

September 8, 2021

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

**Re: California Independent System Operator Corporation
Hybrid Resources and Co-located Resources
Docket No. ER21-____-000**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) requests the Commission accept tariff revisions clarifying market rules for hybrid and co-located resources.¹ Specifically, the CAISO proposes tariff rules to (1) enhance market participation by hybrid and co-located resources, and (2) allow the use of multiple aggregate capability constraints by co-located resources at a single generating facility.

From a substantive perspective, the two categories of tariff changes are separate and discrete from each other. They are not interrelated, interdependent, or affected by Commission action on tariff revisions in the other category. The CAISO requests that the Commission evaluate the justness and reasonableness of each category of tariff changes and the identified sub-category of proposed tariff revisions on their individual merits. Rejection of one proposed set of tariff revisions should not in itself require rejection of the other tariff revisions.

The CAISO is targeting an effective date for most of these tariff revisions in the fall of 2021. The exception is that the CAISO plans to implement dynamic limit functionality for hybrid resources in the spring of 2022 as part of its rules to enhance market participation by hybrid and co-located resources. The CAISO needs additional time to construct and test its market systems to implement this functionality. Accordingly, the CAISO requests the Commission issue an order accepting its tariff revisions other than the dynamic limit functionality on or before November 8, 2021. However, out of an abundance of caution, the CAISO requests the Commission authorize an effective date for such tariff revisions on or before December 1, 2021,

¹ The CAISO submits this filing pursuant to Section 205 of the Federal Power Act, 16 U.S.C. § 824d, Part 35 of the Commission's regulations, 18 C.F.R. § 35, and in compliance with Order No. 714, *Electronic Tariff Filings*, FERC Stats. & Regs. ¶ 31,276 (2009). Capitalized terms not otherwise defined herein have the meanings set forth in the Master Definitions Supplement, Appendix A to the currently effective ISO tariff.

subject to the CAISO filing a notice filed with the Commission within 5 days of the actual effective date. The CAISO requests the Commission accept the tariff revisions to implement the hybrid dynamic limit functionality with an effective date on or before June 1, 2022, subject to the CAISO filing a notice filed with the Commission within 5 days of the actual effective date. The CAISO also requests waiver of Commission's 120-day notice requirement between the date a rate schedule is filed and the date it must take effect.² Waiving requirement will provide the CAISO and market participants with regulatory certainty and ample time to implement the hybrid dynamic limit as part of the CAISO's planned software release in the spring of 2022.

I. Background

A. Hybrid Resources and Co-located Resources

Energy storage development is significant and growing in the CAISO balancing authority area and throughout the western United States. A key benefit of energy storage is its ability to offset the intermittency and optimize the performance of variable energy resources when co-located behind a point of interconnection. Many load-serving entities and developers also seek to pair energy storage with solar resources so the generating facilities can provide consistent power and extend their capability even as the sun sets or wind decreases. They may model these combinations as separate co-located resources or as a single hybrid resource. The CAISO expects deployment of both hybrid and co-located resources in its balancing authority area and balancing authority areas in the western Energy Imbalance Market (EIM) over the next several years, comprised primarily of solar photovoltaic and battery energy storage or wind and battery energy storage.

The distinction between co-located and hybrid resources is that co-located resources operate in the CAISO's markets as separate and independent resources. Although co-located resources are located at the same generating facility from an interconnection perspective, the CAISO treats them as separate market entities, and they have separate Resource IDs.³ Co-located resources submit separate bids and

² Specifically, pursuant to section 35.11 of the Commission's regulations, 18 C.F.R. § 35.11, the CAISO requests waiver of the 120-day notice requirement contained in section 35.3(a)(1) of the regulations, 18 C.F.R. § 35.3(a)(1).

³ Developers may elect to use separate Resource IDs for co-located generating units when different load-serving entities have procured different amounts of capacity from the same site. For example, a 100 MW generator could have one 50 MW contract with one load-serving entity, and one 50 MW contract with another. Bifurcating the resources allows the scheduling coordinators and load-serving entities to administer with their power purchase agreements more efficiently.

A Resource ID is a set of "[i]dentification characters assigned by the CAISO to Generating Units, Loads, Participating Loads, Proxy Demand Resources, Reliability Demand Response Resources,

receive separate market dispatch instructions from other resources with which they are co-located. They submit separate outages and have separate metering arrangements.

In contrast, hybrid resources combine different components at a generating facility, and they are modeled as a single resource. The most prominent example is a resource with an energy storage component and a variable energy component, such as wind or solar, operating as one generator. A hybrid resource has one bid curve that applies to all of its component parts. A hybrid resource receives one dispatch instruction from the CAISO. The hybrid resource operator self-optimizes its components to meet the dispatch instruction. The CAISO settles the aggregate output of each hybrid resource under its single Resource ID.

The CAISO expects many hybrid and co-located resources to commence commercial operation by modifying existing generating facilities. In the CAISO's balancing authority, developers can add energy storage to existing facilities through the modification process established in their generator interconnection agreements rather than submitting a new interconnection request so long as they do not require additional interconnection service capacity or substantially alter their electrical characteristics. This process ensures energy storage may interconnect safely and reliably without the CAISO and participating transmission owners needing to restudy interconnection service for the entire facility.⁴ Developers are adding storage to existing generating facilities because they can do so more quickly and at a lower cost than establishing new and separate interconnections for the storage units. Leveraging existing infrastructure will reduce costs such as step-up transformer equipment that is already a part of an existing generating facility.

B. Hybrid Resources Initiative

The CAISO began a stakeholder initiative dedicated to hybrid resources in July 2019.⁵ The initiative's first goal was to enable developers to elect either the co-located resource or hybrid resource model. The CAISO submitted its first set of tariff revisions from this stakeholder initiative in September 2020. Those tariff revisions included: (1) definitions for hybrid resources and co-located resources; (2) creating an "aggregate capability constraint" in the market optimization to allow co-located resources to manage the sum of their maximum and minimum operating levels without the need for additional interconnection upgrades; and (3) establishing data requirements for hybrid resources to enable the CAISO to monitor hybrid resources and to provide scheduling coordinators with a forecast based on meteorological conditions. The Commission accepted these tariff revisions on November 19, 2020.⁶

System Units, System Resources, and Physical Scheduling Plants." Master Definitions Supplement, Appendix A to the CAISO tariff. The CAISO uses Resource IDs to identify separate market resources.

⁴ CAISO tariff section 25.1 and Article 5.19 of Appendix EE to the CAISO tariff.

⁵ <https://stakeholdercenter.caiso.com/StakeholderInitiatives/Hybrid-resources>.

⁶ *California Independent System Operator Corp.*, 173 FERC ¶ 61,146 (2020).

Earlier this year, the CAISO enhanced its market rules to clarify that co-located resources may deviate from dispatch instructions under certain conditions. Specifically, the CAISO clarified that when an eligible intermittent resource produces energy above its dispatch instruction because meteorological conditions differ from what was forecast, a co-located energy storage resource can produce less energy than its dispatch instruction to ensure the combined resources' output does not exceed their shared interconnection service capacity. This market rule recognizes that the energy storage resource may reduce output to compensate for the over-performing eligible intermittent resource based on control technologies installed to ensure safety and reliability at the resource's point of interconnection.

The tariff revisions in this filing arise from the second phase of the CAISO's Hybrid Resource initiative, as well as an effort undertaken earlier this year to enhance the use of aggregate capability constraints by co-located resources at a single generating facility. Working with stakeholders, the CAISO has developed these rules to support the changing resource mix and evolve the ability of its markets to integrate energy storage resources in a reliable manner.

As part of the CAISO's three-year policy roadmap, the CAISO has planned a stakeholder process in 2022 to address the evolution of hybrid resource deployment. This effort will review the market rules in place for hybrid and co-located resources, and may consider new market functionality to allow them to operate more effectively in the market. This new stakeholder initiative will review operations and market data from actual experience with hybrid and co-located resource operation to inform any new market rules.

II. Proposed Tariff Modifications

The CAISO's proposed tariff changes involve two main categories: (1) enhancing market participation by hybrid and co-located resources; and (2) allowing the use of multiple aggregate capability constraints by co-located resources at a single generating facility. As explained in section III below, the Commission should accept these revisions as just and reasonable.

A. Market Participation Rules for Hybrid Resources and Co-located Resources

The CAISO proposes to increase the detail in its tariff regarding the responsibilities for hybrid resources.⁷ The proposed language clarifies the CAISO will consider hybrid resources to be subject to the same general rules as generating units under Section 4.6 of its tariff. Section 4.6 requires, for example, that generating units have scheduling coordinators and execute participating generator agreements before participating in the CAISO markets. Scheduling coordinators for hybrid resources will need to provide accurate information to the CAISO about their resources' configuration.

Although hybrid resources may have a variable energy component as part of their configuration, these resources will not be eligible intermittent resources under Appendix Q of the CAISO tariff. The CAISO utilizes a real-time forecast of production from eligible intermittent resources to provide them with dispatch operating targets. This approach recognizes the owner or operator of an eligible intermittent resource cannot store electricity and that the resource has variability that is beyond the control of the owner or operator. Accordingly, the CAISO allows them to produce to their capability when their dispatch operating target is equal to its forecasted output.⁸ In contrast, the operator of a hybrid resource can store electricity and manage the variability of its resource.

However, hybrid resources with variable energy components will need to provide information similar to eligible intermittent resources to allow the CAISO to forecast the likely output of their renewable components. This is important to assess overall supply capability on the system and to incorporate the information into the CAISO's renewable forecast models. For example, the CAISO proposes to require that hybrid resources provide meteorological and other information to forecast production from the resource's variable component. The CAISO also proposes that hybrid resources provide the CAISO with resource's high sustainable limit, which is the maximum instantaneous generating capability of the resource in that instant.⁹ The CAISO proposes to require the same information for co-located resources that are

⁷ Proposed Section 4.18.

⁸ CAISO tariff section 34.13.1.

⁹ The CAISO proposes to define the term high sustainable limit as "[t]he instantaneous generating capability of a variable or intermittent Generating Unit (or component thereof), provided to the CAISO through telemetry at the Generating Unit." Hybrid resources would need to provide this information through telemetry to the CAISO every 12 seconds. The high sustainable limit is not the resource's PMax, which is its maximum operating level. The high sustainable limit represents its instantaneous capability based on real-time conditions.

eligible intermittent resources.¹⁰ Hybrid resources that include an energy storage component must provide the CAISO with telemetry on the energy storage component's state of charge.

The CAISO proposes that scheduling coordinators representing hybrid resources will be subject to the generally applicable bidding rules established in section 30.5 of the CAISO tariff, and they must submit hybrid dynamic limits representing the resource's upper and lower economic limits in each five-minute trading interval for at least a three-hour look-ahead period.¹¹ These limits should reflect resource availability based on the operating capabilities such as state of charge and resource forecast. Scheduling coordinators also may use these dynamic limits to manage onsite charging of an energy storage component of a hybrid resource.

The CAISO also proposes to revise its tariff to include certain resource adequacy rules for hybrid resources.¹² Specifically, the CAISO proposes that, like eligible intermittent resources, hybrid resources will be exempt from the CAISO's resource adequacy availability incentive mechanism (RAAIM). Similar to variable energy resources, existing resource adequacy counting rules discount the renewable component of a hybrid resource, which will at least initially reflect the larger component of a hybrid resource. In addition, calculating the availability of a separate energy storage component would be excessively complicated because it would require a methodology to assess whether the resource's offer reflects the capacity of the energy storage component. The CAISO plans to review resource adequacy incentives for hybrid resources in its resource adequacy enhancements initiative.¹³ In addition, the CAISO proposes tariff changes to calculate the effective flexible resource adequacy capacity value of a hybrid resource.

B. Use of multiple aggregate capability constraints by co-located resources at a single generating facility

In 2020, the CAISO filed tariff changes to allow an interconnection customer with co-located resources at a generating facility to request use of an aggregate capability constraint.¹⁴ This constraint models the maximum and minimum capabilities of co-located generating units at a generating facility for purposes of issuing day-ahead market and real-time market awards and dispatches. Currently, the CAISO applies only

¹⁰ Proposed change to Tables in Appendix Q of the CAISO tariff.

¹¹ Proposed CAISO tariff section 30.5.6.1.

¹² Proposed tariff sections 40.9.2(b)(1)(D) and 40.10.4.1(g).

¹³ More information about this initiative is available on the CAISO's website: <https://stakeholdercenter.caiso.com/StakeholderInitiatives/Resource-adequacy-enhancements>.

¹⁴ CAISO filing in Commission Docket ER20-2890 dated September 16, 2020. See also *California Independent System Operator Corp.*, 173 FERC ¶ 61,146 (2020).

one aggregate capability constraint to an entire generating facility. When a co-located resource uses an aggregate capability constraint, the combined PMaxes of generating units at a generating facility may exceed the generating facility's interconnection service capacity. This constraint will ensure market awards of those generating units will not exceed the generating facility's interconnection service capacity.

In this filing, the CAISO proposes to allow multiple sets of co-located resources to use distinct aggregate capability constraints simultaneously within a single generating facility.¹⁵ Using multiple aggregate capability constraints at a single generating facility will allow the CAISO to nest a set of constraints that are subordinate to the master aggregate capability constraint, but still observe the generating facility's total interconnection service capacity limit. These subordinate aggregate capability constraints will support multiple resources at a generating facility by allowing the CAISO to model each set of co-located resources to their maximum contractual operating levels, but limit the awards and dispatch instructions to the portion of the interconnection service capacity represented by the subordinate aggregate capability constraint.

Under this proposed construct, the CAISO may relax enforcement of subordinate aggregate capability constraints in its Real-Time Market prior to relaxing enforcement of the system energy-balance constraint to ensure there is sufficient supply to meet forecasted demand. For purposes of its initial implementation this fall, the CAISO will set the penalty price for master and subordinate aggregate capability constraints at the same level. In the spring of 2022, the CAISO will implement changes to its optimization so that the penalty price of subordinate aggregate capability constraints is less than the system energy-balance constraint. The CAISO will include these penalty prices in its Business Practice Manual for Market Operations. As explained in section III below, the CAISO will not relax these subordinate aggregate capability constraints unless it is necessary to access available generating capability at the generating facility.

Although both hybrid and co-located resources are eligible to provide ancillary services in CAISO markets, the CAISO has limited co-located resources utilizing an aggregate capability constraint to provide only energy. The CAISO plans to lift this restriction in fall 2021 so that co-located resources utilizing an aggregate capability constraint may provide both energy and ancillary services. The CAISO will effect this change by issuing a market notice as contemplated under current tariff section 27.13.¹⁶

¹⁵ Proposed changes to tariff section 27.13.

¹⁶ CASIO tariff section 27. 13 currently reads in part: "Scheduling Coordinators may not offer or self-provide Ancillary Services into the CAISO's Markets or receive Uncertainty Awards from Generating Units that are subject to Aggregate Capability Constraints until the CAISO issues a Market Notice stating this restriction will no longer apply."

III. The CAISO's tariff revisions will support the changing resource mix and evolve the ability of the CAISO's markets to integrate energy storage resources in a reliable manner as part of hybrid and co-located resource configurations

In this section, the CAISO demonstrates why its proposed tariff revisions are just and reasonable. The CAISO also includes Exhibit E, which identifies each proposed tariff change and offers a rationale for that change.

A. Scheduling coordinators for Hybrid Resources will have similar roles and responsibilities as scheduling coordinators for other resources

In existing section 4.6.11 and proposed section 4.18, the CAISO's tariff revisions establish rules to treat hybrid resources and their scheduling coordinators similar to other resources and scheduling coordinators for those resources. The CAISO proposes that scheduling coordinators for hybrid resources with an energy storage component may include various operating constraints, including MWh constraints, among their Master File parameters to the extent they apply.¹⁷ These physical operating constraints will allow the CAISO to track the capabilities of the underlying hybrid components. The CAISO proposes tariff rules to establish the general responsibility for scheduling coordinators for hybrid resources to provide the CAISO with data regarding the capacity and the operating characteristics of the resource's components as the CAISO reasonably requests from time to time.¹⁸ As described below, the CAISO also proposes more specific information requirements that include the high sustainable limit, state of charge, site information, topographic and other information specified in Appendix Q of the CAISO tariff.

Information provided by scheduling coordinators must be accurate. Scheduling coordinators and hybrid resources must adhere to applicable telemetry and metering requirements at both the resource level and component level. These general requirements are similar to requirements that apply to participating generators and other resources.¹⁹

Additionally, the CAISO proposes to modify section 29 of its tariff to recognize requirements related to hybrid resources that include intermittent (wind or solar) components.²⁰ These provisions parallel existing provisions for variable energy resources that apply to EIM participating resources.

¹⁷ Proposed change to tariff section 4.6.11.

¹⁸ Proposed tariff section 4.18.

¹⁹ Cf. CAISO tariff section 4.6.4.

²⁰ Proposed changes to tariff sections 29.2(b), 29.6(e), 29.11(j), and 29.34(q).

The Commission should accept these tariff rules as a foundational element of the CAISO's hybrid resource market participation model because without accurate understanding of hybrid resource's operating capabilities, as well as telemetry data and meter data, the CAISO cannot reliably or effectively integrate them into its day-ahead or real-time market processes.

(i) The CAISO proposes that hybrid resources with a variable component and co-located eligible intermittent resources must provide their high sustainable limit through telemetry

The CAISO proposes to require hybrid resources and co-located eligible intermittent resources to provide the CAISO with their high sustainable limit as a telemetry point every 12 seconds.²¹ The CAISO defines the high sustainable limit as "[t]he instantaneous generating capability of a variable Generating Unit (or component thereof), provided to the CAISO through telemetry at the Generating Unit."²² Effectively, the high sustainable limit is a real-time estimate of the maximum output capability of a variable energy resource or the variable component of a hybrid resource based on the resource's physical properties (*i.e.* the number of solar panels or wind turbines and available inverters) and the fuel available to the resource based on current weather conditions.

This data will help the CAISO improve forecast accuracy for hybrid resources that include a variable component and an energy storage component or an eligible intermittent resource co-located with an energy storage resource.²³ Generally, the CAISO utilizes a persistence forecast model to create the forecast used in the CAISO's real-time dispatch for eligible intermittent resources within its balancing authority area and for variable energy resources within Energy Imbalance Market balancing authority areas. The persistence forecast model predicts the output of a variable energy resource based on its MW telemetry values and weather conditions. Although the MW telemetry of a variable resource may reflect its generating capability some of the time, a resource's MW telemetry value may also reflect negative supplemental dispatches, operating instructions to reduce output, an ancillary services capacity award, and when applicable, losses. For hybrid resources, MW telemetry values will also reflect the

²¹ Proposed changes to Tables in Appendix Q of the CAISO tariff. During the CAISO's stakeholder process it proposed to collect information every 10 seconds but the CAISO's collects information through telemetry in 4-second intervals, so the CAISO has proposed to collect this information every 12 seconds.

²² Proposed definition of High Sustainable Limit in Appendix A to the CAISO tariff.

²³ During the CAISO's hybrid resource phase 2 stakeholder initiative, the CAISO released a white paper explaining the business need for the high sustainable limit: CAISO White Paper *High Sustainable Limit* dated October 14, 2020. A copy of that white paper is available at the following website: <http://www.caiso.com/InitiativeDocuments/FinalWhitePaper-HighSustainableLimit-HybridResourcesPhase2.pdf>.

battery charging and discharging. These values may undermine the use of the persistence forecasting logic to anticipate a resource's output.

The CAISO plans to use the high sustainable limit as an input to the persistence forecast. This will allow the CAISO to use the persistence forecast for the majority of Real Time Dispatch intervals, regardless of battery charging by the hybrid or co-located resource or the market impacts for a variable energy resource or a variable component of a hybrid resource. The high sustainable limit does not reflect market actions or battery charging that may make the MW telemetry value of a variable energy resource or variable component of a hybrid resource unreliable for use in a forecast model. It instead provides an estimate of the resource's physical capability given fuel availability and current weather conditions. For example, when the CAISO issues a negative supplemental dispatch or directs a resource to reduce its output for reliability reasons, the high sustainable limit at the resource or resource component level will provide the CAISO a more accurate representation of what the resource could produce to inform the CAISO's forecasting model.

Today, when a variable resource is subject to a market action that reduces its MW telemetry, the CAISO will shift its persistence forecasting to a forecast created by an external forecast service that reflects current weather conditions. During periods where there is an issue with the receipt of MW telemetry values from a resource, the high sustainable limit may be a more accurate input into the persistence forecast model than the weather-based forecast the CAISO uses today. Based on the data presented by the CAISO during the stakeholder process, using high sustainable limit data correlates more closely to the actual output of a resource than the weather-based forecast model the CAISO uses. This information will also assist the CAISO in assessing modeling practices based on historical data. Accordingly, the CAISO believes the high sustainable limit will enhance the CAISO's persistence forecast logic.

In addition, the CAISO has included this data point as a requirement for hybrid resources and eligible intermittent resource to provide regulation, spinning reserve, and non-spinning reserve.²⁴ The high sustainable limit will be an important data point to support forecasting efforts when a hybrid resource or a co-located eligible intermittent resource either is carrying an ancillary services award or is dispatched to provide energy from the ancillary services it is providing. The high sustainable limit will allow forecasting model to assess the capability of the resource notwithstanding the ancillary service award or dispatch. The high sustainable limit will also provide an additional data point to validate whether an eligible intermittent resource or hybrid resource is capable of providing ancillary services during the real-time market interval.

²⁴ Proposed changes to Parts A.1.2.2.5, B.1.7, and C.2.3 of Appendix K to the CAISO tariff.

(ii) Hybrid resources with a wind or solar component will need to provide data to the CAISO similar to a wind or solar eligible intermittent resource

An important aspect of the CAISO's proposed hybrid resource participation model is that the CAISO does not consider these resources to be eligible intermittent resources under its tariff, notwithstanding the fact that a hybrid resource may have a variable component.²⁵ In contrast to eligible intermittent resources and variable energy resources, operators of hybrid resources with energy storage components are able to store a portion of the electricity produced at the hybrid resource. As such, hybrid resources are neither variable nor intermittent. For these reasons, the CAISO will not extend dispatch rules that apply to eligible intermittent resources to hybrid resources. However, as recognized and accepted by the Commission, the CAISO will require hybrid resources with a wind generation or solar generation component to provide the same forecasting and meteorological data that a wind or solar resource would have to provide CAISO if it were a standalone resource.²⁶ This data helps ensure the CAISO provides hybrid resources with feasible dispatches based on real-time conditions.

Forecasting and meteorological data requirements are set forth in Appendix Q of the CAISO tariff. As part of this filing, the CAISO proposes updates to the requirements of Appendix Q regarding the information it requires from wind and solar eligible intermittent resources and from hybrid resources with a wind or solar component. For the most part, the changes proposed to Appendix Q extend existing requirements to a hybrid resource with a wind or solar generating component and include the requirements that hybrid resources and co-located eligible intermittent resources provide the CAISO with a high sustainable limit. The CAISO discusses other proposed revisions in detail below.

Additional clarifications in Appendix Q include: (1) clarifying that eligible intermittent resources or hybrid resources with a wind generation component may not share metrological stations; (2) revising the format and data categories associated with site information requirements; and (3) requiring the submission of a shape file to illustrate the location of the meteorological station(s) and a resource's project boundaries.

²⁵ The CAISO tariff defines Eligible Intermittent Resource to mean: A Variable Energy Resource that is a Generating Unit or Dynamic System Resource subject to a Participating Generator Agreement, Net Scheduled PGA, Dynamic Scheduling Agreement for Scheduling Coordinators, or Pseudo-Tie Participating Generator Agreement."

The CAISO tariff defines Variable Energy Resource as: "A device for the production of electricity that is characterized by an Energy source that: (1) is renewable; (2) cannot be stored by the facility owner or operator; and (3) has variability that is beyond the control of the facility owner or operator."

²⁶ *Cal. Indep. Sys. Operator Corp.*, 173 FERC ¶¶ 61,146 at P 6 (2020).

Today, subject to specified conditions and prior approval, the CAISO permits solar resources to share meteorological station requirements with another solar resource.²⁷ These conditions include (a) one resource (the host plant) meets the meteorological station requirements, and (b) the site of the other resource lies contiguous to or overlaps the site of the host plant, or meteorological conditions on the other resource's site are substantially similar to those on the host plant site. The CAISO will extend this existing provision to hybrid resources with a solar component.²⁸ The CAISO, however, proposes clarifications to state that wind eligible intermittent resources or hybrid resources with a wind component may not share meteorological stations. Meteorological data points for wind resources are specific to their locations and generating turbines.²⁹ Meteorological stations need to be in a specific area of the site to measure the prevailing wind. By not addressing this topic for wind resources, the existing tariff implicitly forbids such sharing arrangements for wind eligible intermittent resources, and the CAISO's established practice has been to reject such requests from wind resources. To provide greater clarity for its market participants, the CAISO now proposes to make the sharing prohibition for wind resources express.

The CAISO also proposes to modify the site information format and data categories set forth in Appendix Q.³⁰ These site information requirements will apply to both solar and wind eligible intermittent resources and hybrid resources with either a solar or wind component. The more comprehensive list includes additional site information that will assist CAISO efforts to more accurately forecast and integrate eligible intermittent resources and hybrid resources into its markets. These changes involve a shift in format from a defined worksheet for participants to complete to a list of data points market participants will provide through the CAISO's resource interconnection management systems (RIMS). In addition, the updated list includes data needed to onboard eligible intermittent resources and hybrid resources with a wind or solar component. Many of the newly-required data points are already requested and provided, but including a tariff requirement for resources to provide these data points will ensure the CAISO has a uniform set of data points it needs to manage these resources. For example, understanding the "park potential" of a resource will help inform the capability of a wind or solar resource based on different weather conditions, and will help develop an accurate production forecast of the resource. By including this list of data points in the tariff, eligible intermittent resources and hybrid resources will have a clear understanding of data needed to help facilitate onboarding of new resources.

²⁷ Section 3.2.1.4 of Appendix Q of the CAISO tariff.

²⁸ Proposed changes to Section 3.2.1.4 of Appendix Q to the CAISO tariff.

²⁹ Section 3.1.1 of Appendix Q to the CAISO tariff.

³⁰ Proposed changes to Sections 3.1.5 and 3.2.3 of Appendix Q to the CAISO tariff.

Finally, the CAISO will require solar and wind eligible intermittent resources and hybrid resources with a wind or solar component to provide a shape-file that illustrates the location of the meteorological station(s) and the resource's project corner. A shape-file is a commonly used file format that facilitates accurate sharing of geographic information. Receiving a standardized file type from resources will streamline the CAISO's review of resource data submissions and reduce errors in data transfers that ultimately can impact forecast quality negatively. The CAISO will require resources to provide the shape-file in specified file formats depending on resource type. The proposed requirement for submitting a shape-file builds on the existing requirement for resources to provide a topographic map. A topographic map can provide an effective visual representation of a resource site's layout. The shape-file provides similar information but in a digital format that the CAISO can query to facilitate analysis. A shape-file will also help eliminate discrepancies between text values and a topographic map. In addition, a shape-file also will enable automated review of resources, which will make onboarding resources more efficient. Having accurate geographic information for both hybrid and co-located resources that may be located in close proximity to one another is crucial to distinguish clearly between the geographical boundaries of each resource. A customer who provides a topographic map likely already has a shape-file, so compliance with this new requirement should not create any undue burden.

B. The CAISO proposes to enhance its bidding functionality to support market participation by hybrid resources

In the CAISO's real-time market, economic bids and self-schedules apply to an entire trading hour.³¹ Scheduling coordinators may submit bids until seventy-five minutes prior to each applicable trading hour in the real-time market.³² Although a hybrid resource is comprised of renewable and storage components, the CAISO models it as a single resource. Each technology component underlying a hybrid resource may have individual operational challenges. For example, variable energy resources may be unable to produce at full capability during all periods of a trading hour, even though these resources may have predictable operating patterns during the day. Similarly, energy storage resources are only capable of producing if they have sufficient state of charge. A hybrid resource that has variable energy and storage components will have operational challenges given the different limitations of the underlying technology types.

Under the CAISO's hybrid resource participation model, scheduling coordinators will need to submit bids or self-schedules and follow all dispatch instructions. To account for the different components of a hybrid resource, the CAISO proposes to

³¹ CAISO tariff section 30.1.2.

³² CAISO tariff section 34.1.3.

implement a hybrid dynamic limit for scheduling coordinators of hybrid resources to communicate their real-time generating capability to the CAISO.³³ This functionality will allow scheduling coordinators to specify the upper and lower operational limits for the resource for each five-minute interval, over a rolling six-hour forward time horizon. Scheduling coordinators will update dynamic limits once every five minutes. The information will inform the CAISO's market optimization about the hybrid resources' availability both in the next dispatch interval as well as the near-term horizon based on available fuel, state of charge, or site charging needs. The forward time horizon proposed by the CAISO for hybrid dynamic limits encompasses the look-ahead horizons of the CAISO's real time-market processes.³⁴ Hybrid dynamic limits will serve as an input to these market processes

The CAISO proposes that hybrid dynamic limits should reflect resource availability based on operating capabilities such as State of Charge and forecasted output from the variable component of a Hybrid Resource. Scheduling coordinators may also use Hybrid Dynamic Limits to manage onsite charging of an energy storage component of a Hybrid Resource. This functionality, which the CAISO proposes to implement in the spring of 2022, will offer scheduling coordinators for hybrid resources an effective means to ensure the real-time market issues feasible dispatch instructions to a hybrid resource.

Using the dynamic limit tool alleviates the need for scheduling coordinators to utilize the CAISO's outage management system manually and submit outage cards for hourly unavailability for hybrid resources when outages occur for the reasons outlined above. Such a manual process, combined with the large number of outages and updates, would be difficult for scheduling coordinators to maintain and the CAISO to administer. The Commission should accept the hybrid dynamic limit because it reflects a more efficient and effective way to reflect the unavailability of hybrid resources in the real-time market optimization. Recognizing that scheduling coordinators will submit the hybrid dynamic limit to the CAISO, the CAISO plans to monitor the submission of this information and assess the accuracy and effectiveness of this functionality as part of the hybrid evolution stakeholder initiative the CAISO will commence in 2022. The CAISO also intends to monitor this data for potential economic withholding behavior.

C. The CAISO proposes to clarify resource adequacy rules related to hybrid resources

Under the CAISO's existing tariff, eligible intermittent resources and energy storage resources (whether a co-located resource or not) may provide resource adequacy capacity. Hybrid resources comprised of variable components and energy

³³ Proposed tariff section 30.5.6.1.

³⁴ The longest look-ahead period in the real-time market is the short-term unit commitment process, which has a look-ahead period of approximately 5 hours. CAISO tariff section 34.6.

storage components also may provide resource adequacy capacity. Resource adequacy rules are already in place for individual resources that could be co-located. The CAISO is not proposing any changes to the resource adequacy framework for co-located resources. Instead, the CAISO proposes two resource adequacy rule changes applicable to hybrid resources. First, the CAISO proposes to exempt hybrid resources from the resource adequacy availability incentive mechanism (RAAIM), which incentivizes resources to ensure they offer their capacity during specific availability assessment hours. Second, the CAISO clarifies rules for assessing hybrid resources' effective flexible capacity, which is the capacity value for which a hybrid resource can offer flexible resource adequacy capacity. These rules provide greater certainty to hybrid resources seeking to offer resource adequacy capacity.

Most resources shown by load serving entities as resource adequacy resources are subject to RAAIM.³⁵ RAAIM compares a resource's monthly availability to a defined performance threshold. Resource adequacy resources that are available less than the minimum performance standard incur a charge, while resources that perform above the standard receive a payment based on the charges collected. RAAIM's purpose is to incentivize resource adequacy resources to maximize their availability during months they are designated as resource adequacy capacity. Under the CAISO's existing tariff, variable energy resources are exempt from RAAIM. One reason for the exemption is that their resource adequacy capacity value is based on analysis of their historical performance, which accounts for their variable nature. Thus, their resource adequacy capacity value can decrease based on poor historical performance. Applying RAAIM would double penalize these resources for their unavailability, once by discounting their capacity contribution based on their performance in serving electric demand and again through a RAAIM charge.

In the CAISO's balancing authority area, local regulatory authorities such as the California Public Utilities Commission (CPUC) determine qualifying capacity for resource adequacy resources. Currently, the CPUC uses an effective load carrying capability (ELCC) methodology to assign resource adequacy values to solar and wind resources. This methodology applies an "effectiveness factor" to the nameplate value of the resource to determine the capacity value for which the renewable resources may count for resource adequacy purposes. The CPUC determines qualifying capacity for storage resources by determining how much energy the storage resource is capable of continuously discharging for four hours. Resources with a longer discharge duration do not receive a different amount of credit for resource adequacy capacity than those that can only provide energy for four hours. For co-located resources applying RAAIM, the resource adequacy availability incentive mechanism is straightforward. The variable energy resource component is exempt, but the incentive mechanism applies to the storage component. For hybrid resources, which have a single resource ID for the

³⁵ CAISO tariff section 40.9

aggregated components, the CPUC has established that hybrid resources' resource adequacy capacity value is equal to the combined value of the variable energy resource and the storage resource.³⁶ The variable energy resource component capacity value is discounted through the ELCC methodology and onsite charging and is then combined with the storage component capacity value. Applying RAIM to hybrid resources would potentially double penalize the hybrid resource's variable component for its unavailability. Moreover, it would require complex settlement provisions to separate the application of the incentive mechanism to the storage component of a hybrid resource. For these reasons, the Commission should approve the CAISO's proposal to exempt hybrid resources from RAIM.

Additionally, the CAISO proposes that the effective flexible capacity value of a hybrid resource will be the sum of what the effective flexible capacity values of the constituent components of the hybrid resource would be if those components were each a distinct generating unit.³⁷ This treatment is appropriate because it aligns with the flexible capacity counting rules in place for co-located resources and storage resources. Today, storage resources may count for flexibility from their minimum operating level up to their net qualifying capacity. This means that a storage resource can typically count for their full range of charging capability and discharging capability (from PMin to PMax) for flexible resource adequacy capacity. Storage can provide flexible support to the system between any of these values, and hence may show that amount of capacity as credit. Similarly, hybrid resources may also show an amount of credit between minimum and maximum operating levels for similar reasons.

D. Expanding the use of aggregate capability constraints at the generating facility level will accommodate commercial transactions between developers of co-located resources and off takers

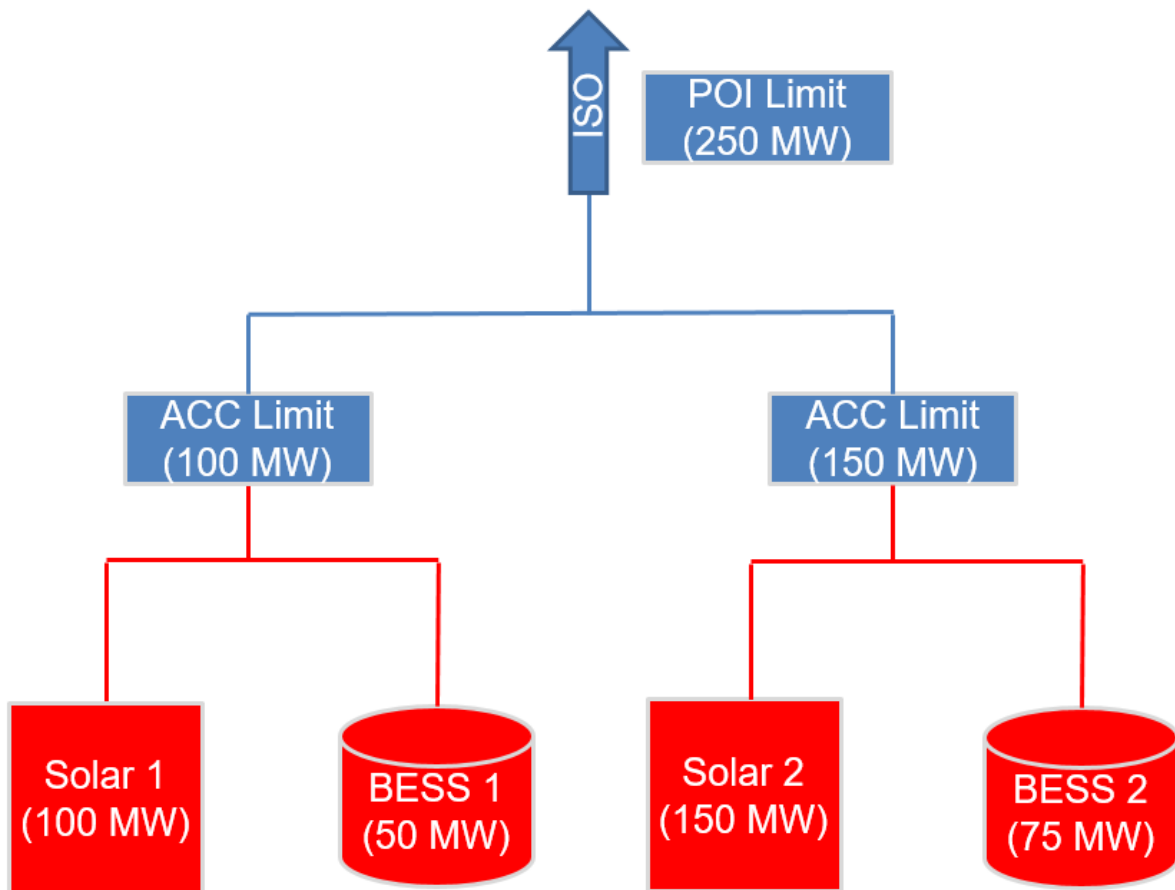
The proposal to allow multiple aggregate capability constraints at a single generating facility will facilitate market integration of a generating facility comprised of multiple co-located resources with different off-takers and scheduling coordinators. Developers and load serving entities alike have requested the CAISO allow use of multiple aggregate capability constraints at a single generating facility. The CAISO therefore proposes functionality to nest subordinate aggregate capability constraints within a master aggregate capability constraint at a generating facility. By nesting subordinate aggregate capability constraints under a master aggregate capability constraint, the CAISO can model each set of co-located resources using a subordinate aggregate capability constraint to reflect their maximum contractual operating levels, but ultimately limit resource awards and dispatch instructions to the portion of the

³⁶ CPUC Decision No.20-06-031 *Decision Adopting Local Capacity Obligations for 2021-2023, Adopting Flexible Capacity Obligations for 2021, and Refining the Resource Adequacy Program* dated June 30, 2020 at 25-31:
<https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M342/K083/342083913.PDF>.

³⁷ Proposed tariff section 40.10.4.1(g).

interconnection service capacity represented by the subordinate aggregate capability constraint. These market constraints will reflect off-takers' contractual limits under normal operating conditions. The Commission should accept this enhancement because it will accommodate current procurement practices designed to integrate energy storage, and it will help ensure an efficient and reliable dispatch of both co-located storage and renewable resources

The following example illustrates how the CAISO's proposal would work.



The figure above shows a scenario with four co-located resources (each with a separate Resource ID) at a single generating facility using two separate subordinate aggregate capability constraints. This example reflects a scenario in which a developer has contracted with two off-takers for portions of two physical resources, a 250 MW solar and a 125 MW storage resource. The first off-taker, represented on the left, receives contractual rights for 100 MW of the solar resource and 50 MW of the storage resource. A second off-taker, represented on the right, contracts for a 150 MW share of the solar facility and a 75 MW share of the storage resource. The CAISO's market considers each of the four resources as individual resources, each with a

resource ID, metering and bidding requirements, and requirements to respond to dispatch instructions.

As part of this proposal, the CAISO will enforce a master aggregate capability constraint to ensure that the market does not issue awards or dispatch instructions to a combination of the four resources that would exceed the studied interconnection limit of 250 MW. In addition, the CAISO will enforce a subordinate aggregate capability constraint on co-located resources utilizing a share of the generating capability at the resource. In this example, the CAISO would enforce a subordinate aggregate capability constraint on the two resources contracted to the first off-taker to limit their dispatch so it does not exceed the contractual operating limit of 100 MW. The CAISO will enforce a similar subordinate aggregate capability constraint on the resources contracted to the second off-taker to limit their dispatch so it does not exceed the 150 MW contracted limit.

During the CAISO's stakeholder process, some stakeholders expressed concern that the CAISO did not need to implement master and subordinate constraints. Under the CAISO's proposal, the master and subordinate aggregate capability constraints serve different functions. The master aggregate capability constraint limits combined dispatch from all co-located resources at a generating facility to no more than the studied interconnection capacity. These constraints are firm to ensure reliable interconnection service, and they cannot be relaxed by the market software. Stakeholders expressed interest in having similar treatment for subordinate aggregate capability constraints in the market optimization. The subordinate constraints are different and represent contractual limitations on the output of co-located resources, not reliability considerations. Subordinate aggregate capability constraints exist as limitations on output based on contractual entitlements.

Initially, the CAISO will utilize the same penalty price for the master and subordinate aggregate capability constraints in its market optimization. The CAISO will set this penalty price at a very high level. As a result, the market optimization will not relax either of these constraints. However, the CAISO proposes tariff language to allow it to relax enforcement of the subordinate aggregate capability constraints in its real-time market prior to relaxing enforcement of the system energy-balance constraint to ensure there is sufficient supply to meet demand.³⁸ The CAISO will only relax the subordinate capability constraint during instances when grid reliability is threatened, and the market optimization cannot balance supply and demand without relaxing the constraint. Under these conditions, the CAISO will relax a subordinate aggregate capability constraint, if the resources behind one of the subordinate constraints cannot generate to the level of their constraint and resources behind the other subordinate aggregate capability constraint can generate additional MW within the interconnection service capability of the generating facility. This condition could occur when one co-

³⁸ Proposed changes to tariff section 27.13.

located resource is on outage or otherwise unavailable. For example, the co-located storage resources for one off-taker may have no state of charge, while the other storage resources have a state of charge remaining to discharge.

The need to relax subordinate aggregate capability constraints should occur infrequently and only if there is capacity that otherwise would be stranded by the subordinate aggregate capability constraint and unavailable to serve demand. The frequency of relaxing the power balance constraints to address a supply and demand imbalance or other reliability concerns can serve as a proxy for an upper bound of how often the CAISO may need to relax a subordinate aggregate capability constraint. In its most recent annual report, the Department of Market Monitoring reported on the frequency of power balance relaxations that occurred in the 15-minute market and 5-minute intervals for calendar years 2018-2020.³⁹ These occurred only in a limited number of intervals. Stranding available generating capability behind a constraint during a potential supply and demand imbalance is unnecessary when the constraint reflects a contractual limit, as opposed to a physical limit. Doing so will not affect other co-located resources subject to a subordinate aggregate capability constraint at the generating facility that cannot operate because of an outage or lack of state of charge. The Commission should accept the CAISO's proposed tariff revisions governing the use of multiple aggregate capability constraints at a generating facility, including its proposal to relax subordinate aggregate capability constraints when necessary to meet reliability requirements.

During the CAISO's stakeholder process, one stakeholder requested the CAISO extend the use of aggregate capability constraints to resources that have pseudo-tie arrangements with the CAISO. The CAISO plans to explore this issue, and any needed rule changes, in the context of the active energy storage enhancements stakeholder initiative.⁴⁰ However, it is beyond the scope of the functionality the CAISO explored in the underlying stakeholder process and proposes herein.

IV. Effective Date and Request for Waiver

The CAISO is targeting an effective date of November 8, 2021 for the majority of these tariff revisions. The exception is that the CAISO plans to implement certain bidding functionality for hybrid resources in the spring of 2022. Out of an abundance of caution, and to accommodate any market preparedness activities, the CAISO requests the Commission authorize an effective date on or before December 1, 2021 for all of

³⁹ Department of Market Monitoring 2020 Annual Report, Figures 2.16 and 2.17:
<http://www.caiso.com/Documents/2020-Annual-Report-on-Market-Issues-and-Performance.pdf>.

⁴⁰ More information about this initiative is available on the following website:
<https://stakeholdercenter.caiso.com/StakeholderInitiatives/Energy-storage-enhancements>

the tariff revisions, except the dynamic limit functionality for hybrid resources. Additionally, these components will be subject to the CAISO filing a notice with the Commission within five days of the actual effective date. For the tariff revisions to implement dynamic limit functionality for hybrid resources, the CAISO requests an effective date on or before June 1, 2022, subject to the CAISO filing a notice with the Commission within five days of the actual effective date.⁴¹ The CAISO also requests waiver of Commission's 120-day notice requirement between the date a rate schedule is filed and the date it must take effect. Waiving this requirement will give the CAISO and market participants regulatory certainty and ample time to implement the tariff revisions as part of the CAISO's planned software release in the spring of 2022.

V. Communications

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

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*Individuals designated for service pursuant to Rule 203(b)(3).⁴²

VI. Service

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

⁴¹ The CAISO has included an effective date of 12/31/9998 for the tariff records submitted in this filing. The CAISO will notify the Commission of the actual effective date of these tariff records within five business days of implementation in an eTariff submittal using Type of Filing code 150 – Report.

⁴² 18 C.F.R. § 385.203(b)(3).

VII. Materials Provided In This Filing

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

- Attachment A Clean tariff sheets incorporating the revisions described in this filing
- Attachment B Sheets showing, in redline format, the changes to the currently effective tariff described in this filing⁴³
- Attachment C: Materials presented to the CAISO Board of Governors regarding Hybrid Resources Phase 2 and record of vote dated November 18, 2020
- Attachment D: Materials presented to the CAISO Board of Governors regarding Hybrid Resources Aggregate Capability Constraint Implementation and record of vote dated July 15, 2021
- Attachment E: Table reflecting each tariff change with justification

⁴³ The CAISO includes pending language not yet in effect for tariff records 29.11, 29.34, and 34.1.6 from active filings in dockets ER21-955 and ER21-2593, both of which are expected to take effect prior to the effective date of this filing.

VIII. Conclusion

For the reasons described above, the CAISO respectfully requests that the Commission accept the CAISO's proposed tariff revisions. Please do not hesitate to contact the undersigned if you have any questions.

Respectfully submitted,

By: /s/ Andrew Ulmer

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Counsel for the California Independent
System Operator Corporation

Dated: September 8, 2021

Attachment A – Clean Tariff
Hybrid Resources and Co-located Resources
California Independent System Operator Corporation
September 8, 2021

Appendix A

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- High Sustainable Limit

The instantaneous generating capability of a variable Generating Unit (or component thereof), provided to the CAISO through telemetry at the Generating Unit.

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- Hybrid Dynamic Limit

A Real-Time Market Bid parameter representing the real-time capabilities of Hybrid Resources, used to ensure feasible Schedules.

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Section 4

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4.6.11 Storage Operating Characteristics

Pursuant to Section 4.6.4, a Scheduling Coordinator for a storage resource participating as a Non-Generator Resource or Pumped-Storage Hydro Unit must submit to the CAISO the operational and technical constraints to the Master File representing an accurate reflection of the resource's design capabilities and its constituent equipment when operating at maximum sustainable performance over Minimum Run Time, recognizing that resource performance may degrade over time. Non-Generator Resources, Hybrid Resources, and Pumped-Storage Hydro Units may include among their Master File parameters the constraints listed in Section 27.9 to the extent they comply with this Section.

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4.18 Hybrid Resources

In addition to the rights and obligations of this section, Hybrid Resources are Generating Units subject to Section 4.6. Scheduling Coordinators for Hybrid Resources will provide data regarding the capacity and the operating characteristics of their components as may be reasonably requested from time to time by the CAISO. All information provided to the CAISO regarding the operational and technical constraints in

the Master File must be an accurate reflection of the design capabilities of the Hybrid Resources and their constituent equipment when operating at maximum sustainable performance over Minimum Run Time, recognizing that performance may degrade over time. Hybrid Resources are not Variable Energy Resources or Eligible Intermittent Resources; however, consistent with Section 4.8.2, Hybrid Resources that include a variable component must provide the CAISO with the data for that component that would be required by Appendix Q. Hybrid Resources with a variable or intermittent component also must provide the CAISO with telemetry and Meter Data on the variable components in addition to the Generating Facility's metering requirements under Section 10. Hybrid Resources' telemetry must include the High Sustainable Limit. Hybrid Resources that include an energy storage component must provide the CAISO with telemetry on the energy storage component's State of Charge.

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Section 27

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27.13 Aggregate Capability Constraint

At the request of the Interconnection Customer, the CAISO may enforce an Aggregate Capability Constraint for Generating Facilities with Co-located Resources that reflects a Generating Facility's maximum and minimum capability or a portion of that capability for purposes of Day-Ahead Market Awards, Real-Time Market Awards, and Real-Time Dispatch as described in the CAISO's Business Practice Manuals. If the combined PMax of Co-located Resources associated with a single Generating Facility would exceed the Interconnection Service Capacity of that Generating Facility, the Interconnection Customer may request that the CAISO enforce an Aggregate Capability Constraint or multiple Aggregate Capability Constraints at the Generating Facility as described in the CAISO's Business Practice Manuals. If the Interconnection Customer requests that the CAISO enforce multiple Aggregate Capability Constraints, the CAISO will enforce an Aggregate Capability Constraint at the Generating Facility level and subordinate Aggregate Capability Constraints at the level of Resource IDs.

If the Interconnection Customer does not elect an Aggregate Capability Constraint(s), the combined PMax of the Co-located Resources registered in the Master File for that Generating Facility may not exceed the Generating Facility's Interconnection Service Capacity. EIM Participating Resource Scheduling Coordinators also may request that the CAISO enforce an Aggregate Capability Constraint or multiple Aggregate Capability Constraints for Co-located Resources, subject to the prior written approval of the applicable EIM Entity Balancing Authority that enforcing an Aggregate Capability Constraint(s) for Co-located Resources does not create a threat to safety or reliability.

As described in the CAISO's Business Practice Manuals the CAISO may relax enforcement of subordinate Aggregate Capability Constraints in its Real-Time Market prior to relaxing enforcement of the system energy-balance constraint specified in Sections 27.4.3.3.4 to ensure there is sufficient Supply to meet the CAISO Forecast of CAISO Demand.

Notwithstanding Section 34.13, a Generating Facility whose Co-located Resources, including Variable Energy Resources, do not comply with Dispatch Instructions such that their output exceeds the

Interconnection Service Capacity of the Generating Facility, will be ineligible for the Aggregate Capability Constraint. In such cases, the CAISO will adjust the PMaxes of those Co-located Resources proportionate to each Generating Unit's capacity such that the sum of the PMax values equals the Interconnection Service Capacity of the Generating Facility, or as requested by the Interconnection Customer so long as the total value does not exceed the Interconnection Service Capacity of the Generating Facility.

Similar to other Generating Facilities with multiple Resource IDs, the CAISO will have no liability with respect to Co-located Resources or their Scheduling Coordinators if Co-located Resources do not comply with Dispatch Instructions and infringe on Interconnection Service Capacity used by other Co-located Resources at a Generating Facility.

In the event that Co-located Resources in an EIM Entity Balancing Authority area do not comply with Dispatch Instructions such that their output exceeds the interconnection service capacity for the Co-located Resources, the CAISO will ask the applicable EIM Entity Balancing Authority whether it will revoke its prior approval of enforcing the Aggregate Capability Constraint for such Co-located Resources. The following resources are not eligible to use the Aggregate Capability Constraint: Multi-Stage Generators, Pseudo-Tie Resources, Proxy Demand Response, Pumped Storage Hydro Units, Metered Subsystems, and Use-Limited Resources.

Scheduling Coordinators may not offer or self-provide Ancillary Services into the CAISO's Markets or receive Uncertainty Awards from Generating Units that are subject to Aggregate Capability Constraints until the CAISO issues a Market Notice stating this restriction will no longer apply. The Pricing Node for the Generating Units or EIM Participating Resources subject to an Aggregate Capability Constraint will be their Point of Interconnection.

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Section 29

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29.2 EIM Entity Access to the Real-Time Market

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(b) Implementation of Access as an EIM Entity.

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(7) **Readiness Criteria.**

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- (C) **Forecasting Capability.** The CAISO and, to the extent the prospective EIM entity will use its own forecasts or is otherwise required to provide forecasting information to the CAISO, the prospective EIM Entity have demonstrated their respective forecasting capability through –
- (i) the definition of EIM Demand forecast boundaries based on the conforming and non-conforming Load characteristics, as applicable;
 - (ii) the accuracy of the CAISO forecast of EIM Demand based on historical actual Load data for the defined EIM Demand forecast boundaries;
 - (iii) the identification of weather stations locations used in forecasting, as applicable;
 - (iv) the identification of the source of Variable Energy Resource forecasts pursuant to Section 29.11(j); and
 - (v) the identification of the source of Hybrid Resource forecasts pursuant to Section 29.11(j).

* * * * *

29.6 Communications

- (a) **EIM Entity.** The EIM Entity shall meet the technical and communication requirements specified in the Business Practice Manual for the Energy Imbalance Market, which shall be based on the Inter-Control Center Communication Protocol and Reliability Standards.
- (b) **EIM Communications and OASIS.** Section 6 shall govern communications and information availability regarding the participation of EIM Market Participants in the Real-Time Market except that –
- (1) references to internal resources shall be deemed to include EIM Resources;
 - (2) references in Sections 6.2.2.1 and 6.5.2.1 to the CAISO Controlled Grid and references in Sections 6.5.4.2.2(a) and 6.5.5.1.1 to CAISO Balancing Authority Area shall be deemed references to the EIM Area; and
 - (3) the provisions of Section 6.3.1 that authorize the CAISO to communicate directly with Generators and Demand Response Providers to ensure System Reliability shall not apply to Generators and Demand Response Providers in the EIM Entity's Balancing Authority Area or pseudo-tied from an external Balancing Authority Area to the EIM Entity Balancing Authority Area.
- (c) **Loss of Communications.**
- (1) **Procedures.** The CAISO and each EIM Entity and EIM Entity Scheduling Coordinator shall establish procedures to address an interruption of Real-Time Market communications, which shall include steps to be taken to restore

communications and address any impact on system or market operations as provided in Section 29.

- (2) **Responsibilities.** An EIM Entity that loses communication with the CAISO remains responsible for managing its Balancing Authority Area imbalance needs without balancing Energy from the Real-Time Market.
- (d) **Variable Energy Resource Forecast Communications.** If the EIM Participating Resource Scheduling Coordinator for a Variable Energy Resource elects to use an independent forecasting service, it must make data transfer arrangements with the CAISO for the CAISO to receive the forecast in a format and on a schedule set forth in the Business Practice Manual for the Energy Imbalance Market.
- (e) **Hybrid Resource Forecast Communications.** If the EIM Participating Resource Scheduling Coordinator for a Hybrid Resource elects to use an independent forecasting service, it must make data transfer arrangements with the CAISO for the CAISO to receive the forecast in a format and on a schedule set forth in the Business Practice Manual for the Energy Imbalance Market.

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29.11 Settlements and Billing for EIM Market Participants.

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- (j) **Variable Energy Resource and Hybrid Resource Forecast Charge.**
 - (1) **In General.** The CAISO will charge EIM Entity Scheduling Coordinators and EIM Participating Resource Scheduling Coordinators a fee for the Variable Energy Resource or Hybrid Resource forecasting services in accordance with Appendix F, Schedule 4.
 - (2) **Waiver.** The CAISO will waive the Variable Energy Resource or Hybrid Resource forecast charge if an EIM Entity has an independent forecast for its Variable Energy Resources or Hybrid Resource and provides the independent forecast to the CAISO.

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29.34 EIM Operations

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- (q) **Variable Energy Resources and Hybrid Resources.** Provisions of Section 34 specifically applicable to Variable Energy Resources and Eligible Intermittent Resources appear in Sections 34.1.3, 34.1.6, 34.2.2, 34.5.1. 34.13.2. Provisions of Section 34 specifically applicable to Hybrid Resources appear in Section 34.1.6.3.

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Section 30

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30.5.6.1 Hybrid Resource Bids

In addition to the Bid components listed in this Section 30.5, Scheduling Coordinators representing Hybrid Resources will submit Hybrid Dynamic Limits representing Hybrid Resources' upper economic limit and lower economic limit in each Real-Time Market five-minute Trading Interval for a rolling six-hour look-ahead period. These limits will reflect the range of the Hybrid Resource's Economic Bids or Self-Schedules. Hybrid Dynamic Limits should reflect resource availability based on operating capabilities such as State of Charge and forecasted output from the variable component of a Hybrid Resource. Scheduling Coordinators may also use Hybrid Dynamic Limits to manage onsite charging of an energy storage component of a Hybrid Resource.

The CAISO will use reasonable efforts to issue Real-Time Market Schedules that respect Hybrid Dynamic Limits. Scheduling Coordinators may not submit Hybrid Dynamic Limits in the Day-Ahead Market.

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Section 31

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31.2 Day-Ahead MPM Process

After the Market Close of the DAM, and after the CAISO has validated the Bids pursuant to Section 30.7, the CAISO will perform the MPM process, which is a single market run that occurs prior to the IFM Market

Clearing run. The Day-Ahead MPM process determines which Bids need to be mitigated to the applicable Default Energy Bids in the IFM pursuant to Section 31.2.3. For Maximum Net Dependable Capacity of Legacy RMR Units, Bids will be mitigated to the RMR Proxy Bids pursuant to Section 31.2.3. The Day-Ahead MPM process optimizes resources to meet Demand reflected in Demand Bids, including Export Bids and Virtual Demand Bids, and to procure one hundred (100) percent of Ancillary Services requirements based on Supply Bids submitted to the DAM. Virtual Bids and Bids from Demand Response Resources, Participating Load, Hybrid Resources, and Non-Generator Resources are considered in the MPM process, but are not subject to Bid mitigation. Bids from Participating Load resources that are not subject to Bid mitigation will also be considered in the MPM process. Bids from resources comprised of multiple technologies that include Non-Generator Resources will remain to be subject to all applicable market power mitigation under the CAISO Tariff, including Local Market Power Mitigation. The mitigated or unmitigated Bids and RMR Proxy Bids identified in the MPM process for all resources that cleared in the MPM are then passed to the IFM. The CAISO performs the MPM process for the DAM for the twenty-four (24) hours of the targeted Trading Day.

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Section 34

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34.1.5 Mitigating Bids in the RTM

34.1.5.1 Generally

After the Market Close of the RTM, after the CAISO has validated the Bids pursuant to Section 30.7 and Section 34.1.4, and prior to conducting any other RTM processes, the CAISO conducts a MPM process. The results are used in the RTM optimization processes. Bids on behalf of Demand Response Resources, Participating Load, Hybrid Resources, and Non-Generator Resources are considered in the MPM process but are not subject to Bid mitigation. Bids from resources comprised of multiple technologies that include Non-Generator Resources will remain to be subject to all applicable market power mitigation under the CAISO Tariff, including Local Market Power Mitigation.

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34.1.6.3 Hybrid Resources

The CAISO will use reasonable efforts to issue Real-Time Market Schedules that observe Hybrid Resources' Dynamic Limits, High Sustainable Limits, State of Charge, and production forecasts, as applicable. Hybrid Resources with a variable component may elect to receive a CAISO forecast to inform their bidding, or they may elect to use their own forecast. For Hybrid Resources that have elected to use their own forecast as specified in Section 4.8.2.1.1, the responsible Scheduling Coordinator must submit to the CAISO its forecast for the variable component for the binding interval by 37.5 minutes prior to flow (the start of the applicable FMM optimization for the binding interval). If such Scheduling Coordinator does not provide such forecast to the CAISO, the CAISO will use the direct telemetry MW output from the resource's variable component.

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Section 40

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40.9.2 Exemptions

- (a) **Capacity Exempt from RAAIM – All Provisions.** The entire capacity of a resource in any of the following categories is exempt from the RAAIM provisions in Section 40.9 –
- (1) Resources with a PMax less than 1.0 MW;
 - (2) Non-specified resources that provide Resource Adequacy Capacity under contracts for Energy delivered within the CAISO Balancing Authority Area;
 - (3) Participating Load that is also Pumping Load; and
 - (4) Legacy RMR Units.
- (b) **Capacity Exempt from RAAIM – Local/System**
- (1) The entire capacity of a resource in any of the following categories is exempt from the RAAIM provisions in Section 40.9 applicable to local and system Resource Adequacy Capacity –
 - (A) Variable Energy Resources;
 - (B) Combined Heat and Power Resources;
 - (C) Run-of-River Resources; and
 - (D) Hybrid Resources.
 - (2) The capacity of a resource with a Load-following MSS as its Scheduling Coordinator that is designated on a Load-following MSS's monthly Resource Adequacy Plan is exempt from the RAAIM provisions in Section 40.9 applicable to local and system Resource Adequacy Capacity, to the extent that the resource's capacity is also designated as Resource Adequacy Capacity on the monthly Supply Plan of that Load-following MSS or another Load-following MSS.
 - (3) Resources with Existing QF Contracts or Amended QF Contracts that are Resource Adequacy Resources are exempt from the RAAIM provisions in Section 40.9 applicable to local and system capacity --
 - (A) if the QF resource previously provided Resource Adequacy Capacity pursuant to an Existing QF Contract that was executed prior to August 22, 2010 and remained in effect pursuant to California Public Utilities Commission Decision 07-09-040 that extended the term of expiring contracts until such time as the new contracts resulting from that decision are available; or

(B) until the QF Resource's Existing QF Contract or Amended QF Contract terminates or if requested by the Scheduling Coordinator for the resource, whichever is earlier.

(c) **Capacity Exempt from RAAIM – Flexible Capacity.**

- (1) The capacity of Use-Limited Resources in a combination under Section 40.10.3.2(b), 40.10.3.3(b) or 40.10.3.4(b) is exempt from the RAAIM provisions in Section 40.9 applicable to Flexible RA Capacity to the extent that the resources are committed to provide Flexible RA Capacity as a combination on their respective monthly Supply Plans.
- (2) The Capacity of a resource with a Load-following MSS as its Scheduling Coordinator that is designated on a Load-following MSS's monthly Flexible RA Plan is exempt from the RAAIM provisions in Section 40.10 applicable to Flexible RA Capacity, to the extent that the resource's capacity is also designated as Flexible RA Capacity on the monthly Supply Plan of that Load-following MSS or another Load-following MSS.

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40.10.4 Effective Flexible Capacity

The CAISO shall calculate the Effective Flexible Capacity value for each resource. The CAISO shall publish the draft and final lists of the Effective Flexible Capacity values for such resources and the Flexible Capacity Categories for which each resource qualifies to provide Flexible Capacity on the CAISO Website each year in accordance with the schedule for publishing the Net Qualifying Capacity values, as set forth in the BPM, for use in the next calendar year.

40.10.4.1 Effective Flexible Capacity Calculation

- (a) **Flexible Resources.** The CAISO will calculate the Effective Flexible Capacity value of a resource, for use (i) if a Local Regulatory Authority has not established criteria for calculating the Effective Flexible Capacity value for eligible resource types, and (ii) for determining if a cumulative deficiency exists under Sections 43A.2.7(a) and (b), as follows, except as provided in Sections 40.10.4.1 (b) through (f) –
 - (1) If the Start-Up Time of the resource is greater than 90 minutes, the Effective Flexible Capacity value shall be the weighted average ramp rate of the resource calculated from PMin to Net Qualifying Capacity multiplied by 180 minutes. The Effective Flexible Capacity shall not exceed the difference between the PMin and PMax of the resource.
 - (2) If the Start-Up Time of the resource is less than or equal to 90 minutes, the Effective Flexible Capacity value shall be the resource's PMin plus the weighted average ramp rate of the resource calculated from PMin to Net Qualifying Capacity multiplied by the difference between 180 minutes and the resource's Start-Up Time. The Effective Flexible Capacity shall not exceed the Net Qualifying Capacity of the resource.
- (b) **Hydroelectric Generating Unit.** The Effective Flexible Capacity of a hydroelectric generating unit will be the amount of capacity from which the resource can produce Energy consistently for 6 hours assuming that the resource's physical storage is at

maximum capacity at the beginning of that six-hour period. The Effective Flexible Capacity of a hydroelectric generation unit cannot, however, exceed its Net Qualifying Capacity.

- (c) **[Not Used]**
- (d) **Energy Storage Resource.** The Effective Flexible Capacity value for an energy storage resource will be determined as follows –
 - (1) for an energy storage resource that provides Flexible RA Capacity but not Regulation Energy Management, the Effective Flexible Capacity value will be the MW output range the resource can provide over three hours of charge/discharge while constantly ramping.
 - (2) for an energy storage resource that provides Flexible RA Capacity and Regulation Energy Management, the Effective Flexible Capacity value will be the resource's 15-minute energy output capability.
- (e) **Multi-Stage Generating Resource.** The Effective Flexible Capacity value for a Multi-Stage Generating Resource will be calculated using the longest Start-Up Time of the resource's configuration that has the lowest PMin.
- (f) **Combined Heat and Power Resource.** The Effective Flexible Capacity value of a Combined Heat and Power Resource will be the lesser of (i) the resource's Net Qualifying Capacity, or (ii) the MW difference between the CHP resource's maximum output and its RMTMax, if the resource has a RMTMax, or its minimum operating level, such quantity not to exceed the quantity of generating capacity capable of being delivered over a three-hour period.
- (g) **Hybrid Resource.** The Effective Flexible Capacity value of a Hybrid Resource is the sum of what the Effective Flexible Capacity values of the constituent components of the Hybrid Resource would be if those components were each a distinct Generating Unit.

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Appendix F

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Schedule 4

Eligible Intermittent Resources Forecast Fee

A charge up to \$.10 per MWh shall be assessed on the metered Energy from (a) Eligible Intermittent Resources; (b) Variable Energy Resources that are EIM Participating Resources; and (c) the variable component of Hybrid Resources as a Forecast Fee, provided that Generating Units smaller than 10 MW that are not Participating Intermittent Resources and that sell power pursuant to a power purchase agreement entered into pursuant to PURPA prior to entering into a PGA or Net Scheduled PGA shall be exempt from the Forecast Fee.

The rate of the Forecast Fee shall be determined so as to recover the projected annual costs related to developing Energy forecasting systems, generating forecasts, validating forecasts, and monitoring

forecast performance, that are incurred by the CAISO as a direct result of participation by Eligible Intermittent Resources Variable Energy Resources that are EIM Participating Resources, and the variable component of Hybrid Resources in CAISO Markets, divided by their projected annual Energy production.

The initial Forecast Fee, and all subsequent changes as may be necessary from time to time to recover costs incurred by the CAISO for the forecasting conducted on the behalf of Eligible Intermittent Resources, Variable Energy Resources that are EIM Participating Resources, and the variable component of Hybrid Resources pursuant to the foregoing rate formula, shall be set forth in a Business Practice Manual.

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Appendix K

Part A CERTIFICATION FOR REGULATION

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A 1.2.2.4 Ancillary Service Providers for Non-Generator Resources (whether or not the resource uses Regulation Energy Management) and Hybrid Resources shall provide CAISO the following additional telemetry data as applicable

- Resource Ramp Rate when operating as Generation (MW/min);
- Resource Ramp Rate when operating as Load (MW/min);
- The maximum instantaneous ability to produce or consume Energy in MW; and
- The maximum capability to provide Energy as expressed in MWh over a fifteen (15) minute interval where the Scheduling Coordinator has elected to provide MWh constraints pursuant to Section 27.9 of the CAISO Tariff.

A 1.2.2.5 Ancillary Service Providers for an Eligible Intermittent Resource or a Hybrid Resource with a variable component must provide the CAISO High Sustainable Limit for their resource.

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Part B CERTIFICATION FOR SPINNING RESERVE

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B 1.7: Ancillary Service Providers for an Eligible Intermittent Resource or a Hybrid Resource with a variable component must provide the CAISO with the High Sustainable Limit for their resource.

Part C CERTIFICATION FOR NON-SPINNING RESERVE

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C 2.3 Ancillary Service Providers for an Eligible Intermittent Resource or a Hybrid Resources with a variable component must provide the CAISO with the High Sustainable Limit for their resource.

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Appendix Q

Eligible Intermittent Resources Protocol (EIRP)

1 SCOPE

1.1 Scope of Application to Parties

This EIRP applies to the CAISO and to:

- (a) Scheduling Coordinators (SCs);
- (b) Eligible Intermittent Resources that are not certified as Participating Intermittent Resources;
- (c) Participating Intermittent Resources; and
- (d) Hybrid Resources with a wind generation or solar generation component.

1.2 Liability of the CAISO

Any liability of the CAISO arising out of or in relation to this EIRP shall be subject to Section 14 of the CAISO Tariff as if references to the CAISO Tariff were references to this EIRP.

2 REQUIREMENTS FOR ELIGIBLE INTERMITTENT RESOURCES, PARTICIPATING INTERMITTENT RESOURCES, AND HYBRID RESOURCES WITH VARIABLE COMPONENT

2.1 No Mandatory Participation

Eligible Intermittent Resources may elect to be scheduled and settled as the CAISO Tariff provides for Generating Units, and are not required to seek certification as Participating Intermittent Resources.

2.2 Minimum Certification Requirements

Eligible Intermittent Resources, Participating Intermittent Resources, and Hybrid Resources with a variable component must meet the following requirements, as applicable.

2.2.1 Agreements

The following agreements must be executed by the owner or operator of any Eligible Intermittent Resource, unless that resource is not subject to any of these agreements pursuant to the CAISO Tariff, such as an Eligible Intermittent Resource of an MSS Operator:

- (a) A Participating Generator Agreement, Net Scheduled PGA, Dynamic Scheduling Agreement for Scheduling Coordinators, or Pseudo-Tie Participating Generator Agreement that, among other things, binds the Eligible Intermittent Resource to comply with the CAISO Tariff; and
- (b) A Meter Service Agreement for CAISO Metered Entities, for all Eligible Intermittent Resources other than Dynamic System Resources.

If an Eligible Intermittent Resource intends to become a Participating Intermittent Resource, it must also execute a letter of intent, which when executed and delivered to the CAISO shall initiate the process of certifying the Participating Intermittent Resource. The form of the letter of intent shall be specified by the CAISO in a Business Practice Manual.

Hybrid Resources with a variable component must execute all agreements that are otherwise required in this CAISO tariff.

2.2.2 Composition of a Participating Intermittent Resource

The CAISO shall develop criteria to determine whether one or more Eligible Intermittent Resources may be included within a Participating Intermittent Resource. Such criteria shall include:

- (a) A Participating Intermittent Resource must be at least one (1) MW rated capacity.
- (b) A Participating Intermittent Resource may include one (1) or more Eligible Intermittent Resources that have similar response to weather conditions or other variables relevant to forecasting Energy, as determined by the CAISO.
- (c) Each Participating Intermittent Resource shall be electrically connected at a single point on the CAISO Controlled Grid, except as otherwise permitted by the CAISO on a case-by-case basis as may be allowed under the CAISO Tariff. Interconnection to a portion of the CAISO Controlled Grid outside or not contiguous to the CAISO Balancing Authority Area does not make an Eligible Intermittent Resource that is a Dynamic System Resource or Pseudo-Tie Generating Unit eligible to be included within a Participating Intermittent Resource.
- (d) The same Scheduling Coordinator must schedule all Eligible Intermittent Resources aggregated into a single Participating Intermittent Resource.

2.2.3 Equipment Installation

Eligible Intermittent Resources and Hybrid Resources with a variable component must install and maintain the communication equipment required pursuant to Section 3 of this EIRP, and the equipment supporting forecast data required pursuant to Section 4 of this EIRP.

2.2.4 Forecast Model Validation

The CAISO must determine that sufficient historic and real-time telemetered data are available to support an accurate and unbiased forecast of Energy generation by a Participating Intermittent Resource, according to the forecasting process validation criteria described in Section 4 of this EIRP.

2.2.5 [Not Used]

2.3 Notice of Certification of a Participating Intermittent Resource

When all requirements described in Section 2.2 of this EIRP applicable to Participating Intermittent Resources have been fulfilled, the CAISO shall notify the Scheduling Coordinator and the representatives of the Eligible Intermittent Resources comprising the Participating Intermittent Resource that the Participating Intermittent Resource has been certified, and is eligible for the settlement terms provided under Section 11.12 of the CAISO Tariff, as conditioned by the terms of this EIRP.

2.4 Additional Requirements

2.4.1 Forecast Fee

An Eligible Intermittent Resource must pay the Forecast Fee for all metered Energy generated by the Eligible Intermittent Resource, as specified in CAISO Tariff Appendix F, Schedule 4. A Hybrid Resource with a variable component must pay the Forecast Fee for all metered Energy generated by variable component, as specified in CAISO Tariff Appendix F, Schedule 4, if it elects, per section 3.1 of this EIRP, to have the CAISO produce a forecast of the output of the Hybrid Resource's variable component.

2.4.2 Modification of Participating Intermittent Resource Composition

A Participating Intermittent Resource may seek to modify the composition of the Participating Intermittent Resource (e.g., by adding or eliminating an Eligible Intermittent Resource from the Participating Intermittent Resource). Such changes shall not be implemented without prior compliance with the written approval by the CAISO. The CAISO will apply consistent criteria and expeditiously review any proposed changes in the composition of a Participating Intermittent Resource.

2.4.3 Changes in Scheduling Coordinator

This EIRP does not impose any additional requirement for CAISO approval to change the Scheduling Coordinator for an approved Participating Intermittent Resource than would otherwise apply under the CAISO Tariff to changes in the Scheduling Coordinator representing a Generating Unit.

2.4.4 Continuing Obligation

Eligible Intermittent Resources (including Participating Intermittent Resources) and Hybrid Resources with a variable component have a continuing obligation to meet all applicable obligations established under the CAISO Tariff and this EIRP, and must fully cooperate in providing all data, other information, and authorizations the CAISO reasonably requests to fulfill its obligation to validate forecast models and explain deviations.

2.4.5 Failure to Perform

If the CAISO determines that a material deficiency has arisen in the Participating Intermittent

Resource's fulfillment of its obligations under the CAISO Tariff and this EIRP, and such Participating Intermittent Resource fails to promptly correct such deficiencies when notified by the CAISO, then the eligibility of the Participating Intermittent Resource for the settlement accommodations provided in Section 11.12 of the CAISO Tariff shall be suspended until such time that the unavailable data is provided or other material deficiency is corrected to the CAISO's reasonable satisfaction. Such suspension shall not relieve the Scheduling Coordinator for the deficient Participating Intermittent Resource from paying the Forecast Fee over the duration of the period covered by the letter of intent described in Section 2.2.1(c) of this EIRP.

3 COMMUNICATIONS

3.1 Forecast Data

The CAISO may require various data relevant to forecasting Energy from an Eligible Intermittent Resource or Hybrid Resource with a variable component to be telemetered to the CAISO, including appropriate operational data, meteorological data or other data reasonably necessary to forecast Energy.

In order for the CAISO to forecast Energy, an Eligible Intermittent Resource or Hybrid Resource with a variable component must provide the CAISO with MW production data and meteorological data as outlined in this Eligible Intermittent Resources Protocol. This data must be collected for a minimum of thirty (30) consecutive days and be of sufficient quality as determined by a CAISO to produce a state of the art forecast.

A Hybrid Resource with a wind generation or solar generation component may elect to provide its own forecasted production in lieu of a CAISO forecast but such election does not relieve the resource of the obligation to provide production data and meteorological data as otherwise required in this Eligible Intermittent Resources Protocol.

3.1.1 Wind Generation Meteorological Station Requirements

Each wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component must install and maintain equipment required by the CAISO to support accurate power generation forecasting and the communication of such forecast, meteorological, and other required data to the CAISO consistent with the timeframes specified in this Eligible Intermittent Resource Protocol.

3.1.1.1 Each wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component shall install a minimum of one meteorological station to measure barometric pressure, temperature, wind speed and direction. If such a resource has a rated capacity of five (5) MW or greater, then the resource shall install a minimum of two meteorological stations to measure barometric pressure, temperature, wind speed and direction. If an Eligible Intermittent Resource or Hybrid Resource with a wind generation component, as part of compliance with any other contractual or regulatory requirement outside of this Eligible Intermittent Resource Protocol, provides data from more than the two required meteorological stations to an entity other than the CAISO, then the resource must also submit data from any additional meteorological station to the CAISO.

3.1.1.2 Each wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component shall locate its meteorological station(s) on the windward side of the wind farm. Each such resource must install one meteorological station at the average hub height of the wind turbines. Hub height is the distance from the ground to the center of the turbine axis. If a second meteorological station is required, then it may be so co-located with the primary station. The approximate distance separating the primary station and the secondary station shall be an average of one (1) rotator blade length. Where placement of the meteorological station(s) in accordance with this Eligible Intermittent Resource Protocol would reduce production or violate a local, state, or federal statute, regulation or ordinance, the CAISO, in coordination with any

applicable forecast service provider, will coordinate with the resource to identify an acceptable placement of the meteorological station.

3.1.1.3 The use of SODAR¹ and/or LIDAR² equipment may be an acceptable substitute for wind direction and velocity only after obtaining prior agreement from the CAISO.

3.1.1.4 Wind Eligible Intermittent Resources and Hybrid Resources with a wind generation component may not satisfy the meteorological station location requirements through a sharing agreement with another resource.

3.1.2 Wind Generation Meteorological Data Requirements

Table Q-1 details the units and accuracy of measurements for telemetry data points wind Eligible Intermittent Resources and Hybrid Resources with a wind generation component must send to the CAISO in real time (i.e., every 4 seconds).

Table Q-1 Wind Telemetry Data Points

Element	Device(s) Needed	Units	Accuracy
Wind Speed (Meter / Second)	Anemometer, wind vane and wind mast	m/s	± 2m/s
Air Temperature (Degrees Celsius)	Temperature probe & shield for ambient temp	°C	± 1°
Barometric Pressure (hecto Pascals)	Barometer	hPA	± 60 hPa
Real Time Data		MWs*	
High Sustainable Limit (for Hybrid Resources with a wind generation component and wind EIRs that are a Co-located Resource)		MWs**	

* Hybrid Resources with a wind generation component must provide MW values through telemetry for both the wind generation component and the overall Hybrid Resource

** High Sustainable Limit may be updated every 12 seconds.

3.1.3 Designated Turbines

For any wind eligible Intermittent Resource or Hybrid Resource with a wind generation component, designated turbines are required to improve forecast accuracy within a wind park. The CAISO shall identify a designated turbine, from which the resource shall provide nacelle wind

¹ SODAR means Sonic Detection and Ranging- a meteorological instrument also known as a wind profiler which measures the scattering of sound waves by atmospheric turbulence.

² LIDAR means Light Detection and Ranging - a meteorological instrument which measures the properties of scattered light waves caused by atmospheric turbulence.

speed and wind direction every four seconds. Wind EIRs with a PGA or NS PGA that are operating or have final regulatory approvals to construct as of November 1, 2018, that have wind turbines without nacelle anemometers need not comply with the requirements of this section for Designation Turbines. However, when the wind EIR repowers or replaces a portion of its existing wind turbines, then the Wind EIR must become compliance with the requirements of this section for Designated Turbines.

3.1.4 Topographical Map

A wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component must submit a topographical map that illustrates the location and height for each wind turbine within a wind park. The map must identify all meteorological stations and turbine location by latitude and longitude and should be in degrees/decimals using WGS84 geodetic datum only.

3.1.5 Site Information

A wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component must provide the site information specified below in the manner and format as specified through the CAISO new resource implementation process. Latitude and Longitude should be in degrees/decimals using WGS84 geodetic datum only.

1. Park Potential (MW; numeric-float field [example: 100.5])
2. Resource Project Corner Coordinates in WGS84 format
3. Meteorological Station ID Numbers
4. Meteorological Station Coordinates in WGS84 format
5. Address
6. Resource ID
7. MW Generation Capacity
8. Plant Location (Latitude and Longitude in WGS84)
9. Lidar or Sodar (required)
10. Make (required; alphanumeric)
11. Model (required; alphanumeric)
12. Wind Speed (Anemometer) (required; alphanumeric)
13. Wind Direction (Anemometer) (required; alphanumeric)
14. Air Temperature (required; alphanumeric)
15. Barometric Pressure (required; alphanumeric)
16. Wind Turbine Group Numbers
17. Turbine Specifications:
18. Number of Turbines (numeric field)
19. Turbine Manufacturer (alphanumeric field)
20. Turbine Model (alphanumeric field)
21. Turbine Maximum Generation Capacity (numeric field)
22. Turbine Height Above Ground Level (numeric field)
23. Cut in Speed (numeric field; in m/s)
24. Cut Out Speed (numeric field; in m/s)
25. Cold Weather Package (Yes or No Dropdown)
26. Hot Weather Package (Yes or No Dropdown)
27. Low Temperature Cut Out (numeric field)
28. High Temperature Cut Out (numeric field)
29. Wind Turbine ID Numbers (alphanumeric field)
30. Elevation (numeric field; in meters)
31. Hub Height. (numeric field; in meters)
32. Turbine(s) Latitude(s) and Longitude(s) Coordinates (WGS84 Coordinate Field)
33. Turbine ID
34. Turbine Latitude and Longitude
35. Turbine Elevation

- 36. Turbine Hub Height
- 37. Turbine Group Number

3.1.6 Shape-File Submission

Each wind Eligible Intermittent Resource and Hybrid Resource with a wind generation component must submit a shape-file that illustrates, at a minimum, the location of the meteorological station(s), resource project corner, and all individual wind turbines comprising the resource. The shape-file must be submitted in .shp, .dbf, or other file format upon which the CAISO and resource mutually agree.

3.2.1 Solar Generation Meteorological Station Requirements

Each solar Eligible Intermittent Resource and Hybrid Resource with a solar generation component must install and maintain equipment required by the CAISO to support accurate power generation forecasting and the communication of such forecast, meteorological, and other required data to the CAISO consistent with the timeframes specified in this Eligible Intermittent Resource Protocol.

3.2.1.1 Each solar Eligible Intermittent Resource and Hybrid Resource with a solar generation component shall install a minimum of one meteorological station. If such a resource has a rated capacity of five (5) MW or greater, the resource shall install a minimum of two meteorological stations. If an Eligible Intermittent Resource or Hybrid Resource with a solar generation component, as part of compliance with any other contractual or regulatory requirement outside of this Eligible Intermittent Resource Protocol, provides data from more than the two required meteorological stations to an entity other than the CAISO, then the resource must also submit data from any additional meteorological station to the CAISO.

3.2.1.2 Solar Eligible Intermittent Resources and Hybrid Resources with a solar generation component that require direct normal irradiance (DNI) and global horizontal irradiance (GHI) measurements may provide alternate radiometry meteorological station data. For example, one meteorological station may report DNI and another meteorological station may report GHI. All other meteorological data reporting requirements shall remain the same.

3.2.1.3 Meteorological stations for solar Eligible Intermittent Resources shall cover at least 90 percent of the facility's footprint for each Resource ID. Meteorological stations for Hybrid Resources with a solar generation component must cover at least 90 percent of the solar generation component's footprint.

3.2.1.4 Subject to the CAISO's prior approval, Solar Eligible Intermittent Resources and Hybrid Resources with a solar generation component may satisfy the meteorological station location requirements by entering a mutually agreeable sharing agreement(s) with another solar Eligible Intermittent Resource or Hybrid Resource with a solar generation component. The following conditions must apply for the CAISO to grant approval:

- (a) One resource (the host plant) meets the meteorological station requirements; and
- (b) The site of the other resource (the sharing plant) lies contiguous to or overlaps the site of the host plant, or
- (c) Meteorological conditions on the sharing plant site are substantially similar to those on the host plant site.

Proof of the agreement between the host plant and sharing plant must be provided to the CAISO.

Should the agreement terminate, the sharing plant must independently demonstrate it meets the meteorological tower requirements specified in this Eligible Intermittent Resource Protocol.

3.2.2 Solar Meteorological Data Requirements

Table Q-2 details the units and accuracy of measurements for telemetry data points solar Eligible Intermittent Resources and Hybrid Resources with a solar generation component must send to the CAISO in real time (i.e., every 4 seconds).

Table Q-2 Solar Eligible Intermittent Resources Telemetry Data Points

Element	Device(s) Needed	Units	Accuracy
Wind Speed (Meter / Second)	Anemometer, wind vane and wind mast	m/s	± 2m/s
Wind Direction (Degrees - Zero North 90CW)	Anemometer, wind vane and wind mast	Degrees	± 5°
Air Temperature (Degrees Celsius)	Temperature probe & shield for ambient temp	°C	± 1°
Barometric Pressure (hecto Pascals)	Barometer	hPA	± 60 hPa
Back Panel Temperature (Degree C)	Temperature probe for back panel temperature	°C	± 1°
Plane of Array Irradiance Watts\Meter Sq.	Pyranometer or Equivalent	W/m ²	± 25 W/m ²
Global Horizontal Irradiance Watts\Meter Sq.	Pyranometer or Equivalent	W/m ²	± 25 W/m ²
Direct Irradiance Watts\Meter Sq.	Pyranometer or Equivalent	W/m ²	± 25 W/m ²
Real Time Data		MWs*	
High Sustainable Limit (for Hybrid Resources with a solar generation component and solar EIRs that are a Co-located Resource)		MWs**	

* Hybrid Resources with a solar generation component must provide MW values through telemetry for both the solar generation component and the overall Hybrid Resource

** High Sustainable Limit may be updated every 12 seconds.

Table Q-3 details the minimum required (R) measurement of solar irradiance by each solar generating technology that solar Eligible Intermittent Resources and Hybrid Resources with a solar generation component must send to the CAISO consistent with the requirements of this Eligible Intermittent Resource Protocol.

Table Q-3 Irradiance and Back Plane Required Measurements

	Direct Irradiance (DIRD)	Global Horizontal Irradiance (GHIRD)	Global Irradiance/ Plane of Array (PAIRD)	Back Panel Temperature (BPTEMP)
Flat-Plate PV (fixed / horizontal / flat roof)			R	R
Flat-Plate PV (fixed angle / azimuth tracking)			R	R
Flat-Plate PV (DNI zenith & azimuth tracking)	R		R	R
Flat-Panel Solar (thermal fixed angle mounted)			R	R
Flat-Panel Thermal Collector (azimuth tracking)			R	R
Low Concentrating PV (LCPV)	R	R		
High Concentrating PV (HCPV)	R	R		
Concentrated Solar Thermal (solar through zenith tracking)	R	R		
Heliostat Power (tracking focusing mirrors)	R	R		
Greenhouse Power Tower (hot air convection turbine)			R	
Stirling Engine (concentrated solar power generation)	R	R		

3.2.3 Site Information

A solar Eligible Intermittent Resource or Hybrid Resource with a solar generation component must provide the site information specified below in the manner and format as further specified in the CAISO new resource implementation process. Latitude and Longitude should be in degrees/decimals using WGS84 geodetic datum only.

General Resource Information

1. Park Potential (MW; numeric-float field [example: 100.5])
2. Resource Project Corner Coordinates in WGS84 format
3. Meteorological Station ID Numbers
4. Meteorological Station Coordinates in WGS84 format
5. Address
6. Resource ID
7. MW Generation Capacity
8. Plant Location (Latitude and Longitude in WGS84)
9. Lidar or Sodar (required)
10. Make (required; alphanumeric)
11. Model (required; alphanumeric)
12. Wind Speed (Anemometer) (required; alphanumeric)
13. Wind Direction (Anemometer) (required; alphanumeric)
14. Air Temperature (required; alphanumeric)
15. Barometric Pressure (required; alphanumeric)
16. Irradiance (required; alphanumeric)
17. Back Panel Irradiance (required; alphanumeric)
18. MW Generation DC
19. Meteorological Station Sharing (Y or N: If 'Yes', require the project ID of the resource that is being shared) (Validate that project key/code of host site exists)
20. Solar Panel Group Number

Solar Panel Specifications:

1. Panel Manufacturer (alphanumeric field)
2. Panel Model (alphanumeric field)
3. Number of Panels (numeric field)
4. Panel Power Rating (numeric field)
5. Number of Inverters (numeric field)
6. Inverter Ratings (alphanumeric field)
7. Tracking (Yes or No Dropdown)
8. Single or Dual Axis Tracking (Single, Dual, or None Dropdown)
9. Tracker Manufacturer (alphanumeric field)
10. Tracker Model (alphanumeric field)
11. Wind Protection (Speed in m/s)
12. Altitude Angle of Panels (alphanumeric field)
13. Azimuth Angle of Fixed Panels (alphanumeric field)
14. Height of Panels Above Ground Level
15. (alphanumeric field)
16. Concentrating PV (Yes or No Dropdown)
17. Solar Panel Coordinates (WGS84)

3.2.4 Shape-File

Each solar Eligible Intermittent Resource and Hybrid Resource with a solar generation component must submit a shape-file that illustrates, at a minimum, the location of the

meteorological station(s) and resource project corner. The shape-file must be submitted in .shp, .dbf, or other file format upon which the CAISO and resource mutually agree.

3.3 Power Reliability Requirements

Each Eligible Intermittent Resource and Hybrid Resource with a wind generation or solar generation component shall provide a backup power source for the Remote Intelligent Gateway, meteorological station equipment, revenue meter, and essential communication equipment (including, but not limited to, the router, network switch, fiber optic transceiver, 120V plug-in power supplies). The backup power source shall be sized accordingly to carry that equipment load. A backup power supply may include, but is not limited to, an uninterruptable power source (UPS) or a battery bank with solar panel charger. Whichever backup power source the Eligible Intermittent Resource installs, it shall be sized and provide power until the primary power source is restored.

3.4 Standards

The standards for communications shall be the monitoring and communications requirements for Generating Units providing only Energy; as such standards may be amended from time to time, and published on the CAISO Website.

3.5 Cost Responsibility

An Eligible Intermittent Resource is responsible for expenses associated with engineering, installation, operation and maintenance of required communication equipment.

4 FORECASTING

The CAISO is responsible for overseeing the development of tools or services to forecast Energy for Participating Intermittent Resources. The CAISO will use its best efforts to develop accurate and unbiased forecasts, as limited by the availability of relevant explanatory data. Objective criteria and thresholds for unbiased, accurate forecasts shall be used to certify Participating Intermittent Resources in accordance with Section 2.2.4 of this EIRP.

4.1 [Not Used]

4.2 [Not Used]

4.3 Confidentiality

The CAISO shall maintain the confidentiality of proprietary data for each Participating Intermittent Resource in accordance with Section 20 of the CAISO Tariff.

5 SCHEDULING AND SETTLEMENT

5.1 Schedules

For all Generating Units that comprise the Participating Intermittent Resources shall comply with the Bidding and scheduling rules specified in Sections 4.8, 30, 31, and 34.

5.2 Settlement

After a Participating Intermittent Resource is certified, Settlement shall be determined for each Settlement Period based on consistency of Bids submitted on behalf of such Participating

Intermittent Resource with the rules specified in the CAISO Tariff and this EIRP.

5.3 [Not Used]

6 DATA COLLECTION FACILITIES

An Eligible Intermittent Resource not otherwise exempt and Hybrid Resource with a variable component that elects to have a CAISO forecast must install and maintain equipment to collect, record and transmit data that the CAISO reasonably determines is necessary to develop and support a forecast model that meets the requirements of Section 4 of this EIRP.

6.1 Other Eligible Intermittent Resources

Eligible Intermittent Resources other than wind or solar projects will be required to provide data of comparable relevance to estimating Energy generation. Standards will be developed as such projects are identified and will be specified in this Eligible Intermittent Resources Protocol.

7 PROGRAM MONITORING

The CAISO shall monitor the operation of these rules, and will in particular seek to eliminate any gaming opportunities provided by the flexibility provided Participating Intermittent Resources to self-select participation on an hourly basis.

Participating Intermittent Resources are expected to bid, schedule, and otherwise perform in good faith, and not seek to act strategically in a manner that causes financial gain through systematic behavior, where such gain results solely from the settlement accommodations provided under CAISO Tariff Section 11.12.

If requirements specified in this EIRP are not met, then Participating Intermittent Resource certification may be revoked pursuant to Section 2.4.5 of this EIRP. Any patterns of strategic behavior by Participating Intermittent Resources will be tracked, and the statistical significance of such deviations will be used by the CAISO to evaluate whether changes in the rules defined in this EIRP are appropriate.

The CAISO will monitor the impact of rules for Participating Intermittent Resources on FMM or RTD imbalance energy and Regulation costs to the CAISO.

8 AMENDMENTS

If the CAISO determines a need for an amendment to this EIRP, the CAISO will follow the requirements as set forth in Section 15 of the CAISO Tariff.

Attachment B – Marked Tariff
Hybrid Resources and Co-located Resources
California Independent System Operator Corporation
September 8, 2021

Appendix A

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- High Sustainable Limit

The instantaneous generating capability of a variable Generating Unit (or component thereof), provided to the CAISO through telemetry at the Generating Unit.

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- Hybrid Dynamic Limit

A Real-Time Market Bid parameter representing the real-time capabilities of Hybrid Resources, used to ensure feasible Schedules.

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Section 4

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4.6.11 Storage Operating Characteristics

Pursuant to Section 4.6.4, a Scheduling Coordinator for a storage resource participating as a Non-Generator Resource or Pumped-Storage Hydro Unit must submit to the CAISO the operational and technical constraints to the Master File representing an accurate reflection of the resource's design capabilities and its constituent equipment when operating at maximum sustainable performance over Minimum Run Time, recognizing that resource performance may degrade over time. Non-Generator Resources, Hybrid Resources, and Pumped-Storage Hydro Units may include among their Master File parameters the constraints listed in Section 27.9 to the extent they comply with this Section.

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4.18 Hybrid Resources

In addition to the rights and obligations of this section, Hybrid Resources are Generating Units subject to Section 4.6. Scheduling Coordinators for Hybrid Resources will provide data regarding the capacity and the operating characteristics of their components as may be reasonably requested from time to time by the CAISO. All information provided to the CAISO regarding the operational and technical constraints in

the Master File must be an accurate reflection of the design capabilities of the Hybrid Resources and their constituent equipment when operating at maximum sustainable performance over Minimum Run Time, recognizing that performance may degrade over time. Hybrid Resources are not Variable Energy Resources or Eligible Intermittent Resources; however, consistent with Section 4.8.2, Hybrid Resources that include a variable component must provide the CAISO with the data for that component that would be required by Appendix Q. Hybrid Resources with a variable or intermittent component also must provide the CAISO with telemetry and Meter Data on the variable components in addition to the Generating Facility's metering requirements under Section 10. Hybrid Resources' telemetry must include the High Sustainable Limit. Hybrid Resources that include an energy storage component must provide the CAISO with telemetry on the energy storage component's State of Charge.

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Section 27

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27.13 Aggregate Capability Constraint

At the request of the Interconnection Customer, ~~the~~ the CAISO may enforce an Aggregate Capability Constraint for Generating Facilities with Co-located Resources that reflects a Generating Facility's maximum and minimum capability or a portion of that capability for purposes of Day-Ahead Market Awards, Real-Time Market Awards, and Real-Time Dispatch as described in the CAISO's Business Practice Manuals. If the combined PMax of Co-located Resources associated with a single Generating Facility would exceed the Interconnection Service Capacity of that Generating Facility, the Interconnection Customer may request that the CAISO enforce an Aggregate Capability Constraint or multiple Aggregate Capability Constraints at the Generating Facility as described in the CAISO's Business Practice Manuals. If the Interconnection Customer requests that the CAISO enforce multiple Aggregate Capability Constraints, the CAISO will enforce an Aggregate Capability Constraint at the Generating Facility level and subordinate Aggregate Capability Constraints at the level of Resource IDs.

If the Interconnection Customer ~~elects to forego~~ does not elect an Aggregate Capability Constraint(s), the combined PMax of the Co-located Resources registered in the Master File for that Generating Facility may not exceed the Generating Facility's Interconnection Service Capacity. EIM Participating Resource Scheduling Coordinators also may request that the CAISO enforce an Aggregate Capability Constraint or multiple Aggregate Capability Constraints for Co-located Resources, subject to the prior written approval of the applicable EIM Entity Balancing Authority that enforcing an Aggregate Capability Constraint(s) for Co-located Resources does not create a threat to safety or reliability.

As described in the CAISO's Business Practice Manuals the CAISO may relax enforcement of subordinate Aggregate Capability Constraints in its Real-Time Market prior to relaxing enforcement of the system energy-balance constraint specified in Sections 27.4.3.3.4 to ensure there is sufficient Supply to meet the CAISO Forecast of CAISO Demand.

Notwithstanding Section 34.13, a Generating Facility whose Co-located Resources, including Variable Energy Resources, do not comply with Dispatch Instructions such that their output ~~would exceed~~ the Interconnection Service Capacity of the Generating Facility, will be ineligible for the Aggregate Capability Constraint. In such cases, the CAISO will adjust the PMaxes of those Co-located Resources' PMaxes proportionate to each Generating Unit's capacity such that the sum of the PMaxes values equals the Interconnection Service Capacity of the Generating Facility, or as requested by the Interconnection Customer so long as the total value does not exceed the Interconnection Service Capacity of the Generating Facility.

Similar to other Generating Facilities with multiple Resource IDs, the CAISO will have no liability with respect to Co-located Resources or their Scheduling Coordinators if Co-located Resources do not comply with Dispatch Instructions and infringe on Interconnection Service Capacity used by other Co-located Resources at a Generating Facility.

In the event that Co-located Resources in an EIM Entity Balancing Authority area do not comply with Dispatch Instructions such that their output exceeds the interconnection service capacity for the Co-located Resources, the CAISO will ask the applicable EIM Entity Balancing Authority whether it will revoke its prior approval of enforcing the Aggregate Capability Constraint for such Co-located Resources. The following resources are not eligible to use the Aggregate Capability Constraint: Multi-Stage Generators, Pseudo-Tie Resources, Proxy Demand Response, Pumped Storage Hydro Units, Metered Sub-~~S~~systems, and Use-Limited Resources.

Scheduling Coordinators may not offer or self-provide Ancillary Services into the CAISO's Markets or receive Uncertainty Awards from Generating Units that are subject to Aggregate Capability Constraints until the CAISO issues a Market Notice stating this restriction will no longer apply. The Pricing Node for the Generating Units or EIM Participating Resources subject to an Aggregate Capability Constraint will be their Point of Interconnection.

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Section 29

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29.2 EIM Entity Access to the Real-Time Market

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(b) Implementation of Access as an EIM Entity.

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(7) Readiness Criteria.

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- (C) **Forecasting Capability.** The CAISO and, to the extent the prospective EIM entity will use its own forecasts or is otherwise required to provide forecasting information to the CAISO, the prospective EIM Entity have demonstrated their respective forecasting capability through –
- (i) the definition of EIM Demand forecast boundaries based on the conforming and non-conforming Load characteristics, as applicable;
 - (ii) the accuracy of the CAISO forecast of EIM Demand based on historical actual Load data for the defined EIM Demand forecast boundaries;
 - (iii) the identification of weather stations locations used in forecasting, as applicable; ~~and~~
 - (iv) the identification of the source of Variable Energy Resource forecasts pursuant to Section 29.11(j); ~~and-~~
 - (v) the identification of the source of Hybrid Resource forecasts pursuant to Section 29.11(j).

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29.6 Communications

- (a) **EIM Entity.** The EIM Entity shall meet the technical and communication requirements specified in the Business Practice Manual for the Energy Imbalance Market, which shall be based on the Inter-Control Center Communication Protocol and Reliability Standards.
- (b) **EIM Communications and OASIS.** Section 6 shall govern communications and information availability regarding the participation of EIM Market Participants in the Real-Time Market except that –
 - (1) references to internal resources shall be deemed to include EIM Resources;
 - (2) references in Sections 6.2.2.1 and 6.5.2.1 to the CAISO Controlled Grid and references in Sections 6.5.4.2.2(a) and 6.5.5.1.1 to CAISO Balancing Authority Area shall be deemed references to the EIM Area; and
 - (3) the provisions of Section 6.3.1 that authorize the CAISO to communicate directly with Generators and Demand Response Providers to ensure System Reliability shall not apply to Generators and Demand Response Providers in the EIM Entity's Balancing Authority Area or pseudo-tied from an external Balancing Authority Area to the EIM Entity Balancing Authority Area.
- (c) **Loss of Communications.**

- (1) **Procedures.** The CAISO and each EIM Entity and EIM Entity Scheduling Coordinator shall establish procedures to address an interruption of Real-Time Market communications, which shall include steps to be taken to restore communications and address any impact on system or market operations as provided in Section 29.
- (2) **Responsibilities.** An EIM Entity that loses communication with the CAISO remains responsible for managing its Balancing Authority Area imbalance needs without balancing Energy from the Real-Time Market.
- (d) **Variable Energy Resource Forecast Communications.** If the EIM Participating Resource Scheduling Coordinator for a Variable Energy Resource elects to use an independent forecasting service, it must make data transfer arrangements with the CAISO for the CAISO to receive the forecast in a format and on a schedule set forth in the Business Practice Manual for the Energy Imbalance Market.
- (e) **Hybrid Resource Forecast Communications.** If the EIM Participating Resource Scheduling Coordinator for a Hybrid Resource elects to use an independent forecasting service, it must make data transfer arrangements with the CAISO for the CAISO to receive the forecast in a format and on a schedule set forth in the Business Practice Manual for the Energy Imbalance Market.

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29.11 Settlements and Billing for EIM Market Participants.

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- (j) **Variable Energy Resource and Hybrid Resource Forecast Charge.**
 - (1) **In General.** The CAISO will charge EIM Entity Scheduling Coordinators and EIM Participating Resource Scheduling Coordinators a fee for the Variable Energy Resource or Hybrid Resource forecasting services in accordance with Appendix F, Schedule 4.
 - (2) **Waiver.** The CAISO will waive the Variable Energy Resource or Hybrid Resource forecast charge if an EIM Entity has an independent forecast for its Variable Energy Resources or Hybrid Resource and provides the independent forecast to the CAISO.

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29.34 EIM Operations

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- (q) **Variable Energy Resources and Hybrid Resources.** Provisions of Section 34 specifically applicable to Variable Energy Resources and Eligible Intermittent Resources appear in Sections 34.1.3, 34.1.6, 34.2.2, 34.5.1. 34.13.2. Provisions of Section 34 specifically applicable to Hybrid Resources appear in Section 34.1.6.3.

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Section 30

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30.5.6.1 Hybrid Resource Bids

In addition to the Bid components listed in this Section 30.5, Scheduling Coordinators representing Hybrid Resources will submit Hybrid Dynamic Limits representing Hybrid Resources' upper economic limit and lower economic limit in each Real-Time Market five-minute Trading Interval for a rolling six-hour look-ahead period. These limits will reflect the range of the Hybrid Resource's Economic Bids or Self-Schedules. Hybrid Dynamic Limits should reflect resource availability based on operating capabilities such as State of Charge and forecasted output from the variable component of a Hybrid Resource. Scheduling Coordinators may also use Hybrid Dynamic Limits to manage onsite charging of an energy storage component of a Hybrid Resource.

The CAISO will use reasonable efforts to issue Real-Time Market Schedules that respect Hybrid Dynamic Limits. Scheduling Coordinators may not submit Hybrid Dynamic Limits in the Day-Ahead Market.

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Section 31

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31.2 Day-Ahead MPM Process

After the Market Close of the DAM, and after the CAISO has validated the Bids pursuant to Section 30.7, the CAISO will perform the MPM process, which is a single market run that occurs prior to the IFM Market

Clearing run. The Day-Ahead MPM process determines which Bids need to be mitigated to the applicable Default Energy Bids in the IFM pursuant to Section 31.2.3. For Maximum Net Dependable Capacity of Legacy RMR Units, Bids will be mitigated to the RMR Proxy Bids pursuant to Section 31.2.3. The Day-Ahead MPM process optimizes resources to meet Demand reflected in Demand Bids, including Export Bids and Virtual Demand Bids, and to procure one hundred (100) percent of Ancillary Services requirements based on Supply Bids submitted to the DAM. Virtual Bids and Bids from Demand Response Resources, Participating Load, Hybrid Resources, and Non-Generator Resources are considered in the MPM process, but are not subject to Bid mitigation. Bids from Participating Load resources that are not subject to Bid mitigation will also be considered in the MPM process. Bids from resources comprised of multiple technologies that include Non-Generator Resources will remain to be subject to all applicable market power mitigation under the CAISO Tariff, including Local Market Power Mitigation. The mitigated or unmitigated Bids and RMR Proxy Bids identified in the MPM process for all resources that cleared in the MPM are then passed to the IFM. The CAISO performs the MPM process for the DAM for the twenty-four (24) hours of the targeted Trading Day.

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Section 34

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34.1.5 Mitigating Bids in the RTM

34.1.5.1 Generally

After the Market Close of the RTM, after the CAISO has validated the Bids pursuant to Section 30.7 and Section 34.1.4, and prior to conducting any other RTM processes, the CAISO conducts a MPM process. The results are used in the RTM optimization processes. Bids on behalf of Demand Response Resources, Participating Load, Hybrid Resources, and Non-Generator Resources are considered in the MPM process but are not subject to Bid mitigation. Bids from resources comprised of multiple technologies that include Non-Generator Resources will remain to be subject to all applicable market power mitigation under the CAISO Tariff, including Local Market Power Mitigation.

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34.1.6.3 ~~[Not Used]~~ Hybrid Resources

The CAISO will use reasonable efforts to issue Real-Time Market Schedules that observe Hybrid Resources' Dynamic Limits, High Sustainable Limits, State of Charge, and production forecasts, as applicable. Hybrid Resources with a variable component may elect to receive a CAISO forecast to inform their bidding, or they may elect to use their own forecast. For Hybrid Resources that have elected to use their own forecast as specified in Section 4.8.2.1.1, the responsible Scheduling Coordinator must submit to the CAISO its forecast for the variable component for the binding interval by 37.5 minutes prior to flow (the start of the applicable FMM optimization for the binding interval). If such Scheduling Coordinator does not provide such forecast to the CAISO, the CAISO will use the direct telemetry MW output from the resource's variable component.

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Section 40

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40.9.2 Exemptions

- (a) **Capacity Exempt from RAAIM – All Provisions.** The entire capacity of a resource in any of the following categories is exempt from the RAAIM provisions in Section 40.9 –
- (1) Resources with a PMax less than 1.0 MW;
 - (2) Non-specified resources that provide Resource Adequacy Capacity under contracts for Energy delivered within the CAISO Balancing Authority Area;
 - (3) Participating Load that is also Pumping Load; and
 - (4) Legacy RMR Units.
- (b) **Capacity Exempt from RAAIM – Local/System**
- (1) The entire capacity of a resource in any of the following categories is exempt from the RAAIM provisions in Section 40.9 applicable to local and system Resource Adequacy Capacity –
 - (A) Variable Energy Resources;
 - (B) Combined Heat and Power Resources; ~~and~~
 - (C) Run-of-River Resources; ~~and-~~
 - (D) Hybrid Resources.
 - (2) The capacity of a resource with a Load-following MSS as its Scheduling Coordinator that is designated on a Load-following MSS's monthly Resource Adequacy Plan is exempt from the RAAIM provisions in Section 40.9 applicable to local and system Resource Adequacy Capacity, to the extent that the resource's capacity is also designated as Resource Adequacy Capacity on the monthly Supply Plan of that Load-following MSS or another Load-following MSS.
 - (3) Resources with Existing QF Contracts or Amended QF Contracts that are Resource Adequacy Resources are exempt from the RAAIM provisions in Section 40.9 applicable to local and system capacity --
 - (A) if the QF resource previously provided Resource Adequacy Capacity pursuant to an Existing QF Contract that was executed prior to August 22, 2010 and remained in effect pursuant to California Public Utilities Commission Decision 07-09-040 that extended the term of expiring contracts until such time as the new contracts resulting from that decision are available; or

(B) until the QF Resource's Existing QF Contract or Amended QF Contract terminates or if requested by the Scheduling Coordinator for the resource, whichever is earlier.

(c) **Capacity Exempt from RAAIM – Flexible Capacity.**

- (1) The capacity of Use-Limited Resources in a combination under Section 40.10.3.2(b), 40.10.3.3(b) or 40.10.3.4(b) is exempt from the RAAIM provisions in Section 40.9 applicable to Flexible RA Capacity to the extent that the resources are committed to provide Flexible RA Capacity as a combination on their respective monthly Supply Plans.
- (2) The Capacity of a resource with a Load-following MSS as its Scheduling Coordinator that is designated on a Load-following MSS's monthly Flexible RA Plan is exempt from the RAAIM provisions in Section 40.10 applicable to Flexible RA Capacity, to the extent that the resource's capacity is also designated as Flexible RA Capacity on the monthly Supply Plan of that Load-following MSS or another Load-following MSS.

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40.10.4 Effective Flexible Capacity

The CAISO shall calculate the Effective Flexible Capacity value for each resource. The CAISO shall publish the draft and final lists of the Effective Flexible Capacity values for such resources and the Flexible Capacity Categories for which each resource qualifies to provide Flexible Capacity on the CAISO Website each year in accordance with the schedule for publishing the Net Qualifying Capacity values, as set forth in the BPM, for use in the next calendar year.

40.10.4.1 Effective Flexible Capacity Calculation

- (a) **Flexible Resources.** The CAISO will calculate the Effective Flexible Capacity value of a resource, for use (i) if a Local Regulatory Authority has not established criteria for calculating the Effective Flexible Capacity value for eligible resource types, and (ii) for determining if a cumulative deficiency exists under Sections 43A.2.7(a) and (b), as follows, except as provided in Sections 40.10.4.1 (b) through (f) –
 - (1) If the Start-Up Time of the resource is greater than 90 minutes, the Effective Flexible Capacity value shall be the weighted average ramp rate of the resource calculated from PMin to Net Qualifying Capacity multiplied by 180 minutes. The Effective Flexible Capacity shall not exceed the difference between the PMin and PMax of the resource.
 - (2) If the Start-Up Time of the resource is less than or equal to 90 minutes, the Effective Flexible Capacity value shall be the resource's PMin plus the weighted average ramp rate of the resource calculated from PMin to Net Qualifying Capacity multiplied by the difference between 180 minutes and the resource's Start-Up Time. The Effective Flexible Capacity shall not exceed the Net Qualifying Capacity of the resource.
- (b) **Hydroelectric Generating Unit.** The Effective Flexible Capacity of a hydroelectric generating unit will be the amount of capacity from which the resource can produce Energy consistently for 6 hours assuming that the resource's physical storage is at

maximum capacity at the beginning of that six-hour period. The Effective Flexible Capacity of a hydroelectric generation unit cannot, however, exceed its Net Qualifying Capacity.

- (c) **[Not Used]**
- (d) **Energy Storage Resource.** The Effective Flexible Capacity value for an energy storage resource will be determined as follows –
 - (1) for an energy storage resource that provides Flexible RA Capacity but not Regulation Energy Management, the Effective Flexible Capacity value will be the MW output range the resource can provide over three hours of charge/discharge while constantly ramping.
 - (2) for an energy storage resource that provides Flexible RA Capacity and Regulation Energy Management, the Effective Flexible Capacity value will be the resource's 15-minute energy output capability.
- (e) **Multi-Stage Generating Resource.** The Effective Flexible Capacity value for a Multi-Stage Generating Resource will be calculated using the longest Start-Up Time of the resource's configuration that has the lowest PMin.
- (f) **Combined Heat and Power Resource.** The Effective Flexible Capacity value of a Combined Heat and Power Resource will be the lesser of (i) the resource's Net Qualifying Capacity, or (ii) the MW difference between the CHP resource's maximum output and its RMTMax, if the resource has a RMTMax, or its minimum operating level, such quantity not to exceed the quantity of generating capacity capable of being delivered over a three-hour period.
- (g) **Hybrid Resource.** The Effective Flexible Capacity value of a Hybrid Resource is the sum of what the Effective Flexible Capacity values of the constituent components of the Hybrid Resource would be if those components were each a distinct Generating Unit.

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Appendix F

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Schedule 4

Eligible Intermittent Resources Forecast Fee

A charge up to \$.10 per MWh shall be assessed on the metered Energy from (a) Eligible Intermittent Resources; (b) Variable Energy Resources that are EIM Participating Resources; and (c) the variable component of Hybrid Resources as a Forecast Fee, provided that Eligible Intermittent Resources Generating Units smaller than 10 MW that are not Participating Intermittent Resources and that sold-sell power pursuant to a power purchase agreement entered into pursuant to PURPA prior to entering into a PGA or Net Scheduled PGA shall be exempt from the Forecast Fee.

The rate of the Forecast Fee shall be determined so as to recover the projected annual costs related to developing Energy forecasting systems, generating forecasts, validating forecasts, and monitoring

forecast performance, that are incurred by the CAISO as a direct result of participation by Eligible Intermittent Resources Variable Energy Resources that are EIM Participating Resources, and the variable component of Hybrid Resources -in CAISO Markets, divided by the ir projected annual Energy production by all Eligible Intermittent Resources.

The initial Forecast Fee, and all subsequent changes as may be necessary from time to time to recover costs incurred by the CAISO for the forecasting conducted on the behalf of Eligible Intermittent Resources, Variable Energy Resources that are EIM Participating Resources, and the variable component of Hybrid Resources pursuant to the foregoing rate formula, shall be set forth in a Business Practice Manual.

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Appendix K

Part A CERTIFICATION FOR REGULATION

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A 1.2.2.4 Ancillary Service Providers for Non-Generator Resources (whether or not the resource uses Regulation Energy Management) and Hybrid Resources shall provide CAISO the following additional telemetry data as applicable

- Resource Ramp Rate when operating as Generation (MW/min);
- Resource Ramp Rate when operating as Load (MW/min);
- The maximum instantaneous ability to produce or consume Energy in MW; and
- The maximum capability to provide Energy as expressed in MWh over a fifteen (15) minute interval where the Scheduling Coordinator has elected to provide MWh constraints pursuant to Section 27.9 of the CAISO Tariff.

A 1.2.2.5 Ancillary Service Providers for an Eligible Intermittent Resource or a Hybrid Resource with a variable component must provide the CAISO High Sustainable Limit for their resource.

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Part B CERTIFICATION FOR SPINNING RESERVE

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B 1.7: Ancillary Service Providers for an Eligible Intermittent Resource or a Hybrid Resource with a variable component must provide the CAISO with the High Sustainable Limit for their resource.

Part C CERTIFICATION FOR NON-SPINNING RESERVE

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C 2.3 Ancillary Service Providers for an Eligible Intermittent Resource or a Hybrid Resources with a variable component must provide the CAISO with the High Sustainable Limit for their resource.

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Appendix Q

Eligible Intermittent Resources Protocol (EIRP)

1 SCOPE

1.1 Scope of Application to Parties

This EIRP applies to the CAISO and to:

- (a) Scheduling Coordinators (SCs);
- (b) Eligible Intermittent Resources that are not certified as Participating Intermittent Resources;
- (c) Participating Intermittent Resources; and
- (d) Hybrid Resources with a wind generation or solar generation component.

1.2 Liability of the CAISO

Any liability of the CAISO arising out of or in relation to this EIRP shall be subject to Section 14 of the CAISO Tariff as if references to the CAISO Tariff were references to this EIRP.

2 REQUIREMENTS FOR ELIGIBLE INTERMITTENT RESOURCES, -AND- PARTICIPATING INTERMITTENT RESOURCES, AND HYBRID RESOURCES WITH VARIABLE COMPONENT

2.1 No Mandatory Participation

Eligible Intermittent Resources may elect to be scheduled and settled as the CAISO Tariff

provides for Generating Units, and are not required to seek certification as Participating Intermittent Resources.

2.2 Minimum Certification Requirements

~~These~~ Eligible Intermittent Resources, ~~and~~ Participating Intermittent Resources, and Hybrid Resources with a variable component must meet the following requirements, as applicable.

2.2.1 Agreements

The following agreements must be executed by the owner or operator of any Eligible Intermittent Resource, unless that resource is not subject to any of these agreements pursuant to the CAISO Tariff, such as an Eligible Intermittent Resource of an MSS Operator:

- (a) A Participating Generator Agreement, Net Scheduled PGA, Dynamic Scheduling Agreement for Scheduling Coordinators, or Pseudo-Tie Participating Generator Agreement that, among other things, binds the Eligible Intermittent Resource to comply with the CAISO Tariff; and
- (b) A Meter Service Agreement for CAISO Metered Entities, for all Eligible Intermittent Resources other than Dynamic System Resources.

If an Eligible Intermittent Resource intends to become a Participating Intermittent Resource, it must also execute a letter of intent, which when executed and delivered to the CAISO shall initiate the process of certifying the Participating Intermittent Resource. The form of the letter of intent shall be specified by the CAISO in a Business Practice Manual.

Hybrid Resources with a variable component must execute all agreements that are otherwise required in this CAISO tariff.

2.2.2 Composition of a Participating Intermittent Resource

The CAISO shall develop criteria to determine whether one or more Eligible Intermittent Resources may be included within a Participating Intermittent Resource. Such criteria shall include:

- (a) A Participating Intermittent Resource must be at least one (1) MW rated capacity.
- (b) A Participating Intermittent Resource may include one (1) or more Eligible Intermittent Resources that have similar response to weather conditions or other variables relevant to forecasting Energy, as determined by the CAISO.
- (c) Each Participating Intermittent Resource shall be electrically connected at a single point on the CAISO Controlled Grid, except as otherwise permitted by the CAISO on a case-by-case basis as may be allowed under the CAISO Tariff. Interconnection to a portion of the CAISO Controlled Grid outside or not contiguous to the CAISO Balancing Authority Area does not make an Eligible Intermittent Resource that is a Dynamic System Resource or Pseudo-Tie Generating Unit eligible to be included within a Participating Intermittent Resource.
- (d) The same Scheduling Coordinator must schedule all Eligible Intermittent Resources aggregated into a single Participating Intermittent Resource.

2.2.3 Equipment Installation

~~An~~ Eligible ~~Participating~~ Intermittent Resources and Hybrid Resources with a variable component must install and maintain the communication equipment required pursuant to Section 3 of this EIRP, and the equipment supporting forecast data required pursuant to Section ~~6-4~~ of this EIRP.

2.2.4 Forecast Model Validation

The CAISO must determine that sufficient historic and real-time telemetered data are available to support an accurate and unbiased forecast of Energy generation by a Participating Intermittent Resource, according to the forecasting process validation criteria described in Section 4 of this EIRP.

2.2.5 [Not Used]

2.3 Notice of Certification of a Participating Intermittent Resource

When all requirements described in Section 2.2 of this EIRP applicable to Participating Intermittent Resources have been fulfilled, the CAISO shall notify the Scheduling Coordinator and the representatives of the Eligible Intermittent Resources comprising the Participating Intermittent Resource that the Participating Intermittent Resource has been certified, and is eligible for the settlement terms provided under Section 11.12 of the CAISO Tariff, as conditioned by the terms of this EIRP.

2.4 Additional Requirements

2.4.1 Forecast Fee

An Eligible Intermittent Resource must pay the Forecast Fee for all metered Energy generated by the Eligible Intermittent Resource, as specified in CAISO Tariff Appendix F, Schedule 4. A Hybrid Resource with a variable component must pay the Forecast Fee for all metered Energy generated by variable component, as specified in CAISO Tariff Appendix F, Schedule 4, if it elects, per section 3.1 of this EIRP, to have the CAISO produce a forecast of the output of the Hybrid Resource's variable component.

2.4.2 Modification of Participating Intermittent Resource Composition

A Participating Intermittent Resource may seek to modify the composition of the Participating Intermittent Resource (e.g., by adding or eliminating an Eligible Intermittent Resource from the Participating Intermittent Resource). Such changes shall not be implemented without prior compliance with the written approval by the CAISO. The CAISO will apply consistent criteria and expeditiously review any proposed changes in the composition of a Participating Intermittent Resource.

2.4.3 Changes in Scheduling Coordinator

This EIRP does not impose any additional requirement for CAISO approval to change the Scheduling Coordinator for an approved Participating Intermittent Resource than would otherwise apply under the CAISO Tariff to changes in the Scheduling Coordinator representing a Generating Unit.

2.4.4 Continuing Obligation

~~A Participating Intermittent Resource or~~ Eligible Intermittent Resources (including Participating Intermittent Resources) and Hybrid Resources with a variable component must have a continuing obligation to meet all applicable obligations established ~~for Participating Intermittent Resources or~~

~~Eligible Intermittent Resources~~ under the CAISO Tariff and this EIRP, and must fully cooperate in providing all data, other information, and authorizations the CAISO reasonably requests to fulfill its obligation to validate forecast models and explain deviations.

2.4.5 Failure to Perform

If the CAISO determines that a material deficiency has arisen in the Participating Intermittent Resource's fulfillment of its obligations under the CAISO Tariff and this EIRP, and such Participating Intermittent Resource fails to promptly correct such deficiencies when notified by the CAISO, then the eligibility of the Participating Intermittent Resource for the settlement accommodations provided in Section 11.12 of the CAISO Tariff shall be suspended until such time that the unavailable data is provided or other material deficiency is corrected to the CAISO's reasonable satisfaction. Such suspension shall not relieve the Scheduling Coordinator for the deficient Participating Intermittent Resource from paying the Forecast Fee over the duration of the period covered by the letter of intent described in Section 2.2.1(c) of this EIRP.

3 COMMUNICATIONS

3.1 Forecast Data

The CAISO may require various data relevant to forecasting Energy from ~~the an~~ Eligible Intermittent Resource or Hybrid Resource with a variable component to be telemetered to the CAISO, including appropriate operational data, meteorological data or other data reasonably necessary to forecast Energy.

In order for the CAISO to forecast Energy, an Eligible Intermittent Resource or Hybrid Resource with a variable component must provide the CAISO with MW production data and meteorological data as outlined in this Eligible Intermittent Resources Protocol. This data must be collected for a minimum of thirty (30) consecutive days and be of sufficient quality as determined by a CAISO to produce a state of the art forecast.

A Hybrid Resource with a wind generation or solar generation component may elect to provide its own forecasted production in lieu of a CAISO forecast but such election does not relieve the resource of the obligation to provide production data and meteorological data as otherwise required in this Eligible Intermittent Resources Protocol.

3.1.1 Wind Generation Meteorological Station Requirements

Each wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component must install and maintain equipment required by the CAISO to support accurate power generation forecasting and the communication of such forecast, meteorological, and other required data to the CAISO consistent with the timeframes specified in this Eligible Intermittent Resource Protocol.

- 3.1.1.1** Each wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component shall install a minimum of one meteorological station to measure barometric pressure, temperature, wind speed and direction. If ~~a wind Eligible Intermittent Resource~~ such a resource has a rated capacity of five (5) MW or greater, ~~then the resource~~ Eligible Intermittent Resource shall install a minimum of two meteorological stations to measure barometric pressure, temperature, wind speed and direction. If an Eligible Intermittent Resource or Hybrid Resource with a wind generation component, as part of compliance with any other contractual or regulatory requirement outside of this Eligible Intermittent Resource Protocol, provides data from more than the two required meteorological stations to an entity other than the CAISO, then the ~~Eligible~~

Intermittent Resource-resource must also submit data from any additional meteorological station to the CAISO.

3.1.1.2 Each wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component shall locate its meteorological station(s) on the windward side of the wind farm. Each wind Eligible Intermittent Resource-such resource must install one meteorological station at the average hub height of the wind turbines. Hub height is the distance from the ground to the center of the turbine axis. If a second meteorological station is required, then it may be so co-located with the primary station. The approximate distance separating the primary station and the secondary station shall be an average of one (1) rotator blade length. Where placement of the meteorological station(s) in accordance with this Eligible Intermittent Resource Protocol would reduce production or violate a local, state, or federal statute, regulation or ordinance, the CAISO, in coordination with any applicable forecast service provider, will coordinate with the Eligible Intermittent Resource-resource to identify an acceptable placement of the meteorological station.

3.1.1.3 The use of SODAR¹ and/or LIDAR² equipment may be an acceptable substitute for wind direction and velocity only after obtaining prior agreement from the CAISO.

3.1.1.4 Wind Eligible Intermittent Resources and Hybrid Resources with a wind generation component may not satisfy the meteorological station location requirements through a sharing agreement with another resource.

3.1.2 Wind Generation Meteorological Data Requirements

Table Q-1 details the units and accuracy of measurements for telemetry data points wind Eligible Intermittent Resources and Hybrid Resources with a wind generation component must send to the CAISO in real time (i.e., every 4 seconds).

Table Q-1 Wind Eligible Intermittent Resources-Telemetry Data Points

Element	Device(s) Needed	Units	Accuracy
Wind Speed (Meter / Second)	Anemometer, wind vane and wind mast	m/s	± 2m/s
Air Temperature (Degrees Celsius)	Temperature probe & shield for ambient temp	°C	± 1°
Barometric Pressure (hecto Pascals)	Barometer	hPA	± 60 hPa
Real Time Data		MWs*	
<u>High Sustainable Limit (for Hybrid Resources with a wind generation component and wind EIRs that are a Co-located Resource</u>		<u>MWs**</u>	

¹ SODAR means Sonic Detection and Ranging- a meteorological instrument also known as a wind profiler which measures the scattering of sound waves by atmospheric turbulence.

² LIDAR means Light Detection and Ranging - a meteorological instrument which measures the properties of scattered light waves caused by atmospheric turbulence.

* Hybrid Resources with a wind generation component must provide MW values through telemetry for both the wind generation component and the overall Hybrid Resource

** High Sustainable Limit may be updated every 12 seconds.

3.1.3 Designated Turbines

For any wind eligible Intermittent Resource or Hybrid Resource with a wind generation component, designated turbines are required to improve forecast accuracy within a wind park. The CAISO shall identify a designated turbine, from which the ~~Eligible Intermittent Resource~~ resource shall provide nacelle wind speed and wind direction every four seconds. Wind EIRs with a PGA or NS PGA that are operating or have final regulatory approvals to construct as of November 1, 2018, that have wind turbines without nacelle anemometers need not comply with the requirements of this section for Designation Turbines. However, when the wind EIR repowers or replaces a portion of its existing wind turbines, then the Wind EIR must become compliance with the requirements of this section for Designated Turbines.

3.1.4 Topographical Map

A wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component must submit a topographical map that illustrates the location and height for each wind turbine within a wind park. The map must identify all meteorological stations and turbine location by latitude and longitude and should be in degrees/decimals using WGS84 geodetic datum only.

3.1.5 Site Information **Form**

A wind Eligible Intermittent Resource or Hybrid Resource with a wind generation component must provide the site information specified below in the manner and format as specified through the complete and submit the site information in Table Q-2 according to the schedule and data submittal requirements of the CAISO new resource implementation process. Latitude and Longitude should be in degrees/decimals using WGS84 geodetic datum only.

1. Park Potential (MW; numeric-float field [example: 100.5])
2. Resource Project Corner Coordinates in WGS84 format
3. Meteorological Station ID Numbers
4. Meteorological Station Coordinates in WGS84 format
5. Address
6. Resource ID
7. MW Generation Capacity
8. Plant Location (Latitude and Longitude in WGS84)
9. Lidar or Sodar (required)
10. Make (required; alphanumeric)
11. Model (required; alphanumeric)
12. Wind Speed (Anemometer) (required; alphanumeric)
13. Wind Direction (Anemometer) (required; alphanumeric)
14. Air Temperature (required; alphanumeric)
15. Barometric Pressure (required; alphanumeric)
16. Wind Turbine Group Numbers
17. Turbine Specifications:
18. Number of Turbines (numeric field)
19. Turbine Manufacturer (alphanumeric field)
20. Turbine Model (alphanumeric field)
21. Turbine Maximum Generation Capacity (numeric field)
22. Turbine Height Above Ground Level (numeric field)

(m/s)					
Rated Speed (m/s)					
Cut-Out Speed (m/s)					
Cold Weather Package (Yes or No)					
Hot Weather Package (Yes or No)					
Low Temperature Cut-Out (deg-C)					
High Temperature Cut-Out (deg-C)					

3.1.6 Shape-File Submission

Each wind Eligible Intermittent Resource and Hybrid Resource with a wind generation component must submit a shape-file that illustrates, at a minimum, the location of the meteorological station(s), resource project corner, and all individual wind turbines comprising the resource. The shape-file must be submitted in .shp, .dbf, or other file format upon which the CAISO and resource mutually agree.

3.2.1 Solar Generation Meteorological Station Requirements

Each solar Eligible Intermittent Resource and Hybrid Resource with a solar generation component must install and maintain equipment required by the CAISO to support accurate power generation forecasting and the communication of such forecast, meteorological, and other required data to the CAISO consistent with the timeframes specified in this Eligible Intermittent Resource Protocol.

3.2.1.1 Each solar Eligible Intermittent Resource and Hybrid Resource with a solar generation component shall install a minimum of one meteorological station. If such a resource a solar Eligible Intermittent Resource has a rated capacity of five (5) MW or greater, the Eligible Intermittent Resource resource shall install a minimum of two meteorological stations. If an Eligible Intermittent Resource or Hybrid Resource with a solar generation component, as part of compliance with any other contractual or regulatory requirement outside of this Eligible Intermittent Resource Protocol, provides data from more than the two required meteorological stations to an entity other than the CAISO, then the Eligible Intermittent Resource resource must also submit data from any additional meteorological station to the CAISO.

3.2.1.2 Solar Eligible Intermittent Resources and Hybrid Resources with a solar generation component that require direct normal irradiance (DNI) and global horizontal irradiance (GHI) measurements may provide alternate radiometry meteorological station data. For example, one meteorological station may report DNI and another meteorological station may report GHI. All other meteorological data reporting requirements shall remain the same.

3.2.1.3 Solar Eligible Intermittent Resources' Meteorological stations for solar Eligible Intermittent Resources shall cover at least 90 percent of the facility's footprint for each Resource ID. Meteorological stations for Hybrid Resources with a solar generation component must cover at least 90 percent of the solar generation component's footprint.

3.2.1.4 Subject to the CAISO's prior approval, Solar Eligible Intermittent Resources and Hybrid

Resources with a solar generation component may satisfy the meteorological station location requirements by entering a mutually agreeable sharing agreement(s) with another solar Eligible Intermittent Resources or Hybrid Resource with a solar generation component. The following conditions must apply for the CAISO to grant approval after obtaining the CAISO's prior approval when the following conditions apply:

- (a) One Eligible Intermittent Resource resource (the host plant) meets the meteorological station requirements; and
- (b) The site of the other Eligible Intermittent Resource resource (the sharing plant) lies contiguous to or overlaps the site of the host plant, or
- (c) Meteorological conditions on the sharing plant site are substantially similar to those on the host plant site.

Proof of the agreement between the host plant and sharing plant must be provided to the CAISO. Should the agreement terminate, the sharing plant must independently demonstrate it meets the meteorological tower requirements specified in this Eligible Intermittent Resource Protocol.

3.2.2 Solar Meteorological Data Requirements

Table Q-23 details the units and accuracy of measurements for telemetry data points solar Eligible Intermittent Resources and Hybrid Resources with a solar generation component must send to the CAISO in real time (i.e., every 4 seconds).

Table Q-23 Solar Eligible Intermittent Resources Telemetry Data Points

Element	Device(s) Needed	Units	Accuracy
Wind Speed (Meter / Second)	Anemometer, wind vane and wind mast	m/s	± 2m/s
Wind Direction (Degrees - Zero North 90CW)	Anemometer, wind vane and wind mast	Degrees	± 5°
Air Temperature (Degrees Celsius)	Temperature probe & shield for ambient temp	°C	± 1°
Barometric Pressure (hecto Pascals)	Barometer	hPA	± 60 hPa
Back Panel Temperature (Degree C)	Temperature probe for back panel temperature	°C	± 1°
Plane of Array Irradiance Watts\Meter Sq.	Pyranometer or Equivalent	W/m ²	± 25 W/m ²

Global Horizontal Irradiance Watts\Meter Sq.	Pyranometer or Equivalent	W/m ²	± 25 W/m ²
Direct Irradiance Watts\Meter Sq.	Pyranometer or Equivalent	W/m ²	± 25 W/m ²
<u>Real Time Data</u>		<u>MWs*</u>	
<u>High Sustainable Limit (for Hybrid Resources with a solar generation component and solar EIRs that are a Co-located Resource)</u>		<u>MWs**</u>	

* Hybrid Resources with a solar generation component must provide MW values through telemetry for both the solar generation component and the overall Hybrid Resource

** High Sustainable Limit may be updated every 12 seconds.

Table Q-34 details the minimum required (R) measurement of solar irradiance by each solar generating technology that solar Eligible Intermittent Resources and Hybrid Resources with a solar generation component must send to the CAISO consistent with the requirements of this Eligible Intermittent Resource Protocol.

Table Q-34 Irradiance and Back Plane Required Measurements

	Direct Irradiance (DIRD)	Global Horizontal Irradiance (GHIRD)	Global Irradiance/ Plane of Array (PAIRD)	Back Panel Temperature (BPTTEMP)
Flat-Plate PV (fixed / horizontal / flat roof)			R	R
Flat-Plate PV (fixed angle / azimuth tracking)			R	R
Flat-Plate PV (DNI zenith & azimuth tracking)	R		R	R
Flat-Panel Solar (thermal fixed angle mounted)			R	R
Flat-Panel Thermal Collector (azimuth tracking)			R	R
Low Concentrating PV (LCPV)	R	R		

	Direct Irradiance (DIRD)	Global Horizontal Irradiance (GHIRD)	Global Irradiance/ Plane of Array (PAIRD)	Back Panel Temperature (BPTMP)
High Concentrating PV (HCPV)	R	R		
Concentrated Solar Thermal (solar through zenith tracking)	R	R		
Heliostat Power (tracking focusing mirrors)	R	R		
Greenhouse Power Tower (hot air convection turbine)			R	
Stirling Engine (concentrated solar power generation)	R	R		

3.2.3 Site ~~Form~~ Information

A solar Eligible Intermittent Resource or Hybrid Resource with a solar generation component must provide the complete and submit the site information specified below in the manner and format as further specified in in Table Q-5 according to the schedule and data submittal requirements of the CAISO new resource implementation process. Latitude and Longitude should be in degrees/decimals using WGS84 geodetic datum only.

General Resource Information

1. Park Potential (MW; numeric-float field [example: 100.5])
2. Resource Project Corner Coordinates in WGS84 format
3. Meteorological Station ID Numbers
4. Meteorological Station Coordinates in WGS84 format
5. Address
6. Resource ID
7. MW Generation Capacity
8. Plant Location (Latitude and Longitude in WGS84)
9. Lidar or Sodar (required)
10. Make (required; alphanumeric)
11. Model (required; alphanumeric)
12. Wind Speed (Anemometer) (required; alphanumeric)
13. Wind Direction (Anemometer) (required; alphanumeric)
14. Air Temperature (required; alphanumeric)
15. Barometric Pressure (required; alphanumeric)
16. Irradiance (required; alphanumeric)
17. Back Panel Irradiance (required; alphanumeric)
18. MW Generation DC
19. Meteorological Station Sharing (Y or N: If 'Yes', require the project ID of the resource that

is being shared) (Validate that project key/code of host site exists)
20. Solar Panel Group Number

Solar Panel Specifications:

1. Panel Manufacturer (alphanumeric field)
2. Panel Model (alphanumeric field)
3. Number of Panels (numeric field)
4. Panel Power Rating (numeric field)
5. Number of Inverters (numeric field)
6. Inverter Ratings (alphanumeric field)
7. Tracking (Yes or No Dropdown)
8. Single or Dual Axis Tracking (Single, Dual, or None Dropdown)
9. Tracker Manufacturer (alphanumeric field)
10. Tracker Model (alphanumeric field)
11. Wind Protection (Speed in m/s)
12. Altitude Angle of Panels (alphanumeric field)
13. Azimuth Angle of Fixed Panels (alphanumeric field)
14. Height of Panels Above Ground Level
15. (alphanumeric field)
16. Concentrating PV (Yes or No Dropdown)
17. Solar Panel Coordinates (WGS84)

~~Table Q-5 CAISO Solar Site Required Information Form~~

Site Name & Physical Address								
CAISO_RES_ID								
Plant Type	PV or Thermal		If thermal, supplemental heating?		Y/N			
Plant Location Use as many points as necessary to describe the site	Corner 1		Corner 2		Corner 3		Corner 4	
	Lat	Long	Lat	Long	Lat	Long	Lat	Long
Meteorological Station Location Provide the location of all met data collection point at the site.	Met 1		Equipment Type		Met 2		Equipment Type	
Met Information	ID	Lat	Long	Height Agl	ID	Lat	Long	Height Agl
Generation Capacity	DC				AC			

Use multiple Groups for different panel types and installations					
	Group-1	Group-2	Group-3	Lat	Long
Panel Manufacturer					
Panel Model					
Number of Panels					
Panel Power Rating					
Number of inverters					
Inverter ratings					
Tracking (Yes or No)					
Single or Dual Axis Tracking					
Tracker Manufacturer					
Tracker Model					
Wind Protection (Speed in m/s for storage)					
Altitude Angle of Panels					
Azimuth Angle of Fixed Panels					
Height of Panels Above Ground Level					
Concentrating PV (Yes or No)					

3.2.4 Shape-File

Each solar Eligible Intermittent Resource and Hybrid Resource with a solar generation component must submit a shape-file that illustrates, at a minimum, the location of the meteorological station(s) and resource project corner. The shape-file must be submitted in .shp, .dbf, or other file format upon which the CAISO and resource mutually agree.

3.3 Power Reliability Requirements

Each Eligible Intermittent Resource and Hybrid Resource with a wind generation or solar generation component shall provide a backup power source for the Remote Intelligent Gateway, meteorological station equipment, revenue meter, and essential communication equipment (including, but not limited to, the router, network switch, fiber optic transceiver, 120V plug-in power supplies). The backup power source shall be sized accordingly to carry that equipment load. A backup power supply may include, but is not limited to, an uninterruptable power source (UPS) or a battery bank with solar panel charger. Whichever backup power source the Eligible Intermittent Resource installs, it shall be sized and provide power until the primary power source is restored.

3.4 Standards

The standards for communications shall be the monitoring and communications requirements for Generating Units providing only Energy; as such standards may be amended from time to time, and published on the CAISO Website.

3.5 Cost Responsibility

An Eligible Intermittent Resource is responsible for expenses associated with engineering, installation, operation and maintenance of required communication equipment.

4 FORECASTING

The CAISO is responsible for overseeing the development of tools or services to forecast Energy for Participating Intermittent Resources. The CAISO will use its best efforts to develop accurate and unbiased forecasts, as limited by the availability of relevant explanatory data. Objective criteria and thresholds for unbiased, accurate forecasts shall be used to certify Participating Intermittent Resources in accordance with Section 2.2.4 of this EIRP.

4.1 [Not Used]

4.2 [Not Used]

4.3 Confidentiality

The CAISO shall maintain the confidentiality of proprietary data for each Participating Intermittent Resource in accordance with Section 20 of the CAISO Tariff.

5 SCHEDULING AND SETTLEMENT

5.1 Schedules

For all Generating Units that comprise the Participating Intermittent Resources shall comply with the Bidding and scheduling rules specified in Sections 4.8, 30, 31, and 34.

5.2 Settlement

After a Participating Intermittent Resource is certified, Settlement shall be determined for each Settlement Period based on consistency of Bids submitted on behalf of such Participating Intermittent Resource with the rules specified in the CAISO Tariff and this EIRP.

5.3 [Not Used]

6 DATA COLLECTION FACILITIES

An Eligible Intermittent Resource not otherwise exempt and Hybrid Resource with a variable component that elects to have a CAISO forecast must install and maintain equipment to collect, record and transmit data that the CAISO reasonably determines is necessary to develop and support a forecast model that meets the requirements of Section 4 of this EIRP.

6.1 Other Eligible Intermittent Resources

Eligible Intermittent Resources other than wind or solar projects will be required to provide data of comparable relevance to estimating Energy generation. Standards will be developed as such projects are identified and will be specified in this Eligible Intermittent Resources Protocol.-

7 PROGRAM MONITORING

The CAISO shall monitor the operation of these rules, and will in particular seek to eliminate any gaming opportunities provided by the flexibility provided Participating Intermittent Resources to self-select participation on an hourly basis.

Participating Intermittent Resources are expected to bid, schedule, and otherwise perform in good faith, and not seek to act strategically in a manner that causes financial gain through systematic behavior, where such gain results solely from the settlement accommodations provided under CAISO Tariff Section 11.12.

If requirements specified in this EIRP are not met, then Participating Intermittent Resource certification may be revoked pursuant to Section 2.4.5 of this EIRP. Any patterns of strategic behavior by Participating Intermittent Resources will be tracked, and the statistical significance of such deviations will be used by the CAISO to evaluate whether changes in the rules defined in this EIRP are appropriate.

The CAISO will monitor the impact of rules for Participating Intermittent Resources on FMM or RTD imbalance energy and Regulation costs to the CAISO.

8 AMENDMENTS

If the CAISO determines a need for an amendment to this EIRP, the CAISO will follow the requirements as set forth in Section 15 of the CAISO Tariff.

Attachment C – Board of Governors Materials – Nov 18, 2020

Hybrid Resources and Co-located Resources

California Independent System Operator Corporation

September 8, 2021



Memorandum

To: ISO Board of Governors

From: Mark Rothleder, Senior Vice President, Chief Operating Officer

Date: November 11, 2020

Re: **Decision on hybrid resources policy proposal**

This memorandum requires Board action.

EXECUTIVE SUMMARY

Interest in energy storage is significant and continues to grow as state and federal policy makers and regulators promote energy storage development to help decarbonize the grid. Throughout the West, it is expected that energy storage paired with wind and solar resources will be pursued to accommodate the retirement of natural gas and coal fired generation. In particular, the ISO has identified a potential shortfall of capacity to meet projected system net load peaks over the next few years because of pending retirements of the once-through cooled natural gas generation fleet. To address this shortfall, storage resource developers have submitted a significant number of interconnection requests and are moving quickly to fill the 3,300 MW procurement mandate from the California Public Utilities Commission prior to 2023. To meet this need, the ISO anticipates a significant amount of new storage generation capacity in California alone in 2020, 2021 and 2022.

Under the hybrid resources initiative, Management has developed two different market models for generation with different technology types located behind the same interconnection. The first option is the 'co-located' resources model and was approved by the Board in July. Under this model the resources behind the interconnection have separate resource IDs and are separately dispatched through the ISO market even though they may have a shared commercial interest. The second option, for which Management seeks Board approval now, is a model for 'hybrid' resources, where the generation resources are modeled under a single resource ID. The hybrid model allows for the underlying resources to be managed by the resource operator as opposed to the ISO. Management proposes market enhancements to allow for the effective management and dispatch under the hybrid resources model and some additional enhancements to the co-located resources model.

First, Management proposes new provisions for managing hybrid resources to allow them to provide both energy and ancillary services. The proposal also includes a dynamic limit tool that will enable the resource operators to communicate their maximum and minimum operating limits to the ISO in real-time. This tool will help the ISO ensure it is issuing feasible dispatches to hybrid resources participating in the market. Next, Management proposes additional functionality to enable co-located resources to provide ancillary services in addition to energy. Management is also expanding the co-located model to accommodate deviations from dispatch instructions under certain conditions to avoid renewable resource curtailments. Finally, Management's proposal includes a new requirement for telemetered data, called the high sustainable limit, from both hybrid and co-located resources that have a variable resource component. This information will help the ISO forecast the variable components of the hybrid and co-located resources.

This initiative falls within the advisory role of the EIM Governing Body and was presented to them during the November 4, 2020 EIM Governing Body meeting. The EIM Governing Body supports this initiative.

Management proposes the following motion:

Moved, that the ISO Board of Governors approves the tariff revisions necessary to implement the proposal for hybrid resources as described in the memorandum dated November 11, 2020; and

Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed deliverability methodology revisions, 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.

PROPOSAL

Ancillary service provision and expansion of the aggregate capability constraint for co-located resources

Management proposes to allow both hybrid and co-located resources to be certified to provide ancillary services. The co-located resources proposal approved by the Board in July includes new functionality for co-located resources to participate in the market where their combined energy delivery is constrained by the capability at their point of interconnection to the grid. This policy proposal expands on this capability and allows co-located resources behind a shared point of interconnection to participate in the ancillary service market. The aggregate capability constraint ensures that the combined energy output of co-located

resources does not exceed the capability of their shared point of interconnection. To allow adequate time for testing and vetting, the proposal only includes market awards for energy in the original specification of the aggregate capability constraint that will be implemented later this year. Management proposes to expand the aggregate capability constraint to also include market awards for ancillary services. This functionality will allow co-located resources to participate in both the energy and the ancillary service markets starting in the fall of 2021.

The Dynamic Limit Tool

A hybrid resource is modeled and operated as a single resource, but it can have multiple underlying generating types supporting it and operating at a single point of interconnection. Each technology type underlying a hybrid resource may have individual operational challenges. For example, variable energy resources may be unable to produce at full capability during all periods of an operating day, although these resources may have predictable operating patterns during the day. Similarly, storage resources are only capable of producing after they have been charged. A hybrid resource that has variable energy and storage components will have operational challenges given the different limitations of the underlying technology types. Management does not propose to extend the same functionality offered to independent variable energy resources to hybrid resources. For instance, unless given a curtailment instruction from the ISO, variable energy resources are allowed to produce as capable to account for variability in output, and the market software optimizes state of charge for storage resources. A hybrid resource will have neither market function, and will have requirements to submit bids to, and follow all dispatch instructions from, the ISO. Hybrid resources will be managed by their operator like other resources available for dispatch to fulfill market awards and commitments.

To account for the variable nature of hybrid resources, Management proposes to develop a new tool for hybrid resources to communicate their generating potential to the ISO. This information will support feasible dispatch instructions in real-time. Management proposes a dynamic limit tool that will be available to hybrid resources to specify the upper and lower operational limits for the resource for each five minute interval, going out three hours into the future.

Allowance for co-located storage to deviate from dispatch instruction

To ensure grid reliability by maintaining supply and demand balance, the ISO expects resources to respond and accurately follow dispatch instructions. During the stakeholder process, stakeholders requested that storage resources co-located with variable generation resources should be given an accommodation to deviate from dispatch instructions to manage the variable output of solar and wind co-located resource components. After considering this request, Management proposes to allow co-located storage resources to deviate from dispatch instructions in limited circumstances where the following criteria are met: 1) the co-located variable resource(s) are able to produce above their dispatch level, 2) additional variable generation above their dispatch level would result in violating the

aggregate capability constraint, and 3) the co-located storage resource is not providing ancillary services. Under these conditions, Management proposes to allow a co-located storage resource to deviate from its dispatch instruction and “back down” (charge more or discharge less) from its dispatch award.

Data Collection and the High Sustainable Limit

Management proposes a new obligation for co-located and hybrid resources with a wind or solar component to provide certain data to the ISO to help the ISO better operate these unique resources. Co-located resources are modelled as two independent resources, and they have data requirements as if they are stand-alone resources. Today, the ISO requires a suite of meteorological data submitted from variable energy resources, wind and solar, including forecast data that is used to estimate the output of these variable resources at any given time. Similarly, the ISO requires that storage resources provide state of charge data to the ISO, which the ISO uses to manage and accurately account for the state of charge for these resources. This policy will require hybrid resources that include either a variable energy or storage resource component submit relevant information about the hybrid resource to the ISO. For example, if a hybrid resource has a solar and storage component, the scheduling coordinator for that resource would be responsible for submitting both meteorological data for the solar component and state of charge data for the storage component of the resource.

Additionally, the ISO proposes to collect a new data field, called the high sustainable limit, for all co-located variable resources and each variable component of hybrid resources. The high sustainable limit estimates the maximum capability for a solar or wind resource at any specific time. This data point will help the ISO produce better forecasts for these resources. Today forecasts are partially based on the actual output of the variable resource and do not consider when the output is dispatched below full capability by the market. Once the high sustainable limit data is available, the ISO will have better visibility into the capability of the co-located resource throughout the operating day.

Application of the resource adequacy availability incentive mechanism to hybrid and co-located resources

Resources shown by load serving entities as resource adequacy resources are subject to the resource adequacy availability incentive mechanism. This provision compares a resource’s monthly availability to the fleet average availability. Resource adequacy resources that are available significantly less than the fleet average incur a charge, while resources that are available more than the fleet average receive a payment based on the charges collected. The intent of the resource adequacy incentive mechanism is to provide an incentive for resource adequacy resources to maximize their availability during months they are designated as resource adequacy resources. Variable energy resources are exempt from the resource adequacy mechanism. The primary reason for the exemption is that their resource adequacy capacity value is based on their historical output (expected load carrying capability methodology) which accounts for their variable nature. Applying the

resource adequacy incentive mechanism would result in double penalizing these resources for their availability.

For co-located resources, the application of the resource adequacy availability incentive mechanism is straightforward. The variable energy resource component is exempt while the incentive mechanism is applied to the storage component. On the other hand, complications arise for hybrid resources which have a single resource ID for the aggregated resources. The CPUC has established the hybrid resources resource adequacy capacity value as the combined value of the variable energy resource and the storage resource. The variable energy resource component capacity value is discounted through the expected load carrying capability methodology and is then combined with the storage component capacity value. Applying the resource adequacy incentive mechanism to hybrid resources would result in potentially double penalizing the variable energy resource component for its availability. Moreover, it would require complex settlement provisions that the ISO would have to implement to separate the application of the incentive mechanism to the storage component of a hybrid resource. Therefore, Management proposes to exempt hybrid resources from the resource adequacy incentive mechanism. This exemption will be in place until the resource adequacy incentive mechanism is replaced with the unforced capacity value methodology (UCAP) currently be developed in the resource adequacy enhancements initiative.

STAKEHOLDER POSITIONS

Stakeholders are generally supportive of the hybrid resources policy and also agree with Management's proposal to move quickly to adopt the proposed hybrid resources models so that new resources coming onto the market will be able to utilize these tools upon interconnection or shortly thereafter. Further, stakeholder feedback was integral for developing provisions to allow co-located storage resources the ability to deviate from dispatch instructions and for determining how best to use the dynamic limit tool to reduce the reliance on the outage management system. However, stakeholders continue to make requests to enhance the functionality proposed in this initiative.

Stakeholders requested allowances for co-located storage to deviate from dispatch instructions to provide additional energy when on-site renewables are producing less than forecast. This would be an additional allowance to what is already included in this proposal. Management understands the desire for additional functionality but is concerned that this specific request could result in reliability concerns. Allowing storage resources to deviate from dispatch and charge less or discharge more in any given interval will potentially result in lower state of charge values for storage resources than anticipated by our market software, which could in turn lead to reliability issues.

Stakeholders also asked a number of questions and for additional clarity around the treatment of hybrid resources within the resource adequacy construct. In particular, several stakeholders raised concerns about the different application of the resource adequacy availability incentive mechanism to co-located and hybrid resources.

Management believes that the different application is justified to not double penalize the variable energy resource component of the hybrid resources and to avoid complex and costly implementation of settlement provisions that would be required to apply the incentive mechanism to hybrid resources. Moreover, the exemption is only expected to be in place for a short period until new availability incentives are implemented as part of the resource adequacy enhancements initiative. This policy will consider how all resources, including hybrid and co-located resources, will count for unforced capacity, or UCAP, values applied under the new paradigm. This policy also will determine bidding rules and obligations for all resources in the future. Management encourages stakeholders engaged in the hybrid resources initiative to also follow policy development in the resource adequacy enhancement initiative for details about treatment of these resources in the resource adequacy market in the future.

CONCLUSION

The ISO is experiencing rapid growth in the amount of storage resources on the system, many of which will be modeled as either co-located or hybrid resources. It is essential that the ISO develop and implement market rules for these resources quickly to accommodate the influx of new resources. This policy advances models for both configurations and puts necessary tools in place for reliable operation of these resources on the grid.



Decision on hybrid resources phase 2 proposal

Greg Cook

Executive Director, Market and Infrastructure Policy

Board of Governors Meeting

General Session

November 18, 2020

The hybrid resources initiative includes two different models for generation with different technology types at the same location

- Co-located resource model – Individual resource ID for each generator behind a single point of interconnection
 - Each component will be modelled similar to other resources on the grid today
 - Approved by Board in July, Fall 2020 implementation
- Hybrid resource model – A single resource ID aggregating multiple generators at a single point of interconnection
 - ISO has visibility to a single resource which can allow flexibility for hybrid resource management
 - ISO Board decision in November, Fall 2021 implementation

The Phase 2 proposal provides enhanced market rules for hybrid resources and additional provisions for co-located resources

- New provisions for managing hybrid resources
 - Allows for hybrid resources to provide ancillary services
 - Enables hybrid resources to communicate their generation availability in real-time through new functionality
- Enhanced functionality to responsibly integrate co-located resources
 - Allow co-located resources to provide ancillary services
 - Allow co-located storage resources to deviate from dispatch instructions under certain conditions to avoid renewable curtailment
- Facilitate hybrid wind and solar resource forecasting by collecting new data from hybrid and co-located resources

Proposal includes a new dynamic limit tool for hybrid resource operators to convey real-time operating limits

- Hybrid resources face unique challenges operating a mix of resources under a single resource ID
 - Physical output limits based on combined resource capabilities of wind or solar and storage component
- The dynamic limit tool enables the unique nature of hybrid resources to inform the ISO of expected real-time capability
 - This new tool conveys information to ISO operators on the upward and downward capability of the hybrid resource
 - Helps ensure ISO issues feasible dispatches to hybrid resources

Allow co-located storage resources to deviate from dispatch instructions under limited conditions to avoid renewable curtailment

- Storage component would be allowed to produce less than dispatch (charge) under the following conditions:
 - The co-located VER resource must be producing above dispatch
 - The co-located resources would otherwise be producing above point of interconnection limits
 - The co-located resources may not be providing ancillary services
- Information sharing necessary to facilitate the deviation would be borne by the co-located resource operators
- Resource deviations would be settled as uninstructed energy

Proposal includes new provisions for collecting data from wind and solar components for forecasting needs

- ISO will require high sustainable limit data from wind and solar components that are either co-located or part of a hybrid resource
 - Provides real-time telemetry data on the maximum expected output of the wind or solar components
- This information will be used to forecast potential output of wind and solar hybrid resource components

Stakeholders largely support Management's Hybrid Phase 2 Proposal

- Most stakeholders recognize that proposal provides new market tools for an emerging technology
 - Quick delivery is necessary to accommodate new resources
 - Feedback from stakeholders was instrumental in developing a more workable dynamic limit tool
- Some stakeholders raised concerns about resource adequacy provisions for hybrid resources
- Stakeholders continue to advocate for additional functionality for operating co-located resources
 - Management will begin policy work to consider extending the hybrid and co-located constructs in the summer of 2021

Management requests the Board approve the hybrid resources phase 2 proposal

- Hybrid proposal provides improved functionality to allow resources located at the same point of interconnection to provide ancillary services
- Policy improves forecasting with a telemetered estimate of generating capabilities for wind and solar components of hybrid and co-located resources
- Policy introduces new tools necessary for hybrid resources to operate in the market and receive feasible dispatch instructions from the ISO market



**Board of Governors
General Session**

November 18, 2020

Decision on Hybrid Resources Phase 2 Proposal

Motion

Moved, that the ISO Board of Governors approves the tariff revisions necessary to implement the proposal for hybrid resources as described in the memorandum dated November 11, 2020; and

Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed deliverability methodology revisions, 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: Bhagwat Second: Leslie

Board Action:	Passed	Vote Count:	5-0
Bhagwat	Y		
Borenstein	Y		
Galiteva	Y		
Leslie	Y		
Olsen	Y		

Motion Number: 2020-11-G1

Attachment D – Board of Governors Materials – July 15, 2021

Hybrid Resources and Co-located Resources

California Independent System Operator Corporation

September 8, 2021



Memorandum

To: ISO Board of Governors

From: Anna McKenna, Vice President, Market Policy and Performance

Date: July 7, 2021

Re: **Decision on Hybrid Resource Aggregate Capability Constraint**

This memorandum requires Board action

EXECUTIVE SUMMARY

In July 2020, the Board of Governors approved Management's phase 1 hybrid resource functionality, followed by the Board's approval of phase 2 hybrid resource functionality in December 2020. Hybrid resources refers to multiple resources behind a single point of interconnection. The most common hybrid resource configuration is a solar resource located with a storage resource behind a single interconnection point. Phase 1 included the authority to specify an aggregate capability constraint in the ISO market that could limit dispatch instructions issued to a set of co-located resources, whose physical generating capability exceeds the ISO studied and approved injection limits at the point of interconnection for the resources. Phase 2 included an expanded definition of the aggregate capability constraint, allowing co-located resources with this constraint to also provide ancillary services, in addition to energy, to the market. The approved policy also included requirements for high sustainable limit data from solar and wind co-located resources and hybrid components, as well as the dynamic limit tool that allows hybrid resources to convey real-time availability changes to the ISO market software.

Stakeholders recently raised concerns that the aggregate capability constraint functionality, approved through phase 1 and phase 2 of the hybrid resources initiative, would be insufficient to manage co-located projects coming on-line in the next few years due to certain contractual provisions that provide off-takes with rights to separately schedule shares of the hybrid resource. Specific contractual provisions prohibit resources from generating above their contractual share of the approved interconnection capacity. To accommodate these contracts, Management proposes a new constraint to enforce these individual contractual restrictions that can also be relaxed by the market software when reliability is threatened.

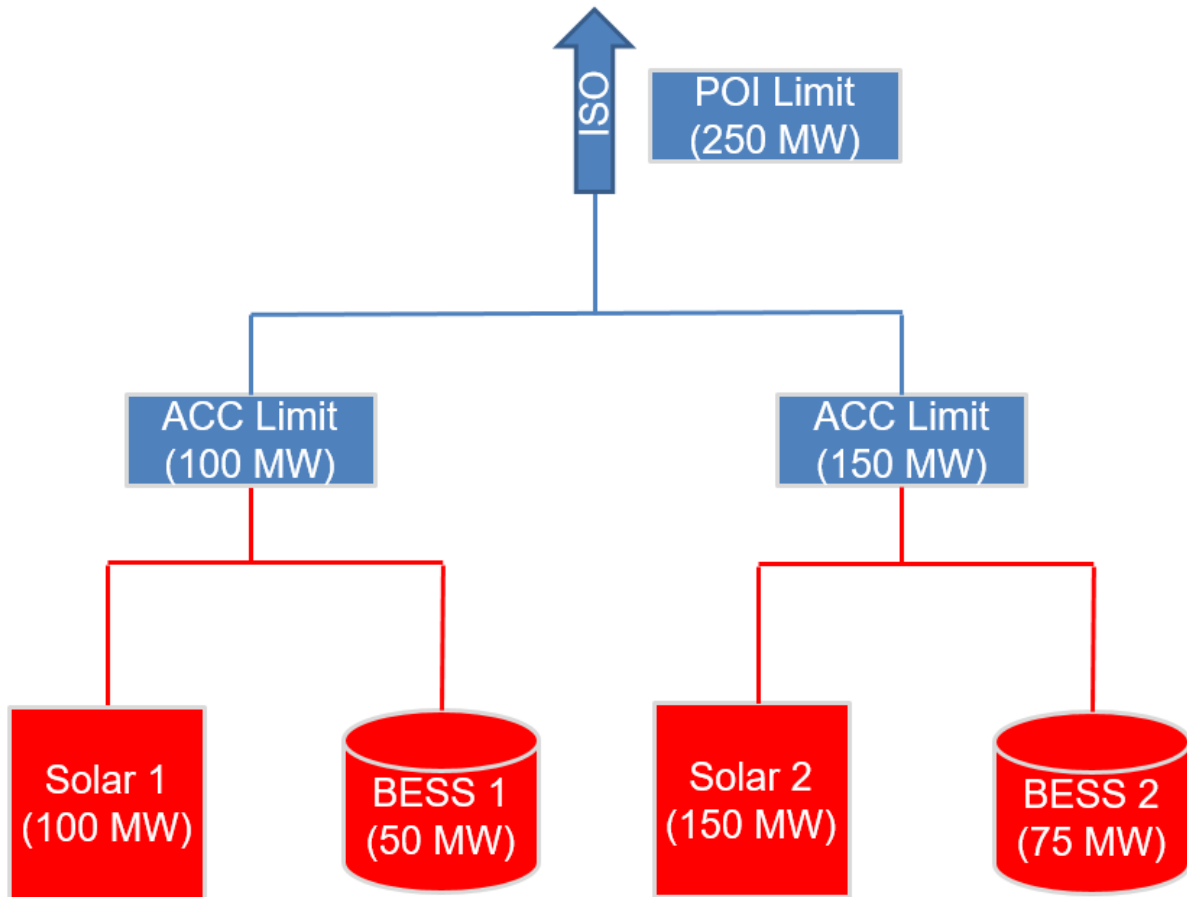
Moved, that the ISO Board of Governors approves the tariff revisions necessary to enhance the hybrid co-located resources model to

include subordinate aggregate capability constraints as described in the memorandum dated July 7, 2021; and

Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposal, 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

Management proposes an enhancement to the hybrid co-located resource model to allow for the use of multiple aggregate capability constraints at a single generating facility. Management proposes to introduce subordinate aggregate capability constraints, which are nested constraints that are subordinate to the master aggregate capability constraint that observes the generating facility's total interconnection service capacity limit. This proposal would allow multiple resources and off-takers at a generating facility comprised of co-located resources. The use of subordinate constraints will allow the ISO to model each set of co-located resources to their maximum contractual operating levels, but limit the awards and dispatch instructions to the portion of the interconnection service capacity represented by the subordinate aggregate capability constraint. Using these market constraints prevents off-takers from exceeding specified contractual limits under normal operating conditions. The following example illustrates how this proposal would work.



The figure above shows a scenario with four co-located resources at a single generating facility and two subordinate aggregate capability constraints. This example reflects a scenario where two physical resources, a 250 MW solar and a 125 MW storage resource, are constructed and the developer enters into contracts with two off-takers. The first off-taker, represented on the left, receives contractual rights to 100 MW of the solar resource and 50 MW of the storage resource. Those components are also contractually obligated to never generate more than 100 MW from a combination of the two underlying resource shares at any time. Similarly, a second off-taker, represented on the right, contracts for a 150 MW share of the solar facility and a 75 MW share of the storage resource. The second off-taker is also contractually obligated to never generate more than 150 MW from a combination of the two underlying resource shares at any time.

This proposal includes a methodology to model this generating facility configuration. Each of the four resource shares, two solar shares and two storage shares, are

represented as four independent resources, each with a resource ID, metering and bidding requirements, and dispatch instructions from the ISO market software. These four resources are related using the methodology established for modeling co-located resources. Additionally, the market will enforce a master aggregate capability constraint to ensure that the market does not issue instructions to a combination of the four resources that would exceed the studied interconnection limit of 250 MW. Further, the market would enforce a subordinate aggregate capability constraint on the two resources contracted to the first off-taker to limit dispatch to not exceed the contractual operating limit of 100 MW. A similar subordinate aggregate capability constraint would be placed on the resources contracted to the second off-taker constraint that would limit dispatch to be below the 150 MW contracted limit.

Management proposes that the master and subordinate aggregate capability constraints be treated differently because these constraints serve different functions. The master aggregate capability constraint serves the function of limiting combined dispatch from all co-located resources at a generating facility to no more than the studied interconnection capacity. This is similar to other physical constraints already enforced on the grid and is often modeled as maximum generating (Pmax) limits for resources. These constraints are firm and cannot be relaxed by the market software. The subordinate constraints are different and represent contractual limitations on the output of co-located resources. These constraints exist as limitations on output and may be based on a share of the interconnection to which an off-taker is contractually entitled. These limitations can be modeled in the market, but Management argues that they should not jeopardize either system or local reliability. Therefore, Management proposes allowing the market software to relax subordinate aggregate capability constraints during instances when grid reliability is threatened and the supply demand balance cannot be achieved without relaxing the constraint. Simply, these constraints would be relaxed slightly before the market software relaxes the power balance constraint. By allowing this relaxation, no megawatts are artificially stranded behind a subordinate aggregate capability constraint during stressed system conditions when reliability could be jeopardized.

Management anticipates that subordinate aggregate capability constraints will be relaxed very infrequently. Power balance constraint relaxations may serve as a proxy for an upper bound of how often a subordinate aggregate capability constraint will be relaxed. In its most recent annual report, from 2019, the Department of Market Monitoring reported that power balance relaxations occurred in .08% of 15-minute market intervals and .2% of 5-minute intervals.¹ In addition to tight system conditions, there must be conditions that allow for the relaxation of the subordinate aggregate capability constraint at the facility. This means that at a co-located facility there would need to be an inability for generation to produce up to one subordinate aggregate

¹ 2019 Annual Report on Market Issues and Performance, Department of Market Monitoring, pp 121:
<http://www.caiso.com/Documents/2019AnnualReportonMarketIssuesandPerformance.pdf>.

capability constraint and the ability to generate above another subordinate constraint. This scenario may occur when one co-located resource is on outage or otherwise unavailable, which could be uncommon, as contracts may have rights to proportional ratios of the same underlying physical resources. This could also occur when storage resources for one off-taker are out of state of charge, while other storage resources have significant state of charge remaining.

POSITIONS OF THE PARTIES

Stakeholders support this proposal, and many asked that it be implemented as quickly as possible. Stakeholders also reiterated how these constraints could help smaller load serving entities contract for small quantities of existing or new resources. They also emphasized how this could help with procurement of storage resources in the coming years.

Stakeholders asked some clarifying questions in their comments. Most common was a request for additional clarity on how the aggregate capability constraints would be implemented. Management has committed to posting additional information on how the new functionality would work. These constraints will be enforced, just like other constraints – such as the power balance constraint or transmission limitations – in the market optimization software. The market software attempts to solve a constrained optimization problem with an objective of serving all load from available resources at the lowest possible cost. To solve this problem, the market may elect to relax some of the imposed constraints at an additional, typically very high, cost. When the market is operating under normal conditions these constraints are never relaxed because the model is able to match demand with supply without needing the additional flexibility of relaxing the constraint. Some constraints, like transmission constraints or the proposed master aggregate capability constraint, have such a high penalty price that the market software will likely never relax them. This is intentional. These constraints represent physical hardware limitations that, if exceeded, could cause damage to the asset. Other constraints, like the subordinate aggregate capability constraint or the power balance constraint, represent constraints that the market would prefer to maintain, but can be relaxed under extreme circumstances. As noted above, in practice these constraints are relaxed very infrequently by the market software.

Several stakeholders expressed concern regarding Management's proposal to relax the subordinate aggregate capability constraints when reliability is threatened. They suggest that the plant could have physical or logical mechanisms set up to enforce off-takers' ability to provide energy above the limits specified in contracts and model by subordinate aggregate capability constraints. The ISO reviews all models for interconnecting resources and additions or changes to existing resources and may not approve specifications that that will not allow for accurate modeling. The ISO notes that each resource configuration is different and each is reviewed independently.

One stakeholder asked how specific constraints could be updated over time. Management understands that the system is not static and is often changing and offers

robust methods to update how resources are modeled in the market today. As market participants change and update contracts, they may change how resources and constraints are modeled by requesting these changes from the ISO's master file team, via the normal procedures that are already in place today.

Finally, one stakeholder requested that master and subordinate constraint relaxations be reported. The ISO is not planning to release any special report outlining when these constraints are relaxed today. There are several outlets, including reports from the Department of Market Monitoring and the market analysis team, that currently report on the relaxation of existing constraints. These reports may include summarized relaxations of aggregate capability constraints in the future.

CONCLUSION

Management requests that the Board of Governors approve the proposed enhancements to the hybrid co-located model to allow for subordinate aggregate capability constraints. This new functionality will facilitate contracting by load serving entities for fractional shares of hybrid co-located projects.



Decision on aggregate capability constraints for co-located hybrid resources

Greg Cook

Executive Director, Market and Infrastructure Policy

Board of Governors Meeting

General Session

July 15, 2021

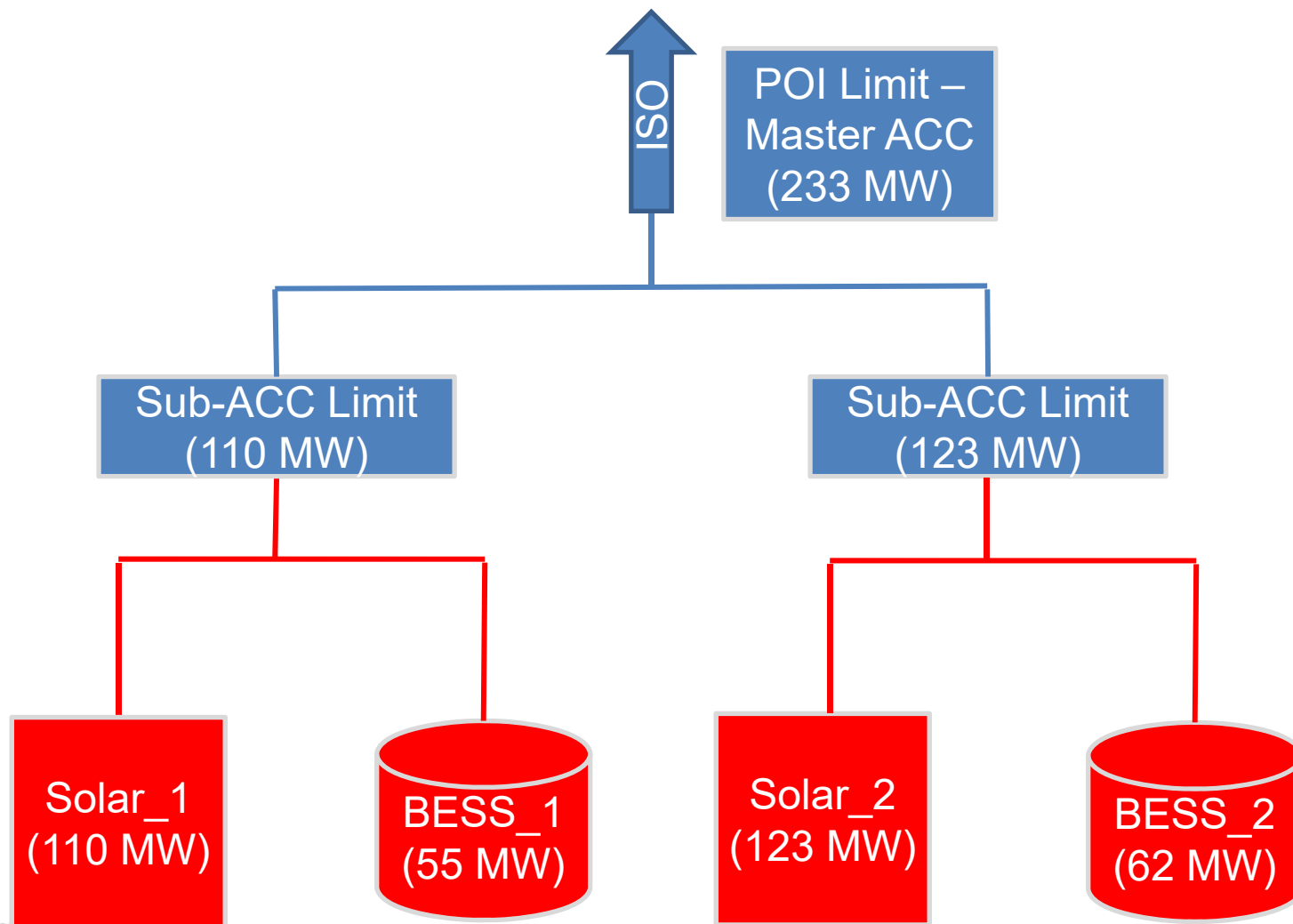
The ISO developed and implemented new functionality to manage hybrid co-located resources

- Policy includes provisions to prevent “oversized” co-located generation from exceeding studied interconnection limits
 - The aggregate capability constraint functionality was implemented in Fall 2020
- Additional functionality will be in place to allow ancillary services in Fall 2021

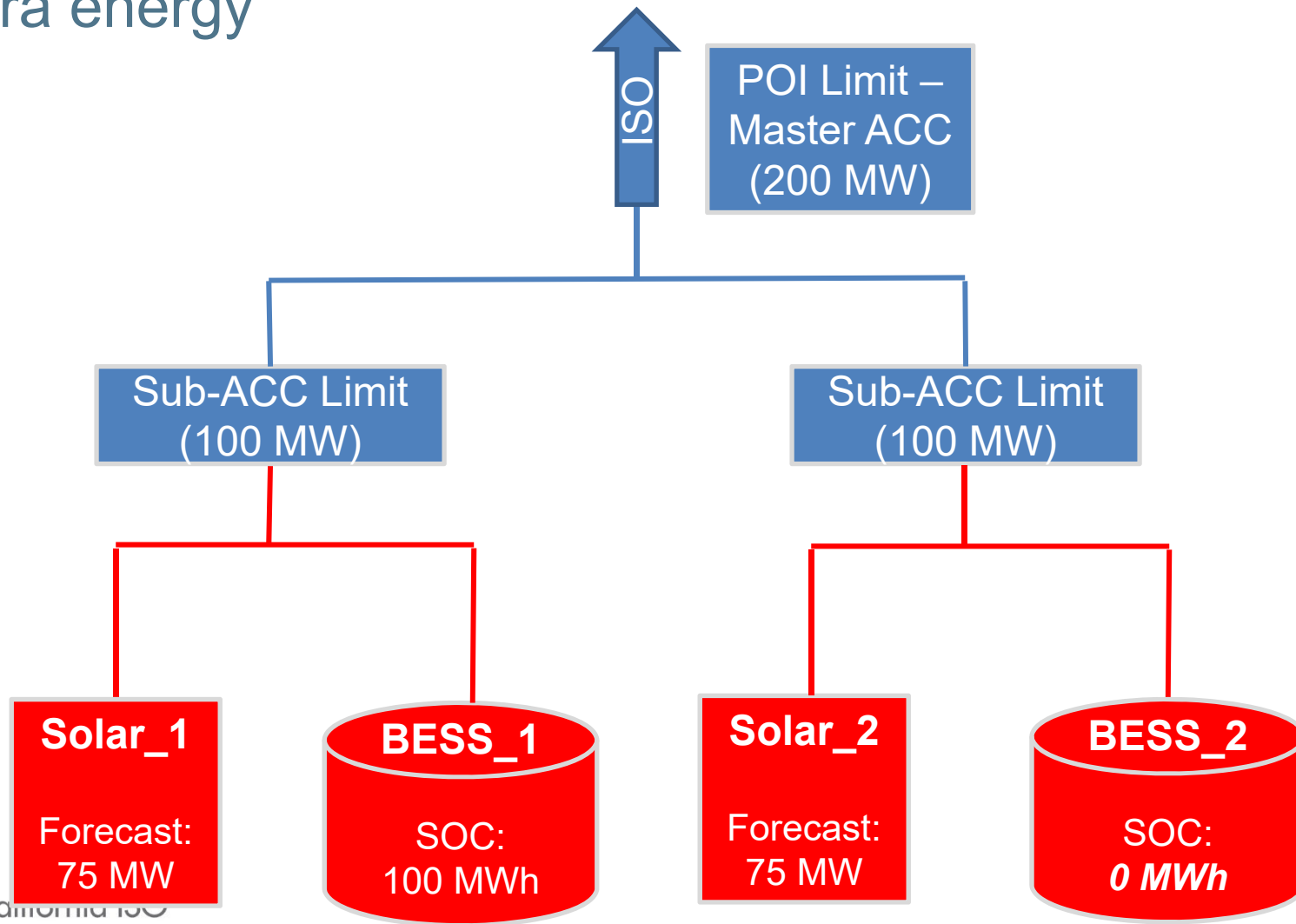
Stakeholders requested the ISO develop subordinate aggregate capability constraints for co-located resources

- Developers are contracting with off-takers for fractional shares of resources **and** interconnection limits
- This is prevalent for large energy projects with solar and storage at the same location
- Responding to stakeholder requests, Management proposes new functionality to model contractual limits
 - Master aggregate capability constraint will model point of interconnection limits
 - Sub-aggregate capability constraint will model contractual limits

New provisions will allow dispatch of co-located resources with contractual limitations



When reliability is at risk, the ISO market can relax sub-aggregate capability constraints to schedule extra energy



Management proposes functionality to enable access to available energy under emergency scenarios

- The ISO market software will enforce fixed master aggregate capability constraints
 - The ISO has procedures to temporarily re-evaluate point of interconnection constraints in emergency scenarios and these may be re-evaluated using the same process
- The ISO market software can relax subordinated aggregate capability constraints for reliability concerns
 - When the market software cannot find sufficient supply to match demand, it may relax these modeled contractual limits

Management requests the Board approve the proposed enhancements to the co-located resource model

- Adding the sub-aggregate capability constraint to the co-located model will facilitate contracts for fractional shares of resources
- Proposal includes provisions to access available energy under emergency conditions to support reliable grid operations



Board of Governors

July 15, 2021

Decision on Hybrid Resources – Aggregate Capability Constraints Implementation

General Session

Motion

Moved, that the ISO Board of Governors approves the tariff revisions necessary to enhance the hybrid co-located resources model to include subordinate aggregate capability constraints as described in the memorandum dated July 7, 2021; and

Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposal, 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: Schori

Second: Leslie

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

Motion Number: 2021-07-G3

Attachment E – Tariff Change Justification Table
Hybrid Resources and Co-located Resources
California Independent System Operator Corporation
September 8, 2021

Hybrid Resources – Tariff Redline Justification Table

Section No.	Revisions	Justification
4.6.11	Addition of hybrid resources to the list of resources that may include operational constraints related to their energy storage component as Master File parameters.	This change recognizes that hybrid resources with energy storage components will have operational constraints similar to stand-alone energy storage resources.
4.18	Requires hybrid resources to provide accurate information regarding the capacity and the operating characteristics of their components as may be reasonably requested from time to time by the CAISO. Clarifies hybrid resources are not Variable Energy Resources or Eligible Intermittent Resources but requires hybrid resources that include a variable component to provide the CAISO with the data required by Appendix Q. Requires hybrid resources with a variable component also to provide the CAISO with telemetry and Meter Data on the variable components in addition to the Generating Facility's metering requirements under Section 10. Requires hybrid resources to provide their high sustainable limit via telemetry. Requires hybrid resources that include an energy storage component to provide the CAISO with telemetry on the energy storage component's state of charge.	This change parallels responsibilities of other participating resources. Information requirements for hybrid resources that have a variable component or energy storage component will support integration of hybrid resources into the CAISO's markets and improve forecasting for variable components of hybrid resources.
27.13	Clarifies interconnection customers or EIM participating resource scheduling coordinators may request the use of one or multiple aggregate capability constraints at a generating facility or EIM participating resource. Establishes modeling practice to recognize subordinate aggregate capability constraints at a generating facility or EIM participating resource. Provides authority for the CAISO to relax enforcement of subordinate aggregate capability Constraints in its real-time market prior to relaxing enforcement of the system energy-balance constraint to ensure there is sufficient supply to meet demand.	This change allows the CAISO market to recognize commercial transactions in which developers have multiple off-takers from co-located renewable and storage resources. Ensures the CAISO market can dispatch available capacity stranded behind a subordinate aggregate capability constraint, if needed to balance supply and demand.

Section No.	Revisions	Justification
29.2 (b) (7) (C) (v)	Clarifies readiness criteria for prospective EIM entities to include the identification of the source of hybrid resource forecasts.	This change extends existing requirements for an EIM entity to identify the source of forecasts for variable energy resource forecasts to forecasts for the variable component of hybrid resources.
29.6 (e)	Requires an EIM participating resource scheduling coordinator for a hybrid resource electing to use an independent forecasting service to make data transfer arrangements with the CAISO for the CAISO to receive the forecast in a format and on a schedule set forth in the Business Practice Manual for the Energy Imbalance Market.	This change extends an existing requirement for EIM participating resource scheduling coordinators that elect to use their own forecasts for variable energy resources to EIM participating resource scheduling coordinators for hybrid resources that that elect to use their own forecasts.
29.11 (j)	Clarifies that the CAISO will charge EIM entity scheduling coordinators a fee for hybrid resources forecasting services in accordance with Appendix F, Schedule 4. Clarifies that the CAISO will waive forecast charge if an EIM entity has an independent forecast for its hybrid resources and provides the independent forecast to the CAISO.	This change extends existing provisions relating to charging EIM entity scheduling coordinators forecasting fees for variable energy resource forecasting fees charged to hybrid resource forecasts.
29.34 (q)	Clarifies that tariff provisions for the real-time market specifically applicable to hybrid resources appear in Section 34.1.6.3.	This change provides a tariff cross-reference for EIM participants to real-time market provisions specifically applicable to hybrid resources.
30.5.6.1	Establishes responsibility for scheduling coordinators hybrid resources to submit a hybrid dynamic limit for at least a three-hour look ahead period to inform the real-time market of the resource's availability. Clarifies scheduling coordinators may use hybrid dynamic limits to manage onsite charging of an energy storage component of a hybrid resource. States that the CAISO will use reasonable efforts to issue real-time market schedules that respect hybrid dynamic limits.	This change provides automated functionality for the real-time market to reflect hybrid resource availability through a means other than the outage management system. The requirement to submit hybrid dynamic limits and the functionality to incorporate these limits in the CAISO's market systems will help ensure the CAISO issues feasible dispatch instructions to scheduling coordinators for hybrid resources.
31.2	Provides that the CAISO will consider bids from hybrid resources in the market power mitigation process for the day-ahead market, but these bids will not be subject to bid mitigation.	This change clarifies the CAISO's initial hybrid resource market participation model does not subject bids from hybrid resources to local market power mitigation processes. As hybrid resources come

Section No.	Revisions	Justification
		<p>online, the CAISO may need to enhance its market power mitigation process to mitigate bids from these resources. The CAISO will explore including bid mitigation for hybrid resources in its hybrid resource evolution initiative to address any concern that these resources might exercise local market power.</p>
34.1.5.1	<p>Provides that the CAISO will consider bids from hybrid resources in the market power mitigation process for the real-time market, but these bids will not be subject to bid mitigation.</p>	<p>This changes clarifies the CAISO's initial hybrid resource market participation model does not subject bids from hybrid resources to local market power mitigation processes. As hybrid resources come online, the CAISO may need to enhance its market power mitigation process to mitigate bids from these resources. The CAISO will explore including bid mitigation for hybrid resources in its hybrid resource evolution initiative to address any concern that these resources might exercise local market power.</p>
34.1.6.3	<p>Explains that the CAISO will use reasonable efforts to issue real-time market schedules that observe various information points, including information about hybrid dynamin limits submitted by scheduling coordinators. Provides that hybrid resources with a variable component may elect to receive a CAISO forecast to inform their bidding, or they may elect to use their own forecast. Requires hybrid resources using their own forecast to submit its forecast for the variable component for the binding interval by 37.5 minutes prior to flow (the start of the applicable FMM optimization for the binding interval).</p>	<p>This change mirrors existing tariff language in section 34.1.6.2 applicable to eligible intermittent resources participation in the real-time market. The CAISO is propping to extend similar requirements to hybrid resources with a variable component.</p>
40.9.2 (b)	<p>Provides an exemption for hybrid resources from the CAISO's Resource Adequacy Availability Incentive Mechanism.</p>	<p>Similar to variable energy resource, this change proposes to exempt hybrid resources from the Resource Adequacy Availability Incentive Mechanism. Resource Adequacy counting rules already discount the qualifying capacity of the renewable component of a hybrid resource. Applying the Resource Adequacy Availability Incentive Mechanism during availability assessment hours to a hybrid resource will double penalize the resource for its unavailability during hours</p>

Section No.	Revisions	Justification
		when its renewable component does not have fuel. Developing a process to separate the energy storage component of a hybrid resource for purposes of applying the Resource Adequacy Availability Incentive Mechanism would involve a complicated calculation and enhancements. If required to implement such features, the CAISO would need to undertake significant work on its settlements systems before hybrid resources could offer resource adequacy capacity.
40.10.4.1 (g)	Clarifies that the effective flexible capacity value of a hybrid resource is the sum of what the effective flexible capacity values of the constituent components of the Hybrid Resource would be if those components were each a distinct generating unit.	This change recognizes each component of a hybrid resource may contribute to flexible resource adequacy capacity as if it were a separate generating unit. Allows variable component and energy storage component to offer their maximum capacity as flexible resource adequacy capacity.
Appendix A High Sustainable Limit	Defines the high sustainable limit that the CAISO will obtain via telemetry from hybrid resources and co-located resources that are eligible intermittent resources.	This change defines information required from hybrid resources and co-located resources that are eligible intermittent resources via telemetry to help integrate these resources into the CAISO's markets.
App A Hybrid Dynamic Limit	Defines hybrid dynamic limit that the CAISO will obtain from scheduling coordinators for hybrid resources to enhance real-time market assessment of resource availability.	This change clarifies information required from hybrid resources to help ensure feasible dispatches in the real-time market.
Appendix F Schedule 4	Clarifies the forecast fee charged by the CAISO will apply to eligible intermittent resources, variable energy resource that are EIM participating resources for hybrid resources with a variable component for which the CAISO generates a forecast.	This change provides greater detail regarding which resources are subject to the CAISO's forecast fee.
Appendix K Part A	Requires hybrid resources and eligible intermittent resources to provide the CAISO with the high sustainable limit to obtain certification to offer regulation services.	This change establishes data requirements from hybrid resources and eligible intermittent resources to enhance persistence forecasting logic when these resources are carry an ancillary services award that reduces their MW telemetry below what they are

Section No.	Revisions	Justification
		capable of producing. This data will also help validate that the resource can support the ancillary services award.
Appendix K Part B	Requires hybrid resources and eligible intermittent resources to provide the CAISO with the high sustainable limit to obtain certification to offer spinning reserves.	This change establishes data requirements from hybrid resources and eligible intermittent resources to enhance persistence forecasting logic when these resources are carry an ancillary services award that reduces their MW telemetry below what they are capable of producing. This data will also help validate that the resource can support the ancillary services award.
Appendix K Part C	Requires hybrid resources and eligible intermittent resources to provide the CAISO with the high sustainable limit to obtain certification to offer non-spinning reserves.	This change establishes data requirements from hybrid resources and eligible intermittent resources to enhance persistence forecasting logic when these resources are carry an ancillary services award that reduces their MW telemetry below what they are capable of producing. This data will also help validate that the resource can support the ancillary services award.
Appendix Q 1.1	Clarifies that Appendix Q information requirements apply to eligible intermittent resources not certified as a participating intermittent resource.	Non-substantive change to clarify applicability of Appendix Q.
Appendix Q 2	Modifies title of section.	Non-substantive change to clarify applicability of Appendix Q, section 2.
Appendix Q 2.2	Modifies text to clarify section 2.2 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 2.2.
Appendix Q 2.2.1	Modifies section to state hybrid resources with a variable component must execute all agreements that are otherwise required in this CAISO tariff.	This change clarifies hybrid resources must execute agreements as required by the CAISO tariff.
Appendix Q 2.2.3	Modifies text to clarify section 2.2.3 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 2.2.3.

Section No.	Revisions	Justification
Appendix Q 2.4.1	Clarifies that A hybrid resource with a variable component must pay the forecast fee for all metered Energy generated by variable component, as specified in CAISO Tariff Appendix F, Schedule 4, if it elects, per section 3.1 of this EIRP, to have the CAISO produce a forecast of the output of the Hybrid Resource’s variable component.	This change incorporates text consistent with tariff section 4.8.2, which provides: “Scheduling Coordinators for Hybrid Resources that include an individual component that is capable of being separately registered with the CAISO as an Eligible Intermittent Resource must provide the CAISO with the meteorological data for that component that would be required by Appendix Q, if it were registered with the CAISO as an Eligible Intermittent Resource. Scheduling Coordinators electing to use the forecast provided by the CAISO also are subject to the Forecast Fee.”
Appendix Q 2.4.4	Modifies text to clarify section 2.4.4 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 2.4.4.
Appendix Q 3.1	Modifies text to clarify section 3.1 extends to hybrid resources with a variable component Clarifies that a hybrid resource with a wind generation or solar generation component may elect to provide its own forecasted production in lieu of a CAISO forecast but such election does not relieve the resource of the obligation to provide production data and meteorological data as otherwise required by Appendix Q of the CAISO tariff.	Non-substantive change to clarify applicability of Appendix Q, section 3.1. Language treats hybrid resources with a wind or solar component similar to other wind and solar resources subject to Appendix Q and is consistent with requirements to provide the CAISO with information as specified in proposed section 4.18.
Appendix Q 3.1.1	Modifies text to clarify section 3.1.1 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 3.1.1.
Appendix Q 3.1.1.1	Modifies text to clarify section 3.1.1.1 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 3.1.1.1
Appendix Q 3.1.1.2	Modifies text to clarify section 3.1.1.2 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 3.1.1.2
Appendix Q 3.1.1.4	Clarifies that wind eligible intermittent resources and hybrid resources with a wind generation component may not share meteorological stations with another resource.	This change confirms an existing practice. Consistent with the CAISO’s existing tariff (section 3.1.1.2 of Appendix Q), meteorological data points for wind resources are specific to their locations and generating

Section No.	Revisions	Justification
		turbines. Meteorological stations need to be in a specific area of the site to measure the prevailing wind. By not addressing this topic for wind resources, the existing tariff implicitly forbids such sharing arrangements for wind eligible intermittent resources, and the CAISO's established practice has been to reject such requests from wind resources.
Appendix Q 3.1.2	<p>Modifies text to clarify section 3.1.2 extends to hybrid resources with a variable component.</p> <p>Requires the submission of and the high sustainable limit by hybrid resources and co-located eligible intermittent resources. Clarifies telemetry points for wind eligible intermittent resources and hybrid resources with a wind component.</p>	<p>Non-substantive change to clarify applicability of Appendix Q, section 3.1.2</p> <p>Parallels responsibilities of other participating resources to provide information to the CAISO. Information requirements for hybrid resources that have a variable component or energy storage component will support integration of hybrid resources into the CAISO's markets and improve forecasting for variable components of hybrid resources.</p>
Appendix Q 3.1.3	Modifies text to clarify section 3.1.3 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 3.1.3.
Appendix Q 3.1.4	Modifies text to clarify section 3.1.4 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 3.1.4.
Appendix Q 3.1.5	Restates data points for site information from wind eligible intermittent resources and hybrid resources with a wind components.	<p>This change Identifies a more comprehensive list of site information that will assist CAISO efforts to more accurately forecast and integrate eligible intermittent resources and hybrid resources into its markets. These changes involve a shift in format from a defined worksheet for participants to complete to a list of data points market participants will provide through the CAISO's resource interconnection management systems (RIMS). The updated list includes data needed to onboard eligible intermittent resources and hybrid resources with a wind or solar component. Many of the newly-required data points are already requested and provided, but including a tariff requirement for resources to provide these data points</p>

Section No.	Revisions	Justification
		<p>will ensure the CAISO has a uniform set of data points it needs to manage these resources. For example, understanding the “park potential” of a resource will help inform the capability of a wind or solar resource based on different weather conditions, and will help develop an accurate production forecast of the resource. By including this list of data points in the tariff, eligible intermittent resources and hybrid resources will have a clear understanding of data needed to help facilitate onboarding of new resources.</p>
<p>Appendix Q 3.1.6</p>	<p>Establishes a requirement for wind eligible intermittent resources and a hybrid resources with a wind component and to submit a shape-file that illustrates, at a minimum, the location of the meteorological station(s), resource project corner, and all individual wind turbines comprising the resource</p>	<p>This change builds on existing requirements. The data in a shape-file formats builds on the existing requirement for resources to provide a topographic map. A topographic map can provide an effective visual representation of a resource site’s layout. The shape-file provides similar information but in a digital format the CAISO can query to facilitate analysis. A shape-file will also help eliminate discrepancies between text values and a topographic map. In addition, a shape-file also will enable automated review of resources, which will make onboarding resources more efficient. Having accurate geographic information for both hybrid and co-located resources that may be located in close proximity to one another is crucial to distinguish clearly between the geographical boundaries of each resource. A customer who provides a topographic map likely already has a shape-file, so compliance with this new requirement should not create any undue burden.</p>
<p>Appendix Q 3.2.1</p>	<p>Modifies text to clarify section 3.2.1 extends to hybrid resources with a variable component.</p>	<p>Non-substantive change to clarify applicability of Appendix Q, section 3.2.1.</p>
<p>Appendix Q 3.2.1.1</p>	<p>Modifies text to clarify section 3.2.1.1 extends to hybrid resources with a variable component.</p>	<p>Non-substantive change to clarify applicability of Appendix Q, section 3.2.1.1.</p>
<p>Appendix Q 3.2.1.2</p>	<p>Modifies text to clarify section 3.2.1.2 extends to hybrid resources with a variable component.</p>	<p>Non-substantive change to clarify applicability of Appendix Q, section 3.2.1.2.</p>

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Appendix Q 3.2.1.3	Modifies text to clarify section 3.2.1.3 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 3.2.1.3.
Appendix Q 3.2.1.4	Reformats and modifies text to clarify section 3.2.1.4 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 3.2.1.4.
Appendix Q 3.2.2	<p>Modifies text to clarify section 3.2.2 extends to hybrid resources with a variable component.</p> <p>Requires the submission of and the high sustainable limit by hybrid resources and co-located eligible intermittent resources. Clarifies telemetry points for hybrid resources with a solar component.</p>	<p>Non-substantive change to clarify applicability of Appendix Q, section 3.2.2</p> <p>Parallels responsibilities of other participating resources to provide information to the CAISO. Information requirements for hybrid resources that have a variable component or energy storage component will support integration of hybrid resources into the CAISO's markets and improve forecasting for variable components of hybrid resources.</p>
Appendix Q 3.2.3	Restates data points for site information from solar eligible intermittent resources and hybrid resources with a solar component.	<p>This change identifies a more comprehensive list of site information that will assist CAISO efforts to more accurately forecast and integrate eligible intermittent resources and hybrid resources into its markets. These changes involve a shift in format from a defined worksheet for participants to complete to a list of data points market participants will provide through the CAISO's resource interconnection management systems (RIMS). The updated list includes data needed to onboard eligible intermittent resources and hybrid resources with a wind or solar component. Many of the newly-required data points are already requested and provided, but including a tariff requirement for resources to provide these data points will ensure the CAISO has a uniform set of data points it needs to manage these resources. For example, understanding the "park potential" of a resource will help inform the capability of a wind or solar resource based on different weather conditions, and will help develop an accurate production forecast of the resource. By including this list of data points in the</p>

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		tariff, eligible intermittent resources and hybrid resources will have a clear understanding of data needed to help facilitate onboarding of new resources.
Appendix Q 3.2.4	Establishes a requirement for solar eligible intermittent resources and a hybrid resources with a solar component to submit a shape-file that illustrates, at a minimum, the location of the meteorological station(s) and resource project boundaries.	This change builds on existing requirements. The data in a shape-file formats builds on the existing requirement for resources to provide a topographic map. A topographic map can provide an effective visual representation of a resource site's layout. The shape-file provides similar information but in a digital format the CAISO can query to facilitate analysis. A shape-file will also help eliminate discrepancies between text values and a topographic map. In addition, a shape-file also will enable automated review of resources, which will make onboarding resources more efficient. Having accurate geographic information for both hybrid and co-located resources that may be located in close proximity to one another is crucial to distinguish clearly between the geographical boundaries of each resource. A customer who provides a topographic map likely already has a shape-file, so compliance with this new requirement should not create any undue burden.
Appendix Q 3.3	Modifies text to clarify section 3.3 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 3.3.
Appendix Q 6	Modifies text to clarify section 6 extends to hybrid resources with a variable component.	Non-substantive change to clarify applicability of Appendix Q, section 6.
Appendix Q 6.1	Modifies text to refer to eligible intermittent resources other than wind and solar resources.	Non-substantive change to clarify applicability of Appendix Q, section 6.1.