the result of the CAISO, resource owners, and scheduling coordinators' lack of significant experience with the storage fleet in the CAISO market, failing to address the situation now will result in more, and perhaps greater, undue bid cost recovery payments. Addressing this issue promptly is consistent with the Commission's guidance that the CAISO should monitor and gauge the impacts of the bid cost recovery provisions on energy storage resource settlements.²⁵

D. Need for Prompt Action to Address the Issue

The CAISO believes immediate action is necessary to prevent future excessively high bid cost recovery payments to storage resources under the circumstances above. Undertaking a stakeholder initiative to explore options for addressing the issue before the unanticipated and adverse market outcomes are addressed could have the perverse effect of informing scheduling coordinators

²³ As explained below, the CAISO does not attribute misfeasance to this bidding behavior, but it is inappropriate for resources in these circumstances to reflect opportunity costs through their energy bids. The ancillary service payment already provides an opportunity to recover those costs. Rather than increasing their energy offers, these resources should reflect their opportunity costs through ancillary service offers.

²⁴ In other words, without producing more energy or providing more ancillary services.

²⁵ *Cal. Indep. Sys. Operator Corp.*, 177 FERC ¶ 61,051 at P 28.

for storage resources how to exploit this situation, without a solution in place. Therefore, the CAISO sought and received approval for this tariff amendment from its Board of Governors and the Western Energy Imbalance Market (WEIM) Governing Body on an expeditious basis without an advance stakeholder process.²⁶ The WEIM Governing Body authorized the CAISO to submit this tariff amendment at a meeting held on August 30, 2022. The CAISO Board of Governors authorized the CAISO to submit this tariff amendment at a meeting held on August 31, 2022.²⁷

The CAISO also is immediately initiating a process to discuss with stakeholders what, if any, other longer-term enhancements might be made to the tariff to address this issue. The CAISO will submit any tariff revisions resulting from the upcoming stakeholder process for Commission acceptance.

III. Proposed Tariff Revisions

The CAISO proposes to revise its tariff to prevent excessively high bid cost recovery payments to storage resources in the circumstances described in Section II of this transmittal letter. The CAISO also proposes to make the Ancillary Service State of Charge Constraint as express as possible in the tariff so all scheduling coordinators and resource owners understand it fully.

First, the CAISO proposes to revise the tariff to specify that storage resources are ineligible to receive bid cost recovery payments for real-time market intervals in which the Ancillary Service State of Charge Constraint applies.²⁸ Specifically, the storage resource will be ineligible to receive RTM Bid Cost Shortfalls, which represent the negative amount resulting from the difference between a resource's RTM Bid Cost and its RTM Market Revenue.²⁹ Storage resources are already under similar provisions when they submit self-schedules or use the CAISO's end-of-hour state of charge bid parameter to prioritize a particular state of charge over their bid curve.³⁰ Bid cost recovery is a

²⁶ The Commission has previously accepted CAISO tariff amendments in the absence of a stakeholder process. See *Cal. Indep. Sys. Operator Corp.*, 174 FERC ¶ 61,037 (2021); *Cal. Indep. Sys. Operator Corp.*, 151 FERC ¶ 61,108 (2015).

²⁷ Attachment C to this tariff amendment contains a memorandum on the subject dated August 31, 2022 from Anna McKenna, Vice President of Market Policy and Performance, to the CAISO Board of Governors (Board Memorandum).

²⁸ Revised tariff section 11.6.6.

²⁹ *Id.* "RTM Bid Cost Shortfall," Appendix A to the CAISO tariff.

³⁰ See Section 11.6.6 of the CAISO tariff. *Cal. Indep. Sys. Op. Corp.* 177 FERC ¶ 61,051 at P 28 (2021) ("We agree that this limitation will address concerns regarding over-recovery and gaming, and that a resource should bear the cost of an uneconomic dispatch if it arises from CAISO respecting that resource's preferred end-of-hour state of charge target").

daily calculation among various costs and revenues for each resource. Under the CAISO's proposal, the storage resource would not receive RTM Bid Cost Shortfalls in those real-time market intervals where the market optimization software dispatches the resource to ensure it has sufficient state of charge to meet its ancillary service requirements.

This revision is just and reasonable because it will prevent recurrence of the excessively high, unjustified bid cost recovery payments to storage resources the CAISO market has experienced. Further, ineligibility for bid cost recovery in the limited circumstances proposed here is consistent with existing principles underlying bid cost recovery. As noted, this class of resources faces no appreciable start-up or minimum load costs. Also, their fast ramping capabilities limits the sort of inter-temporal constraints that could lead a resource to be infra-marginal in one interval and then hold online when it becomes supra-marginal because of inter-temporal constraints. Although storage resources may receive legitimate bid cost recovery in some cases, reducing bid cost recovery in the circumstances described here would not create incentives for storage resources to internalize new costs within their existing bids.

The CAISO understands that some storage resources may view their \$1,000/MWh energy bids as legitimately indicating a strong preference not to be dispatched in a certain interval and, as such, reflect an opportunity cost that appropriately should be considered through bid cost recovery. Although the CAISO does not attribute misfeasance to this bidding behavior, it is inappropriate for resources in these circumstances to reflect that opportunity cost through their energy bids because the ancillary service payment already provides an opportunity to recover those costs. Rather than increasing their energy offers, these resources should reflect their opportunity costs through ancillary service offers.

Second, although the CAISO tariff already describes the 30-minute continuous ancillary service capability requirement, the CAISO proposes to make the Ancillary Service State of Charge Constraint express in the tariff so resource owners and scheduling coordinators understand the market optimization will enforce the requirement if they do not meet it on their own.³¹ Although the CAISO originally included the Ancillary Service State of Charge Constraint solely in the BPM for market operations as an implementation detail, the CAISO believes that making the constraint more transparent by including it in the tariff is warranted.

³¹ Revised tariff sections 8.4.1.1(g) and 8.4.3.

IV. Effective Date and Request for Waiver of Notice Requirement

The CAISO respectfully requests the Commission grant waiver of its prior notice requirement to accept the tariff revisions contained in this filing effective the day after the filing was submitted, namely, September 20, 2022.³² Good cause exists to grant the requested waiver. Permitting the tariff revisions to go into effect on September 20 will expeditiously address the issue of storage resources' unwarranted high bid cost recovery payments and immediately prevent resources from taking advantage of the existing rules. For good cause shown, the Commission has previously accepted CAISO tariff revisions that went into effect the day after the submittal of a tariff amendment in order to address financial settlement issues, including issues with bid cost recovery payments.³³ Therefore, granting an effective date of September 20, 2022 is appropriate.

The CAISO does not, however, request that the Commission establish a shortened comment period or issue an order on this tariff amendment by a particular date. The tariff revisions contained in this filing solely concern financial settlements, which means the CAISO can adjust bid cost recovery payments in the future as part of its standard settlements cycle as appropriate to reflect Commission acceptance of the tariff amendment.

³² Specifically, pursuant to section 35.11 of the Commission's regulations, 18 C.F.R. § 35.11, the CAISO respectfully requests waiver of the notice requirement contained in section 35.3(a)(1) of the Commission's regulations, 18 C.F.R. § 35.3(a)(1), to allow the tariff revision to go into effect on September 20.

³³ See *Cal. Indep. Sys. Operator Corp.*, 151 FERC ¶ 61,108 at PP 11, 20.

V. Communications

Correspondence and other communications regarding this filing should be directed to:

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VI. Service

The CAISO has served copies of this filing on the California Public Utilities Commission, the California Energy Commission, and all parties with scheduling coordinator agreements under the CAISO tariff. In addition, the CAISO has posted a copy of the filing on the CAISO website.

VII. Contents of Filing

In addition to this transmittal letter, this filing includes the following attachments:

Attachment A	Clean tariff sheets incorporating the tariff revisions proposed in this filing
Attachment B	Tariff sheets showing in red-lining format the proposed tariff revisions
Attachment C	Board Memorandum

VIII. Conclusion

For the reasons set forth in this filing, the CAISO respectfully requests that the Commission accept the proposed tariff revisions contained in the filing effective September 20, 2022.

Respectfully submitted,

/s/ William H. Weaver

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Attachment A – Clean Tariff
Bid Cost Recovery Tariff Amendment
California Independent System Operator Corporation
September 19, 2022

8.4.1.1 Regulation

A resource offering Regulation must have the following operating characteristics and technical capabilities:

- (a) it must be capable of being controlled and monitored by the CAISO EMS by means of the installation and use of a standard CAISO direct communication and direct control system, a description of which and criteria for any temporary exemption from which, the CAISO shall publish on the CAISO Website;
- (b) it must be capable of achieving at least the Ramp Rates (increase and decrease in MW/minute) stated in its Bid for the full amount of Regulation capacity offered;
- (c) the Regulation capacity offered must not exceed the maximum Ramp Rate (MW/minute) of that resource times ten (10) minutes;
- (d) the resource to CAISO Control Center telemetry must, in a manner meeting CAISO standards, include indications of whether the resource is on or off CAISO EMS control at the resource terminal equipment;
- (e) the resource must be capable of the full range of movement within the amount of Regulation capability offered without manual resource operator intervention of any kind;
- (f) each Ancillary Service Provider must ensure that its CAISO EMS control and related SCADA equipment for its resource are operational throughout the time period during which Regulation is required to be provided;
- (g) Regulation capacity offered must be dispatchable on a continuous basis for at least sixty (60) minutes in the Day-Ahead Market and at least thirty (30) minutes in the Real-Time Market after issuance of the Dispatch Instruction. The CAISO will measure continuous Energy from the time a resource reaches its award capacity. In the Real-Time Market, where a storage resource using the Non-Generator Resource model will not have sufficient State of Charge to meet its Ancillary Services Schedule, the CAISO will dispatch the storage resource to have sufficient State of Charge to meet its Ancillary Services Schedule. Scheduling Coordinators for Non-Generator Resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time

Market to offer their full capacity as Regulation may request the use of Regulation Energy Management as described in Section 8.4.1.2; and

- (h) Regulation capacity offered must meet or exceed the minimum performance threshold of twenty-five (25) percent measured accuracy as specified in Section 8.2.3.1.1.

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8.4.3 Ancillary Service Capability Standards

The providers of Ancillary Services under this CAISO Tariff must comply with the following capability standards for Spinning Reserve and Non-Spinning Reserve Capability. Each resource or external import of a System Resource scheduled to provide Spinning Reserve and each resource providing Non-Spinning Reserve must be capable of converting the full capacity reserved to Energy production within ten (10) minutes after the issue of the Dispatch Instruction by the CAISO. Each resource scheduled to provide Spinning Reserve and each resource scheduled to provide Non-Spinning Reserve must be capable of maintaining that output or scheduled Interchange for at least thirty (30) minutes from the point at which the resources reaches its award capacity. In the Real-Time Market, where a storage resource using the Non-Generator Resource model will not have sufficient State of Charge to meet its Ancillary Services Schedule, the CAISO will dispatch the storage resource to have sufficient State of Charge to meet its Ancillary Services Schedule.

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11.6.6 Settlements of Non-Generator Resources

Settlements for Energy generated or consumed by a Non-Generator Resource or a resource using Non Generator Resource Generic Modeling functionality will reflect the applicable PNode or Aggregated PNode. For such resources comprising a single PNode, settlement for Energy transactions will reflect the LMP at that PNode. For such resources comprising multiple PNodes settlement for Energy transactions will reflect the weighted average LMP of the PNode(s) based on the applicable Generation Distribution Factors submitted through the resources' Bid or as registered in the Master File. Consistent with the provisions of Section 11.5.2, the CAISO will impose UIE on a resource's Scheduling Coordinator if the

resource does not follow a Dispatch Instruction. When operating in a negative range between P_{Min} and 0, the CAISO will not consider a Non-Generator Resource or a resource using Non-Generator Resource Generic Modeling functionality as Measured Demand so long as the resource can generate Energy. If a Non-Generator Resource operates solely as dispatchable demand response, the CAISO will treat the resource as Measured Demand. Where Scheduling Coordinators elect to submit end-of-hour state-of-charge targets, storage resources participating as Non-Generator Resources will be ineligible for RTM Bid Cost Shortfalls in the two hours preceding the scheduled Operating Hour. Where Scheduling Coordinators elect to submit Self-Schedules in the CAISO Real-Time Markets, storage resources participating as Non-Generator Resources will be ineligible for RTM Bid Cost Shortfalls in the hour preceding the scheduled Operating Hour. Where the CAISO dispatches storage resources participating as Non-Generator Resources to charge or discharge pursuant to Sections 8.4.1.1(g) or 8.4.3 for the Real-Time Market, they will be ineligible for RTM Bid Cost Shortfalls.

Attachment B – Marked Tariff
Bid Cost Recovery Tariff Amendment
California Independent System Operator Corporation
September 19, 2022

8.4.1.1 Regulation

A resource offering Regulation must have the following operating characteristics and technical capabilities:

- (a) it must be capable of being controlled and monitored by the CAISO EMS by means of the installation and use of a standard CAISO direct communication and direct control system, a description of which and criteria for any temporary exemption from which, the CAISO shall publish on the CAISO Website;
- (b) it must be capable of achieving at least the Ramp Rates (increase and decrease in MW/minute) stated in its Bid for the full amount of Regulation capacity offered;
- (c) the Regulation capacity offered must not exceed the maximum Ramp Rate (MW/minute) of that resource times ten (10) minutes;
- (d) the resource to CAISO Control Center telemetry must, in a manner meeting CAISO standards, include indications of whether the resource is on or off CAISO EMS control at the resource terminal equipment;
- (e) the resource must be capable of the full range of movement within the amount of Regulation capability offered without manual resource operator intervention of any kind;
- (f) each Ancillary Service Provider must ensure that its CAISO EMS control and related SCADA equipment for its resource are operational throughout the time period during which Regulation is required to be provided;
- (g) Regulation capacity offered must be dispatchable on a continuous basis for at least sixty (60) minutes in the Day-Ahead Market and at least thirty (30) minutes in the Real-Time Market after issuance of the Dispatch Instruction. The CAISO will measure continuous Energy from the time a resource reaches its award capacity. In the Real-Time Market, where a storage resource using the Non-Generator Resource model will not have sufficient State of Charge to meet its Ancillary Services Schedule, the CAISO will dispatch the storage resource to have sufficient State of Charge to meet its Ancillary Services Schedule. Scheduling Coordinators for Non-Generator Resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time

Market to offer their full capacity as Regulation may request the use of Regulation Energy Management as described in Section 8.4.1.2; and

- (h) Regulation capacity offered must meet or exceed the minimum performance threshold of twenty-five (25) percent measured accuracy as specified in Section 8.2.3.1.1.

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resource does not follow a Dispatch Instruction. When operating in a negative range between P_{Min} and 0, the CAISO will not consider a Non-Generator Resource or a resource using Non-Generator Resource Generic Modeling functionality as Measured Demand so long as the resource can generate Energy. If a Non-Generator Resource operates solely as dispatchable demand response, the CAISO will treat the resource as Measured Demand. Where Scheduling Coordinators elect to submit end-of-hour state-of-charge targets, storage resources participating as Non-Generator Resources will be ineligible for RTM Bid Cost Shortfalls in the two hours preceding the scheduled Operating Hour. Where Scheduling Coordinators elect to submit Self-Schedules in the CAISO Real-Time Markets, storage resources participating as Non-Generator Resources will be ineligible for RTM Bid Cost Shortfalls in the hour preceding the scheduled Operating Hour. Where the CAISO dispatches storage resources participating as Non-Generator Resources to charge or discharge pursuant to Sections 8.4.1.1(g) or 8.4.3 for the Real-Time Market, they will be ineligible for RTM Bid Cost Shortfalls.

Attachment C – Board Memo
Bid Cost Recovery Tariff Amendment
California Independent System Operator Corporation
September 19, 2022

Confidential – Executive Session

Memorandum

To: ISO Board of Governors
From: Anna McKenna, Vice President of Market Policy and Performance
Date: August 24, 2022
Re: **Decision on bid cost recovery for storage resources providing ancillary services**

This memorandum requires ISO Board of Governors action.

EXECUTIVE SUMMARY

In light of recent appreciable bid cost recovery payouts, Management proposes to disqualify energy storage resources that are providing ancillary services from receiving bid cost recovery payments for real-time market intervals in which the optimization moves the resource to ensure it has sufficient state-of-charge to meet ancillary service requirements.

This change is in response to unintended market outcomes that could be exploited by adverse market behavior identified by the ISO Department of Market Monitoring. High real-time energy bids combined with awarded regulation schedules have led to significant uplift payments when the market must dispatch a resource to have sufficient state of charge to meet the 30-minute energy requirement for providing ancillary services. Management will make a filing to the Federal Energy Regulatory Commission upon Board approval and consideration of the changes proposed herein by the WEIM Governing Body in its advisory role. This filing will preclude bid cost recovery payment contributions during intervals in which the optimization ensures sufficient state-of-charge to meet a regulation award. Management will also initiate a stakeholder process after the FERC filing to assess whether other potential changes may be more appropriate to address this issue.

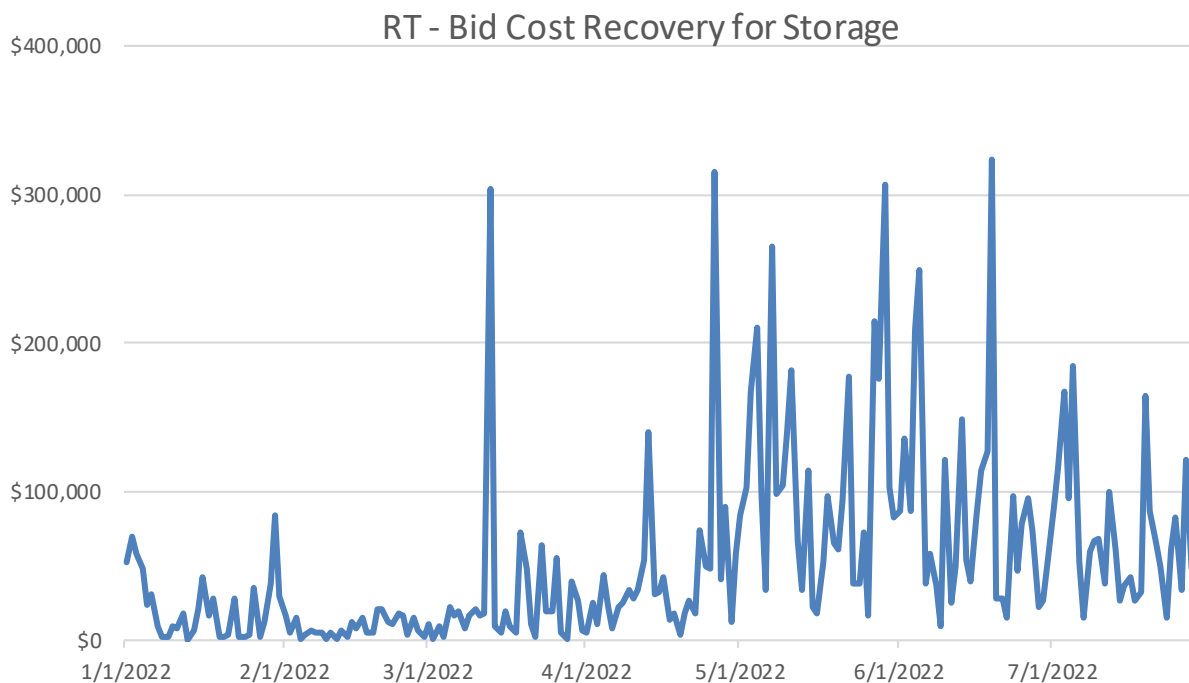
Moved, that the ISO Board of Governors approve the change to real-time bid cost recovery qualification for energy storage resources as described in the memorandum dated August 24, 2022; and

Moved, that the ISO Board of Governors authorize Management to make all necessary and appropriate filings with the Federal Energy

Regulatory Commission to implement the change proposed in this memorandum, 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.

DISCUSSION AND ANALYSIS

In March 2022, the ISO Department of Market Monitoring (DMM) reviewed bid cost recovery payments and discovered there were unusually large bid cost recovery payments made to energy storage resources using the non-generator resource (NGR) model.



Bid cost recovery is an uplift payment made to a resource when revenues from the sale of energy and ancillary services do not cover start-up, minimum load, and energy bid costs over the course of a day. It is unusual for storage resources to receive significant real-time bid cost recovery because they have neither start-up costs nor minimum load costs, and generally do not have slow ramp rates, which tend to be primary drivers for bid cost recovery. DMM determined that these bid cost recovery payments were due to a combination of relatively high energy bids coupled with ancillary service awards or self-provisions, particularly downward frequency regulation.

The tariff requires that all resources providing ancillary services have sufficient energy available to be able to provide the awarded level of ancillary service for least 30 minutes in the real-time market. For example, this means a storage resource receiving an award for 100 MW of regulation-up must hold at least 50 MWh state-of-charge to ensure it can meet its ancillary service schedule for 30 minutes. Without sufficient state-of-charge, the

resource would be unable to respond to help balance grid frequency. The ISO enforces a constraint in its real-time market to ensure sufficient state of charge, helping to ensure compliance with continuous energy requirements to support an ancillary service award or self-provision.

The outcomes observed for the storage resources receiving high bid cost recovery payments were the result of multiple consecutive hours of regulation down awards, which resulted in charging the resource. This was combined with relatively high energy bids to discharge. When a resource has an award for regulation down it must hold headroom below its maximum state of charge to ensure ability to provide the ancillary service. Thus, when a resource is charged above the headroom requirements, the optimization will dispatch the resource to discharge energy so that a sufficient amount of headroom can be maintained to meet this requirement. In the case of the observed outcomes, the discharge instructions were uneconomic, that is, prevailing locational marginal prices were below the resource's energy bids, and as a result the resource received bid cost recovery revenues for the difference between the bids and the prevailing prices during the interval when the resource was issued instructions to discharge. Because the storage resources' bids were at or near the bid cap, the bid cost recovery payments were abnormally high.

This bidding pattern could result in excessive bid cost recovery payments that Management believes are not warranted. Under the current market rules, if a storage resource must be charged or discharged to meet requirements to provide ancillary services, it can pair regulation bids with high energy bids to inappropriately inflate uplift payments. The observed patterns can result in large payments that are settled through the bid cost recovery process. For this reason, Management believes immediate action is necessary to prevent this outcome. Beginning a stakeholder initiative prior to the filing to explore options could have the unintended effect of instructing scheduling coordinators on how to exploit this situation, without a solution in place. For this reason, Management proposes in the interim to disqualify energy storage resources from receiving bid cost recovery payments for real-time market intervals in which the optimization moves the resource to ensure it has sufficient state-of-charge to meet ancillary service requirements.

POSITIONS OF THE PARTIES

Because this requires an expedited filing with the Federal Energy Regulatory Commission to address a potential avenue for market manipulation, the issue has not been discussed with stakeholders.

CONCLUSION

Management believes it is necessary to take immediate action to prevent further bid cost recovery awards to storage resources in intervals where the optimization ensures they have sufficient state of charge to meet ancillary service requirements. This action will prevent the situation from continuing or growing worse, and will provide the ISO sufficient time to explore potential long-term solutions with stakeholders.



ISO Board of Governors

August 31, 2022

Executive session

Decision on bid cost recovery for storage resources providing ancillary services

Motion

Moved, that the ISO Board of Governors approve the change to real-time bid cost recovery qualification for energy storage resources as described in the memorandum dated August 24, 2022; and

Moved, that the ISO Board of Governors authorize Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the change proposed in this memorandum, 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.

Moved: Galiteva

Second: Borenstein

ISO Board of Governors Action: Passed Vote Count: 5-0	
Bhagwat	Y
Borenstein	Y
Galiteva	Y
Leslie	Y
Schori	Y