BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

FILED
01/23/26
04:59 PM
R2510003

Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Reforms and Refinements, and Establish Forward Resource Adequacy Procurement Obligations.	Rulemaking 25-10-003

MULTI-DAY STORAGE ACCOUNTING PROPOSAL OF THE PUBLIC ADVOCATES OFFICE

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January 23, 2026

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I. INTRODUCTION

Pursuant to the Track 1 schedule adopted in the December 12, 2025, *Assigned Commissioner's Scoping Memo and Ruling,*[1] the Public Advocates Office at the California Public Utilities Commission (Cal Advocates) submits this proposal for a multi-day energy sufficiency requirement (MDESR Proposal). If adopted, the MDESR Proposal would establish a slice-of-day (SOD) energy sufficiency accounting approach for multi-day storage (MDS) resources. The proposal allows the Commission's existing load-serving entity (LSE) storage excess capacity check[2] to account for the charging energy necessary to support the MDS shown by LSEs for resource adequacy (RA) compliance. The MDESR Proposal calculates charging energy over multiple days but retains the existing SOD design of using a single-day "snapshot" that represents a month's RA supply and RA requirements. The Commission should adopt the MDESR Proposal, as discussed in detail below, to require that LSEs contract for sufficient charging energy to support the monthly RA compliance plan for MDS resources.

II. DISCUSSION

A. SOD Energy Sufficiency Requirement Summary and Problem Statement

The Commission designed the existing SOD framework to account for energy sufficiency requirements to charge storage shown by LSEs.[3] The Commission's existing

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[1] *Assigned Commissioner's Scoping Memo and Ruling,* December 12, 2025 (Scoping Ruling) at 4 and 8. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M590/K884/590884355.PDF.

[2] The existing storage excess capacity process for SOD is used on the SOD showing template and "[c]hecks that sufficient excess capacity above system requirements across all hours are shown to supply the total storage charging needs, accounting for efficiency losses." *Resource Adequacy Slice-of-Day Showing Template User's Guide: Revision 36,* September 23, 2025 (SOD Template Guide) at 31-32. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/resource-adequacy-compliance-materials/guides-and-resources/rashowing_template_usersguide_rev36.pdf.

[3] The Commission's design principles for SOD included accounting for storage charging needs given increasing reliance on use-limited resources in California, consistent with renewable policies:

> Principle 2 is the concept that any RA framework must balance the need for hourly energy sufficiency to ensure reliable operations with advancing California's clean energy, greenhouse gas emission reduction, and air pollution reduction goals. As California advances its clean energy goals through the directives mandated by Senate Bill (SB) 100 and SB 350, we recognize that the current RA MCC bucket construct, which aims to limit

SOD energy sufficiency requirement supports system reliability because it ensures that LSEs contract for sufficient energy resources to support the shown RA of energy-limited storage resources. The Commission accounts for energy sufficiency by requiring LSEs to show additional RA capacity to charge the LSEs' RA storage resources, with consideration of storage resources' round-trip efficiency (RTE).[4] This approach works well for 4-hour and most 8-hour storage resources.[5] However, the SOD framework's use of a single "worst day" set of 24 hours to represent each RA compliance month makes the energy sufficiency accounting design incompatible with storage resources that cannot fully charge and discharge within 24 hours. Additionally, the SOD framework does not capture the reliability benefits that MDS resources can provide by discharging over a multi-day period. The SOD framework also fails to capture the charging energy required for that multi-day discharge.

To appropriately count MDS resources that LSEs use to meet RA requirements, the Commission should modify the SOD framework to adopt energy sufficiency

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> overreliance on use-limited resources, does not account for energy storage charging needs and is non-binding on LSEs. With the growing penetration of renewable resources, the Commission seeks a framework that can better manage reliance on use-limited resources to meet reliability needs.

Decision (D.) 21-07-014, *Decision on Track 3B.2 Issues: Restructure of the Resource Adequacy Program,* July 15, 2021 at 27; issued in Rulemaking (R.) 19-11-009, *Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Refinements, and Establish Forward Resource Adequacy Procurement Obligations.* Available at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M393/K334/393334426.PDF.

[4] The Commission also terms this energy sufficiency as "capacity required to offset storage usage." The Commission requires that:

> To the extent an LSE uses energy storage to meet its Load+[Planning Reserve Margin] requirement, the LSE must demonstrate it has excess capacity (i.e., capacity that exceeds the LSE's hourly [RA requirement] that offsets the storage capacity plus efficiency losses. In other words, LSEs must bring enough extra capacity to serve their own batteries.

D.23-04-010, *Decision on Phase 2 of the Resource Adequacy Reform Track*, April 6, 2023, Appendix A, 24-Hour Slice Framework, at A-2; issued in R.21-10-002, *Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Reforms and Refinements, and Establish Forward Resource Adequacy Procurement Obligations*. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M505/K753/505753716.PDF.

[5] Typically, batteries of this duration capability can fully discharge and fully charge within 24 hours. However, for a resource with a low round-trip efficiency, it may take longer than 24 hours to both fully charge and discharge the resource.

requirements beyond the 24-hour "worst day" timeframe. Similarly, to credit the ability for MDS to discharge over consecutive days, the Commission should modify the SOD framework to account for the charging energy that is necessary to support those dispatches over multiple days. These modifications are necessary to enable LSEs to show MDS as RA resources and accurately calculate the MDS contribution to reliability and the energy required to charge those resources.[6] Proper accounting would inform LSEs and MDS developers of the RA compliance costs and value associated with MDS as RA resources. These changes to SOD are necessary to allow MDS resources to receive accurate RA value, which would result in increased ratepayer benefits from MDS resources.[7] The MDESR Proposal modifies the SOD framework to account for MDS energy charging needs over multiple days while maintaining the existing 24-hour "worst day" structure and compliance showing process. The MDESR Proposal does not modify the existing energy sufficiency requirement approach for other types of storage resources.

B. MDESR Proposal Design

1. MDESR Proposal Summary

The Commission should expand the existing SOD single-day energy storage charging and discharging time horizons to multiple days for MDS. An expanded time horizon would allow MDS resources to participate in the RA program in a way that takes advantage of their capability to store energy over multiple days, hold the energy for an extended period, and discharge the energy over consecutive days. The MDESR Proposal

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[6] The Commission authorized the California Department of Water Resources (DWR) to centrally procure storage that can discharge for at least 12 hours and that procurement will lead to RA credits allocated to LSEs that must be accounted for in SOD compliance. D.24-08-064, *Decision Determining Need for Centralized Procurement of Long Lead-Time Resources,* August 22, 2024, Ordering Paragraph 1 at 86, issued in R.20-05-003, *Order Instituting Rulemaking to Continue Electric Integrated Resource Planning and Related Procurement Processes.* Available at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M539/K202/539202613.PDF.

[7] Form Energy, Inc. (Form Energy) has also raised concerns that, lacking an appropriate accreditation, MDS procured for Integrated Resource Planning (IRP) and Renewables Portfolio Standard (RPS) requirements would not be reflected in the RA program and would harm ratepayers by failing to reflect the value of MDS for RA compliance. Form Energy, *Form Energy Track 3 Proposal,* January 17, 2025 (Form Energy Track 3 Proposal) at 5; filed in R.23-10-011, *Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Reforms and Refinements, and Establish Forward Resource Adequacy Procurement Obligations.* Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M553/K679/553679354.PDF.

has two components: (1) a multi-day charging period that accounts for MDS charging energy on the LSE compliance plan and (2) a requirement that MDS that is needed to provide more than 24-hours of continuous dispatch demonstrate sufficient energy to deliver over a multi-day period.

Cal Advocates designed its MDESR Proposal with the following principles in mind:

(1) All energy-storage resources should be shown with sufficient energy to charge.

(2) Accounting and accreditation should be straightforward, easily implementable, adaptable, and minimize additional data requirements and changes to existing SOD policy.

(3) Accounting and accreditation should treat resources equitably and avoid creating incentives to build or represent resources as MDS or non-MDS because of MDESR.

(4) Accounting and accreditation should appropriately state the reliability contribution of storage resources.

2. MDS Definition

Under the MDESR Proposal, MDS is defined as a storage resource with a full discharge and charge cycle that is longer than 24 hours. In other words, if a storage resource cannot discharge from 100% state-of-charge (SOC) to 0% SOC, then charge back up to 100% SOC within 24 hours, it is an MDS resource for the purpose of the MDESR Proposal.[8] MDS resources are dependent on charging energy that is sourced from a *forward charging period* (FCP) prior to the 24-hour SOD timeframe. Intra-day storage — storage that can complete a full charge and discharge cycle in under 24 hours — is not included in the MDS definition and Cal Advocates proposes no changes to how the Commission accounts for or credits intra-day storage under the existing SOD framework. Open-loop systems, such as open-loop pumped hydroelectric storage, are also outside the scope of this proposal.

[8] Cal Advocates acknowledges that non-linearity (also known as "foldback") can slow charge and discharge rates near zero and 100% SOC. Cal Advocates does not propose specific treatment for foldback issues in the MDESR Proposal.

3. Forward Charging Period

To calculate LSEs' energy sufficiency requirements for MDS shown as RA, the MDESR Proposal design spreads out the energy required to charge the MDS over the FCP. The FCP represents the number of days over which MDS resources are assumed to charge to reach an SOC that supports their capacity and slices shown on LSE supply plans. The MDESR Proposal assumes that the supply and load conditions of those forward days are the same as the "worst day" SOD load and supply conditions for the compliance month. The FCP is Cal Advocates' solution to account for sufficient charging of MDS over a forward period, since MDS is unable to complete a full charge and discharge cycle in a single day.

The FCP parameter value must be based upon relevant notification and operational timeframes that the California Independent System Operator Corporation (CAISO) uses to respond to emergency events. The Commission should establish an FCP that provides a reasonable amount of time for MDS to charge and that is also consistent with CAISO emergency response to anticipate supply scarcity events. Although LSE SOD compliance plans do not dictate how CAISO deploys resources, the goal of energy sufficiency testing for SOD energy-limited resources is to ensure adequate resources are available for CAISO operations.

CAISO's notification and operational response timeframe has a seven day outlook that assesses weather forecasts, grid conditions, and resource adequacy availability.[9] CAISO may issue an extreme weather event bulletin to the public and market participants within that seven day forecast to prepare for an anticipated scarcity event.[10] CAISO does not take operational action until four days before the anticipated event, when it reviews and validates the most current information on actual and potential system conditions, resource adequacy, weather, and other potential factors impacting the grid.[11] CAISO may issue restricted maintenance operation (RMO) notifications to transmission and

[9] CAISO Operating Procedure 4420 Version 16.3, October 23, 2025 (CAISO OP4420) at Section 3.2. Available at: https://www.caiso.com/documents/4420.pdf.

[10] CAISO OP4420 at Section 3.2.1.

[11] CAISO OP4420 at Section 3.2.2 and 3.2.3.1.

generation owners from four to one days before the event.[12] In the day-ahead timeframe, apart from typical day-ahead operations and real-time considerations, CAISO may issue Flex Alerts and/or Energy Emergency Alert Watch notices to prepare for operational actions, including load-shedding.[13]

CAISO's forecast protocols should guide the length of the FCP since those protocols inform MDS decisions to charge and retain energy ahead of stressed conditions. An FCP longer than seven days is not appropriate because CAISO does not procedurally take action to inform generators of the potential need to prepare for an extreme event more than seven days ahead of time.[14] An FCP shorter than four days is not appropriate because it may be infeasible for an MDS resource to charge sufficiently in less than four days.[15]

Accordingly, the Commission should adopt an FCP value of four days. Four days is the mid-point of CAISO's extreme weather notification process and corresponds to the point when CAISO initiates RMOs. Four days is also a reasonable period for an MDS resource with a low RTE to charge to meet a 24-slice compliance showing and potential consecutive-day dispatches.

The MDESR Proposal uses energy available on the SOD "worst day" showing day as the basis for determining energy sufficiency. This is a practical consideration — it avoids the need to introduce data about energy availability on the days before the SOD

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[12] CAISO, *Extreme Weather Event – Process and Communications,* retrieved December 31, 2025 at: https://www.caiso.com/documents/extreme-weather-event-process-and-communications.pdf.

[13] CAISO OP4420 at Section 3.3.

[14] CAISO may take actions any number of days ahead of a known emergency but is not prescribed to do so according to CAISO OP4420.

[15] For example, the California Energy Commission (CEC) considered a Form Energy MDS project that could charge and discharge at 1.5 megawatts (MW) and hold 150 megawatt-hours (MWh), with an RTE of 35%. If an LSE shows 1.5 MW in twenty-four slices, the total charging energy would be 102.9 MWh (1.5 MW * 24 hours / 0.35 RTE) to reach a SOC of 36 MWh. Given that the resource can increase its SOC by only 0.525 MWh per hour (1.5 MW * 0.35 RTE), it would take 2.9 days (36 MWh / 0.525 MWh/h / 24 hours) to charge the MDS to support the LSE's showing. However, for the sake of simplicity, Cal Advocates *is not* proposing that the Commission include a charging rate constraint in the MDS RA showing process. For more information on this Form Energy project and the characteristics that the CEC considered, see: https://www.energy.ca.gov/publications/2023/initial-study-and-proposed-mitigated-negative-declaration-east-road-storage.

day — but it also approximates reality. Many days preceding monthly peak days are similar to the peak days when those preceding days do not fall on weekends or holidays.[16]

It would be feasible for the SOD framework to consider FCP values that differ for different resources. Such a differentiation could be motivated by differences in resources' charging time or a desire to minimize the discontinuity between long intra-day storage and short MDS. As a preliminary matter, these complications do not outweigh the more fundamental need to base the FCP value on actual CAISO emergency response procedures as described above. Cal Advocates does not recommend that the Commission conduct additional development to consider other FCP values at this time.

4. The Function of the MDESR Proposal Under SOD

The Commission should establish a collective energy sufficiency requirement for MDS and intra-day resources that LSEs must follow in their RA showings. The existing SOD framework's energy sufficiency check requires that intra-day resources be supported by additional shown capacity to charge the resource.[17] The Commission should allow for a multiple-day FCP for MDS charging, and maintain the assumption of zero initial SOC currently applied to intra-day storage on the showing day for MDS at the beginning of the FCP. Although some MDS resources may have a non-zero SOC at the start of the FCP, the existing SOD framework requires that LSEs provide energy sufficiency to fully charge their shown storage resources; Cal Advocates does not propose to change that principle of the Commission's existing SOD design.[18]

The Commission should require that MDS, like intra-day storage, be required to account for all energy necessary to support how MDS is shown on LSE compliance plans. Track 3 of R.23-10-011 included several proposals that would not apply energy sufficiency requirements to MDS resources.[19] Failing to apply energy sufficiency

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[16] Determined by Cal Advocates analysis of CAISO OASIS data, using monthly peaks and preceding four days for 2025 from seven-day-ahead forecasts for the CAISO area.

[17] SOD Template Guide at 31-32.

[18] D.21-07-014 at 27. See also D.23-04-010 at A-2.

[19] California Energy Storage Alliance, *Track 3 Proposals of the California Energy Storage Alliance,* January 17, 2025 at 19-21; filed in R.23-10-011. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M555/K430/555430538.PDF; Hydrostor, Inc.,

requirements to MDS resources would harm reliability since LSEs would not be required to ensure sufficient energy is available on the grid to charge the MDS the LSEs show for their RA compliance. A lack of an energy sufficiency requirement for MDS would cause MDS to be treated differently than intra-day battery RA resources. Additionally, the use of an initial SOC assumption that is greater than zero would fail to account for the energy used to charge to that assumed level.[20] The MDESR Proposal also incorporates a *minimum consecutive day discharge* (MCDD) parameter to represent the minimum number of days over which the MDS must be able to discharge.

An energy sufficiency requirement that includes both intra-day and MDS storage ensures there is sufficient excess energy available to charge both categories of resources. Such a requirement is a reasonable means to ensure that sufficient energy will be available on the grid to charge the MDS and the intra-day resources, and to support the LSE's SOD compliance plan that includes MDS and intra-day storage. The MDESR Proposal is a straightforward extension of the existing SOD energy sufficiency framework and creates minimal modifications to the SOD compliance process.

5. Minimum Consecutive Day Discharge

To account for some MDS resources' capability to discharge up to 24 hours per day over consecutive days, the MDESR Proposal includes MCDD to account for energy sufficiency to support those lengthy discharges. However, the MDESR Proposal initially sets the MCDD to one day for all months, corresponding to the one monthly SOD "worst day" and assuming no consecutive day dispatches. An initial MCDD parameter value of one day is reasonable because the Commission has not yet found a need for consecutive day dispatches provided by MDS in the Commission's IRP proceeding.[21] For example,

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Hydrostor, Inc. Track 3 Proposal, January 17, 2025 at 8; filed in R.23-10-011. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M553/K678/553678699.PDF; and Form Energy Track 3 Proposal at 6, 15, and 20-21.

[20] Stakeholders discussed initial SOC assumptions to reduce an MDS energy sufficiency requirement during the November 4, 2025 resource adequacy workshop. See Energy Division, *LDES and VER Accreditation Workshop*, at slides 67-68. Available at: https://webproda.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/resource-adequacy-compliance-materials/resource-adequacy-history/r23-10-011/20251104-ver--ldes-workshop-final.pdf.

[21] As mentioned above, the Commission authorized DWR to procure storage that can dispatch for at least 12 hours and the Commission issued LSE procurement mandates for batteries that can dispatch for at least

the Commission's proposed 2026-2027 Transmission Planning Portfolio does not select any generic MDS with a duration of more than twelve hours for economic or reliability reasons.[22]

The MCDD value accommodates the need for MDS to provide multi-day reliability services.[23] If and when the Commission orders any procurement for MDS on the basis that the resource is needed for discharge over more than one day, the Commission should set the MCDD parameter to a value of more than one day, which would correspond to the number of days of consecutive[24] MDS dispatch needed to provide multi-day reliability in the IRP's quantitative need determination.

Consider a case where the Commission determines there is a need for extremely long-duration storage. For example, a California Energy Commission (CEC) report on MDS, co-authored with Form Energy, identified a need for a 100-hour MDS that could continuously discharge over an 11-day period of low solar production, without charging during that period.[25] If the Commission determines that 100-hour storage is the lowest-cost means of maintaining reliability and mandates that LSEs procure 100-hour storage, the MCDD for that storage should be 4.17 days (100 hours). Similarly, if the Commission mandates that LSEs procure 70-hour storage, it would be appropriate to set the MCDD to 2.92 days (70 hours) for resources used to meet the mandate.

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eight consecutive hours. However, these directives do not establish a need for consecutive day dispatchable storage resources.

[22] *Administrative Law Judge's Ruling Seeking Comments on Electricity Portfolios for 2026-2027 Transmission Planning Process and Need for Additional Reliability Procurement*, September 30, 2025 at 14; filed in R.25-06-019, *Order Instituting Rulemaking to Continue Oversight of Electric Integrated Resource Planning and Procurement Processes*. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M582/K082/582082526.PDF. The portfolio does include economically selected 12-hour pumped hydro storage.

[23] For example, Form Energy has argued that the Commission should order multi-day MDS procurement to provide continuous dispatch during multi-day reliability events during stressed grid conditions. Form Energy Track 3 Proposal at 4.

[24] In this context, "consecutive" means a need over multiple, back-to-back days, without an opportunity to reset the SOC. It does not mean the resource is assumed to discharge for every hour of the multi-day period.

[25] Multiple authors from Energy and Environmental Economics, Form Energy, University of California San Diego, and California Energy Commission, *Assessing the Value of Long-Duration Energy Storage in California*, December 2023. Example is from figure 19 at 31. Available at: https://www.energy.ca.gov/sites/default/files/2024-01/CEC-500-2024-003.pdf.

While the MDESR Proposal initially uses a single day for MCDD, the proposal is designed to easily adopt other MCDD values once a Commission directive establishes need-specific values.

6. MDESR Formulation

Under the MDESR Proposal, the excess energy shown by an LSE on its monthly supply plan must be greater than or equal to the collective energy sufficiency requirement, which is the sum of two components: (1) the existing intra-day storage energy requirement, and (2) the MDESR. The intra-day energy requirement is the sum over all intra-day resources of the number of slices for each resource times the capacity per slice, divided by the product of the RTE and one charging day, corresponding to the 24-hour SOD period.[26] The LSE's MDS energy requirement is the sum over all MDS of the number of slices for each resource times the capacity per slice times the MCDD, divided by the product of the FCP and the MDS' RTE.

The calculations below do not include deliverability considerations for generating resources that are paired with co-located or hybrid storage. The Commission has not yet developed accreditation rules for generation paired with MDS. The Commission could modify the MDESR equations, if necessary, if it adopts specific deliverability requirements and accreditation rules for paired MDS.

The MDESR Proposal is represented in the following equations:[27]

$$\text{Energy Sufficiency Requirement}_{j,m} = \text{MDESR}_{j,m} + \text{Intra-day Energy Sufficiency}_{j,m}$$

$$\text{Excess Energy on Supply Plan}_{j,m} \geq \text{Energy Sufficiency Requirement}_{j,m}$$

[26] The intra-day storage energy requirement may also include any demand response resources shown and may also consider paired generation. SOD Template Guide at 31-32.

[27] The Intra-day Energy Sufficiency equation shown below is a simplified version of what the Commission currently implements. Cal Advocates simplified the equation for illustrative and ease of comparison purposes. Cal Advocates is not proposing that the Commission change the existing Intra-day Energy Sufficiency check (also known as the "Storage Excess Capacity" check). For the full equation of the Intra-day Energy Sufficiency equation, see SOD Template Guide at 32.

$$\text{MDESR}_{j,m} = \sum_{k \in \text{MDS}} \left(\frac{\text{MCDD}_k \times \text{Slices}_{k,m} \times \text{Capacity}_{k,m}}{\text{RTE}_k \times \text{FCP}_k} \right)$$

$$\text{Intra-day Energy Sufficiency}_{j,m} = \sum_{i \in \text{Intra-day}} \frac{\text{Slices}_{\text{i,m}} \times \text{Capacity}_{i,m}}{\text{RTE}_i}$$

Equations Key:

- j indexes load serving entities
- i indexes intra-day storage resources (or the portion of the resource shown by j)
- k indexes MDS resources (or the portion of the resource shown by j)
- m indexes months
- $\text{Slices}_{i,m}$: Number of slices (hours) for intra − day storage i, month m
- $\text{Slices}_{k,m}$: Number of slices (hours)for MDS k, month m
- $\text{Capacity}_{i,m}$: Capacity shown per slice for intra − day storage i, month m
- $\text{Capacity}_{k,m}$: Capacity shown per slice for MDS k, month m
- Set of MDS: Storage resources with full discharge duration + full charge duration > 24 hours
- Set of intra-day storage: Full Discharge Duration + Full Charge Duration ≤ 24 hours
- $\text{Capacity}_{i,m} \leq \text{Max capacity}_i$ for $i \in$ Intra − day
- $\text{Capacity}_{k,m} \leq \text{Max capacity}_k$ for $k \in$ MDS
- RTE: Round trip efficiency
- FCP_k: Forward Charging Period for MDS k

The equations above implicitly assume that the MDS does not charge on the SOD showing day,[28] only during the FCP. This formulation avoids implementation complexity from separating out MDS charging hours from discharging hours or splitting energy available on the SOD day between intra-day and MDS charging. This assumption

[28] In the context of the FCP and the MDESR Proposal, the "showing day" that represents the SOD compliance "worst day" is assumed to be a day the MDS resources are being dispatched during theoretical scarcity or emergency grid conditions. The FCP concept assumes that charging occurs in days prior to dispatch.

is less restrictive than it may appear. First, as in SOD generally, the assumption that MDS does not charge on the SOD showing day does not constrain how CAISO dispatches storage resources to charge or discharge. Second, because LSEs would divide energy between intra-day and MDS resource charging, MDS charging on the SOD showing day would be equivalent to only adding a fraction of an additional FCP day.

LSEs may show MDS resources on their supply plans for any or all slices. The capacity shown per slice may also vary, up to the MDS resource's net qualifying capacity.[29] An LSE's MDS capacity shown for a slice will count as capacity towards the LSE's RA requirement for that slice. An MDS resource shown on an LSE's SOD supply plan will create a must-offer obligation for that resource's shown capacity to CAISO, in accordance with the CAISO tariff and the resource's participating generator agreement.

7. Example A

Example A demonstrates an LSE's compliance plan for one MDS resource shown for 24 slices and two intra-day storage resources. The three resources share a collective energy sufficiency requirement. Resource 1 has a capacity of 100 MW, an energy capacity of 400 MWh, a full discharge time of four hours, a full charge time of 4.5 hours, and an RTE of 89%. Resource 2 has a capacity of 75 MW, an energy capacity of 600 MWh, a full discharge time of eight hours, a full charge time of ten hours, and an RTE of 80%. Resources 1 and 2 both qualify as intra-day because the full discharge time plus the full charge time is less than 24 hours. The LSE also shows one MDS resource. The MDS resource has a capacity of 50 MW, an energy capacity of 2,500 MWh, a full discharge time of 50 hours, a full charge time of 100 hours, and an RTE of 50%. This resource is classified as MDS because the full charge and discharge time is longer than 24 hours. For all three resources, the respective charging and discharge power is the same. The storages' technical parameters and the LSES's compliance showing are summarized in the following tables:

[29] The MDESR equation above assumes each slice is shown at the same capacity amount. However, the $Slices_{k,m}$ and $Capacity_{k,m}$ variables may be further broken down into a per slice basis that multiplies each slice by the amount of capacity shown in each slice. See Examples A and B below.

Example A: Storage Characteristics and SOD Showing

	Capacity (MW)	Energy (MWh)	Discharge Time (hours)	RTE	Storage Type	FCP (days)	MCDD (days)
Resource 1	100	400	4	89%	Intra-day	N/A	N/A
Resource 2	75	600	8	80%	Intra-day	N/A	N/A
Resource MDS	50	2500	50	50%	MDS	4	1

Resource	HE 1	HE 2	HE 3	HE 4	HE 5	HE 6	HE 7	HE 8	HE 9	HE 10	HE 11	HE 12	HE 13	HE 14	HE 15	HE 16	HE 17	HE 18	HE 19	HE 20	HE 21	HE 22	HE 23	HE 24
Res. 1																		50	50	100	100	100		
Res. 2																	75	75	75	75	75	75	75	75
Res. MDS	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

The LSE shows Resource 1 for three slices at 100 MW per slice and two slices at 50 MW per slice, a total equal to the capacity and energy of Resource 1. As illustrated in the following table, the energy sufficiency requirement for Resource 1 is 3 times 100 MW plus 2 times 50 MW, divided by 89 percent, a total of 449 MWh. The LSE shows Resource 2 for eight slices at 75 MW per slice. The energy sufficiency requirement is 8 times 75 MW divided by 80 percent, a total of 750 MWh. The LSE shows the MDS resource for 24 slices at 50 MW per slice. The FCP for the MDS resource is four days and the MCDD is one day. The energy sufficiency requirement for the MDS resource is 24 times 50 MW times 1 divided by the product of 4 and 50 percent, a total of 600 MWh. The LSE can show the MDS resource for 24 slices at 50 MW per slice because the LSE's total shown energy capacity for the MDS resource, 1,200 MWh, is less than the maximum energy capacity of the MDS resource, and the hourly capacity is less than or equal to the maximum power capacity.

Example A: Energy Storage Requirements and Calculations

Resource	Short-hand Equation	Energy Sufficiency Requirement Calculation	Energy Sufficiency Requirement
Res. 1	(Slices * Capacity)/RTE	([(2 * 50) + (3 * 100)] / 0.89)	449
Res. 2	(Slices * Capacity)/RTE	(8 * 75 / 0.80)	750
Res. MDS	(Slices * Capacity * MCDD)/(RTE * FCP)	(24 * 50 * 1) / (0.5 * 4)	600
			Total: **1799**

The LSE must show a total monthly excess energy of at least 1,799 MWh to support the SOD compliance plan showings of its three energy storage resources.

8. Example B

Example B focuses on MDS resources which the LSE shows for a varying number of slices and a varying capacity per slice. Example B assumes that the Commission establishes an MCDD parameter of 3 days.[30] Resource Y has a capacity of 4 MW, an energy capacity of 500 MWh, and an RTE of 45%. Resource Z has a capacity of 45 MW, an energy capacity of 600 MWh, and an RTE of 60%. The FCP for the MDS resources in this example is four days and the MCDD is three days. The LSE shows Resource Y for 24 slices at 4 MW per slice and Resource Z for 18 hours at a varying capacity per slice, as illustrated in the following tables.

Example B: Storage Characteristics and SOD Showing

	Capacity (MW)	Energy (MWh)	Discharge Time (hours)	RTE	Storage Type	FCP (days)	MCDD (days)
Resource Y	4	500	125	45%	MDS	4	3
Resource Z	45	600	13.3	60%	MDS	4	3

Resource	HE 1	HE 2	HE 3	HE 4	HE 5	HE 6	HE 7	HE 8	HE 9	HE 10	HE 11	HE 12	HE 13	HE 14	HE 15	HE 16	HE 17	HE 18	HE 19	HE 20	HE 21	HE 22	HE 23	HE 24
Res. Y	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Res. Z	20	20	20	30	20	45	45	45	30							20	30	45	45	45	45	45	30	20

The energy sufficiency requirement for Resource Y is 24 slices times 4 MW times 3 MCDD days divided by the product of 45% RTE and 4 FCP days, a total of 160 MWh. The LSE shows Resource Z in a variable manner:[31] 5 slices at 20 MW, 4 slices at 30

[30] As mentioned above, Cal Advocates proposes an MCDD value of 1 day until the Commission determines the economic and reliability need for MDS. An MCDD value of 3 days for this example is illustrative and the value of 3 was arbitrarily chosen.

[31] Since Resource Z cannot support a showing of its full capacity in all 24 slices (24 * 45 = 1,080, beyond the resource's energy capacity of 600 MWh), the LSE could either show 24 slices with a lower capacity (600 MWh / 24 slices = 25 MW), or show less capacity in all or certain slices. In this example, the total discharge equals Resource Z's energy capacity of 600 MWh.

MW, and 8 slices at 45 MW. The energy sufficiency requirement for Resource Z is the sum of slices multiplied by relevant capacity shown,[32] times 3 MCDD days divided by the product of 60% RTE and 4 FCP days, or 725 MWh.

Example B: Energy Storage Requirements and Calculations

Resource	Short-hand Equation	Energy Sufficiency Requirement Calculation	Energy Sufficiency Requirement
Res. Y	(Slices * Capacity * MCDD) / (RTE * FCP)	(24 * 4 * 3) / (0.45 * 4)	160
Res. Z	(Slices * Capacity * MCDD) / (RTE * FCP)	[(5 * 20 + 4 * 30 + 8 * 45) * 3] / (0.6 * 4)	725
		Total:	**885**

The LSE must show a total monthly excess energy of at least 885 MWh to support the SOD compliance plan showing these two MDS resources.

Examples A and B illustrate how the Commission can use the MDESR equations to set an LSE's SOD energy sufficiency requirement to support the capacity shown for the LSE's energy-limited intra-day and MDS resources. Commission adoption of the MDESR proposal will help ensure that there is sufficient energy available to CAISO to charge the LSE's storage resources to maintain system reliability.

III. CONCLUSION

The Commission should adopt the MDESR Proposal to require LSEs to include sufficient energy to support their SOD MDS compliance plan showings, which will help ensure system reliability. The MDESR Proposal will also establish RA accreditation that recognizes MDS resources' capability to provide 24 or more hours of consecutive discharge, which will help inform resource valuation to guide MDS procurement and project financing to meet any future Commission-identified need for multi-day reliability.

[32] That is, 5 slices times 20 MW, plus 4 slices times 30 MW, plus 8 slices times 45 MW.

Respectfully submitted,

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January 23, 2026