Resource Adequacy Enhancements

Revised Straw Proposal

July 1, 2019

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1. Executive Summary

The California Independent System Operator (CAISO) is performing a comprehensive review of CAISO's Resource Adequacy (RA) provisions and proposing enhancements that ensure effective procurement of capacity to reliably operate the grid all hours of the year. This comprehensive review has identified potential modifications to CAISO provisions for System, Local, and Flexible RA.

CAISO's revised straw proposal considers enhancements to RA counting rules and assessments. This includes considering forced outage rates for system and flexible RA requirements. It is common practice among other ISOs to include an assessment of unforced capacity value that relies on the probability a resource will experience a forced outage at some point when it has been procured for RA capacity. CAISO proposes to develop a methodology for calculating unforced capacity values and an assessment to ensure the shown RA capacity is collectively adequate to meet the CAISO's system operational needs in all hours. The proposal also considers the assessment of planned outages and substitution rules under an unforced capacity paradigm and the elimination of the substitution obligation for forced outages.

CAISO proposes modifications to the RA import provisions, including adoption of certain existing California Public Utilities Commission (CPUC) rules to ensure firm delivery of imports used to meet RA obligations. The proposal also contemplates changes to incorporate an auction mechanism into the import capability allocation process.

Regarding flexible RA, CAISO includes an initial proposal to modify the current provisions for identifying flexible RA needs, including long ramping (3 hour), fast ramping (1 hour), and uncertainty (15 minute) needs. The proposal also incorporates Effective Flexible Capacity (EFC) counting rules and allowing imports to qualify to meet flexible RA requirements. CAISO also proposes rules for allocation of identified flexible RA needs, updated showings and assessments rules, and updated Must Offer Obligations for flexible RA capacity.

CAISO is also exploring adding tariff authority to address local capacity needs that are met with availability limited resources, and seeks authority to procure additional resources through the capacity procurement mechanism in response to planned outages that reduce capacity below requirements if no substitute capacity is provided. Proposed modifications to CAISO's backstop capacity procurement provisions are included to align backstop authority with the resource adequacy counting rules and adequacy assessments outlined above. These potential modifications include additional procurement authority to use the capacity procurement mechanism as an option to fulfill load serving entities' unforced capacity deficiencies and system deficiencies as determined through a resource adequacy portfolio showing analysis.

2. Introduction and Background

The rapid transformation to a cleaner, yet more variable and energy limited resource fleet, and the migration of load to smaller and more diverse load serving entities requires re-examining all aspects of CAISO's Resource Adequacy program. In 2006, at the onset of the RA program in California, the predominant energy production technology types were gas fired, nuclear, and

hydroelectric resources. While some of these resources were subject to use-limitations because of environmental regulations, start limits, or air permits, they were generally available to produce energy when and where needed given they all had fairly dependable fuel sources. However, as the fleet transitions to achieve the objectives of SB 100,[1] CAISO must rely on a very different resource portfolio to reliably operate the grid. In this stakeholder initiative, the CAISO, in collaboration with the California Public Utilities Commission (CPUC) and stakeholders, will explore reforms needed to the CAISO's resource adequacy rules, requirements, and processes to ensure continued reliability and operability under the transforming grid.

CAISO has identified certain aspects within CAISO's current RA tariff authority that, among other things, require refinement to ensure effective procurement, help simplify overly complex rules, and ensure resources are available when and where needed all hours of the year. The following issues are of growing concern to the CAISO:

- The current RA counting rules do not adequately reflect resource availability, and instead rely on complicated substitution and availability incentive mechanism rules;
- Flexible capacity counting rules may not sufficiently align with operational needs;
- The current available import capability allocation process may result in inefficient outcomes and withholding of import capabilities;
- The eligibility rules and must offer obligations for import resources may need clarification to ensure firm energy delivery from RA imports;
- Current system and flexible RA showings assessments do not consider the overall effectiveness of the RA portfolio to meet CAISO operational needs; and
- The growing reliance on availability-limited resources where these resources may not have sufficient run hours or dispatches to maintain and serve the energy needs in local capacity areas and sub-areas.

CAISO is conducting a holistic review of its existing RA tariff provisions to make necessary changes to ensure CAISO's RA tariff authority adequately supports reliable grid operations into the future. The revised straw proposal specifically presents CAISO proposals for changes to system RA regarding the following topics; system RA requirements, showings and sufficiency testing, RA capacity counting rules, Must Offer Obligations and bid insertion, the planned outage process, and RA imports and Maximum Import Capability.

CAISO also provides updates to its proposal for flexible RA capacity. CAISO's proposal addresses identifying flexible RA capacity needs and products, setting flexible RA requirements and counting rules for EFC values, as well as flexible RA allocation, showings, and sufficiency tests and flexible RA Must Offer Obligation modifications.

[1] The objective of SB 100 is "that eligible renewable energy resources and zero-carbon resources supply 100% of retail sales of electricity to California end-use customers and 100% of electricity procured to serve all state agencies by December 31, 2045."
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

Regarding local RA modifications, CAISO proposes changes to local capacity assessments to address availability limited resources, and meeting local capacity needs with slow demand response. CAISO also presents its proposal to modify aspects of its backstop capacity procurement, including certain enhancements to the Capacity Procurement Mechanism.

The remaining stakeholder initiative schedule is detailed below.

3. Stakeholder Engagement Plan

Table 1 outlines the schedule for this stakeholder initiative below. CAISO plans to seek CAISO board approval of the elements in this RA enhancements initiatives in the second quarter of 2020.

Table 1: Stakeholder Engagement Plan

Date	Milestone
July 1	Revised straw proposal
July 8-9	Stakeholder meeting on revised straw proposal
July 24	Stakeholder comments on revised straw proposal due
Sep 9	Second revised straw proposal
Sep 16-17	Stakeholder meeting on second revised straw proposal
Oct 9	Stakeholder comments on second revised straw proposal due
Dec 17	Third revised straw proposal
Jan 7-8	Stakeholder meeting on third revised straw proposal
Jan 22	Stakeholder comments on third revised straw proposal
Feb 26	Draft final proposal
March 3-4	Stakeholder meeting on draft final proposal
March 25	Stakeholder comments on draft final proposal due
Q2 2020	**Present proposal to CAISO Board**

4. Resource Adequacy Enhancements: Principles and Objectives

Principles

The resource adequacy framework must reflect the evolving needs of the grid

As the fleet transitions to a decarbonized system where fuel backed resources are replaced with clean, variable, and/or energy-limited resources, traditional measures of resource adequacy must be revisited to include more than simply having sufficient capacity to meet peak demand. The RA products procured and the means to assess resource adequacy must be re-examined and refreshed to remain relevant. Any proposed changes must assure that RA accounting methods effectively evaluate the RA fleet's ability to meet the CAISO's operational and reliability needs all hours of the year. The evolving fleet is altering the CAISO's operational needs. As more variable supply and demand interconnects to the system, the CAISO requires resources that are more flexible and can quickly and flexibly respond to greater levels of supply and demand uncertainty. RA requirements and assessments must reflect the evolving needs of the grid and the RA framework must properly evaluate and value resources that can meet these evolving needs.

RA counting rules should promote procurement of the most dependable, reliable, and effective resources

Both RA and non-RA resources should be recognized and rewarded for being dependable and effective at supporting system reliability. If a non-RA resource has a higher availability and is more effective at relieving local constraints relative to other similar RA resources, then such information should be publicly available to enable load-serving entities to compare and contrast the best, most effective resources to meet their procurement needs. Having this information publicly available to load-serving entities will improve opportunities for the most dependable and effective resources to sell their capacity. Thus, in principle, RA counting rules should incentivize and ensure procurement of the most dependable, reliable, and effective resources.

The RA program should incentivize showing all RA resources

Modifications to the existing RA structure should encourage showing as much contracted RA capacity as possible and not create disincentives or barriers to showing excess RA capacity. Although it may be appropriate to apply additional incentive mechanisms for availability, CAISO must balance the impact that such incentives may have on an LSE's willingness to show all of its contracted RA capacity.

LSE's RA resources must be capable of meeting its load requirements all hours of the year

RA targets should be clear, easily understood and based on reasonably stable criteria applied uniformly across all LSEs. For example, to date, the CAISO has relied on a planning reserve margin that is met through a simple summation of the shown RA resources' Net Qualifying Capacity (NQC) values. Most Local Regulatory Authorities (LRAs) set a planning reserve margin at fifteen percent above forecasted monthly peak demand. However, some LRAs have set lower planning reserve margins. It is not possible to determine if those LSEs with lower

planning reserve margins impair the CAISO system without comparing the attributes of the underlying resources in LSE's portfolios, relative to resources' attributes in other portfolios. In other words, the simple summation of NQC values in a LSE's portfolio does not equate to resource adequacy and does not assure an LSE can satisfy its load requirements all hours of the year. As California Public Utilities Code section 380 states, "Each load-serving entity shall maintain physical generating capacity and electrical demand response adequate to meet its load requirements, including, but not limited to, peak demand and planning and operating reserves" (emphasis added).[2] In other words, resource adequacy also encompasses LSEs meeting their load requirements all hours of the year, not just meeting peak demand.

Objectives

In evaluating RA enhancements, CAISO is reviewing NQC rules, forced outage rules, adequacy assessments, and availability obligations and incentive provisions. These existing rules are inextricably linked and require a holistic review and discussion. This review includes considering assessing the reliability and dependability of resources based on forced outage rates. Incorporating forced outages into the CAISO's RA assessment will help inform which resources are most effective and reliable at helping California decarbonize its grid.

Based on the CAISO's review of best practices and the diverse stakeholder support for further exploration of these matters, CAISO is proposing a new resource adequacy framework to assess the forced outage rates for resources and conduct RA adequacy assessments based on both the unforced capacity of resources and the RA portfolio's ability to ensure CAISO can serve load and meet reliability standards.

The CAISO's proposal seeks to remain aligned with the CPUC process. However, CAISO notes that solely relying on an installed-capacity-based PRM as the basis for resource adequacy, as is the case today, is not sustainable into the future given the transforming grid and the new resource mix and its operational characteristics. A more complete discussion on the need for coordination with the CPUC's RA program is included in section 5.1.2.

CAISO must consider the express intent of the original legislated RA mandate; to ensure each load-serving entity maintains physical generating capacity and electrical demand response adequate to meet its load requirements. This is essential as California transitions to greater reliance on more variable, less predictable, and energy limited resources that may have sufficient capacity to meet a planning reserve margin, but may not have sufficient energy to meet reliability needs and load requirements all hours of the year. Given this growing concern, CAISO is proposing to develop a new resource adequacy test that will ensure there is sufficient capacity to not only meet peak load needs, but, just as importantly, to ensure sufficient energy is available within the RA fleet to meet load requirements all hours of the year.

As noted above, the current RA practices rely heavily on the existing NQC counting rules. CAISO believes that resource's NQC values will continue to be an important aspect of the RA

[2] California Public Utilities Code Section 380: http://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=PUC&division=1.&title=&part=1.&chapter=2.3.&article=6.

program in the future. For example, the local RA assessments and studies rely heavily on NQC. CAISO also envisions Must Offer Obligations being tied to NQC values. However, CAISO is also considering how to incorporate resource forced outage rates into RA assessments. Similar to the current provisions of other ISOs, CAISO proposes calculating and publishing both installed capacity (NQC) and unforced capacity (UCAP) values and utilizing both figures in the CAISO's RA processes.

5. RA Enhancements Revised Straw Proposal

The following sections detail the CAISO's proposed modifications and provide CAISO's rationale and supporting justification. This Revised Straw Proposal is reorganized from previous versions into sections covering System, Local, and Flexible RA and related sub topics, as well as a section covering proposed modifications to the CAISO's backstop procurement provisions.

The RA Enhancements Revised Straw Proposal covers the following topics:

- System Resource Adequacy
    - Determining System RA Requirements
    - Forced Outage Rates and RA Capacity Counting
    - System RA Showings and Sufficiency Testing
    - Must Offer Obligation and Bid Insertion Modifications
    - Planned Outage Process Enhancements
    - RA Import provisions
    - Maximum Import Capability provisions
- Flexible Resource Adequacy
    - Identifying Flexible Capacity Needs and Requirements
    - Identifying Flexible RA Requirements
    - Setting Flex RA Requirements
    - Establishing Flexible RA Counting Rules: Effective Flexible Capacity Values and Eligibility
    - Flexible RA Allocations, Showings, and Sufficiency Tests
    - Must Offer Obligation modifications
- Local Resource Adequacy
    - Local Capacity Assessments with Availability Limited Resources
    - Meeting Local Capacity Needs with Slow Demand Response
- Backstop Capacity Procurement provisions
    - Capacity Procurement Mechanism modifications
    - Reliability Must-Run modifications
    - UCAP Deficiency Tool

5.1. System Resource Adequacy

Resource deliverability under stressed system conditions remains an essential and important part of a resource's ability to support reliable grid operations, and the CAISO intends to preserve the current NQC calculations for resources i.e., CAISO will continue to perform NQC calculations exactly as they are today, and will continue to derate Qualifying Capacity values (QC) based on deliverability.

For all resources with NQC values, CAISO proposes to establish UCAP values to identify the unforced capacity value (discounted for units' forced outage rates) for use in system and flexible RA showings and assessments.[3] The UCAP value speaks to the quality and dependability of the resources procured to meet RA requirements. CAISO also proposes to establish system RA requirements and associated sufficiency tests that account for unit forced outage rates. In other words, resource's RA value would be measured in terms of its UCAP value and individual LSE sufficiency tests would be measured based on meeting UCAP requirements each month. The following section provides CAISO's proposed modifications to incorporate these changes into CAISO RA processes and tariff.

5.1.1. Determining System RA Requirements

CAISO proposes that RA accounting should reflect both NQC and UCAP values. CAISO will coordinate with the CPUC and LRAs to ensure alignment with individual LRA requirements.

System UCAP Requirement

CAISO believes it is reasonable to expect that the amount of UCAP made available is sufficient to serve forecasted peak load and ancillary services requirements. This is because CAISO has observed the impacts of forced outages exceeding resource margins established through existing planning reserve margin requirements during certain periods. To address these instances, CAISO is proposing to establish a system UCAP requirement to more directly account for forced outages. CAISO must carry reserves for three percent of load and three percent of generation, or cover the Most Severe Single Contingency according to BAL-002. Additionally, CAISO must have sufficient capacity to provide regulation and flexible ramping product. Therefore, CAISO proposes to develop a minimum system UCAP requirement that all LSEs must meet and show as RA.

If CAISO had perfect foresight, then this UCAP requirement would be, for example, equal to the forecasted peak, plus all other ancillary serves and flexible ramping needs, or about 109 percent of the 1:2 year peak load forecast. However, CAISO does not have perfect foresight. Therefore, CAISO is considering an additional factor for observed year-ahead forecast error (*i.e.*, if the 1:2 year peak load forecast was 40,000 MW, but observed was 42,000).

CAISO believes this bottom-up approach to establish a minimum system RA UCAP requirement is appropriate and helps ensure minimum resource adequacy requirements are achieved, given the number of LRAs and potential variance in the LRAs' PRM targets. A system UCAP

[3] Resources without an NQC are not eligible to provide system or local RA capacity.

requirement should also help mitigate the potential for capacity leaning by LRAs and their respective LSEs.

CAISO also notes that it has received stakeholder feedback indicating a need for CAISO to consider how to coordinate these important system RA modifications with the CPUC's RA program. CAISO agrees this is an important consideration. For a detailed discussion on matters related to coordination of the proposed UCAP concepts with the CPUC's programs, please see section 5.1.2 below.

5.1.2. Forced Outage Rates and RA Capacity Counting

CAISO is proposing new RA counting rules that account for the probability of forced outages, eliminating the need for complicated replacement capacity rules. Many of the U.S. Independent System Operators (ISOs) and Regional Transmission Operators (RTOs) with Centralized Capacity Markets operate using an Installed Capacity (ICAP) or Unforced Capacity (UCAP) market. ICAP values generally account for impacts to resources caused by ambient weather conditions and represents physical generating capacity. UCAP is a percent of the ICAP available once outages are taken into consideration. NYISO, PJM, and MISO incorporate forced outages when calculating each resource's qualifying capacity and measure capacity using UCAP in their respective markets. In contrast, ISO-NE relies on an ICAP value that incorporates historical forced outage data when establishing its Installed Capacity Requirement.

The methodological assumptions for calculating UCAP values vary somewhat among system operators and the criteria inputs are unique for each resource type. Generally, UCAP incorporates the availability of a resource using a derating factor referred to as Equivalent Forced Outage Rate on demand (EFORd), also referred to as unit's Effective Forced Outage Rate in some regions. The EFORd factor is a performance measurement that adjusts a resource's potential RA capacity value accounting for the portion of time a unit is needed but unavailable to deliver due to forced outages. XEFORd is a similar probability measurement but adjusted to exclude Outside Management Control (OMC) events.

There are several key advantages for integrating forced outages into a generator's calculated RA qualifying capacity value. Recognizing a unit's contribution to reliability enables a resource to be compared and contrasted to the reliability of other resources. Greater resource accountability should produce market signals that promote procurement of better performing resources with improved operational reliability and availability. The inclusion and accessibility of information on the forced outage rates of resources can help buyers avoid risks and make better informed decisions when making bilateral trades or when procuring replacement RA capacity.

To date, neither the CAISO nor the CPUC account for system-wide resources on forced outage beyond the margins included in the established planning reserve margin requirement. Instead, CAISO relies on substitution rules and the Resource Adequacy Availability Incentive Mechanism (RAAIM). RAAIM calculates incentive payments and resource non-availability charges based on a resource's bidding behavior. It is intended to incentivize compliance with bidding and must-offer obligations and ensure adequate availability of RA resources.

Calculating NQC, UCAP, and EFC values

CAISO proposes to calculate and publish monthly NQC and UCAP values for all resources each year. This calculation will limit UCAP at the resource's NQC value and will only consider forced outages in determining a resources UCAP value. The UCAP value will not be impacted by CAISO approved planned outages.

CAISO will calculate UCAP values for all resource types that do not rely on the CPUC's Effective Load Carrying Capability (ELCC) methodology for determining QC values. For resource's with ELCC values calculated using the CPUC's ELCC methodology, CAISO will use the ELCC value as the UCAP value. Additional discussion regarding the basis for this proposal is provided below.

As a starting point, CAISO proposes to adopt the standard UCAP calculation similar to the approach applied by PJM. Specifically, CAISO proposes to calculate UCAP as:

UCAP = (NQC) * (1 - EFOR)

Although CAISO is proposing the above UCAP calculation, it also notes that it is doing so as an initial concept simply because it is a generally accepted methodology. CAISO is still examining alternative variations of this calculation, such as the approaches used by MISO and NYISO.

CAISO is also assessing the benefits of calculating unit's forced outage rate seasonally as is done in NYISO and MISO. The forced outage rate could, for example, measure January through April and October through December as one season (winter or off-peak), and May through September as another season (summer or on-peak). Once calculated, the forced outage rate would be set for each season for the upcoming RA year. Although seasonal calculations may add some complexity, they likely better reflect resources' availability during peak and off-peak seasons. CAISO proposes to utilize three years of historic data to determine these calculations for unit forced outage rates. In other words, each forced outage will impact a resource's seasonal forced outage rate and its UCAP value for the next three years.

CAISO is considering incorporating a weighting method that places more weight on the most recent years that more historic periods would have less of an impact on resulting average forced outage rates that would be utilized in determining resource's UCAP values. An initial proposal for stakeholder consideration on this issue is to place the following weights on the proposed calculation; 50% weight for the most recent annual forced outage rate, 30% weight on the second annual forced outage rate period, and 20% weight on the third annual forced outage rate period (most historical observation included in the proposed three year calculation). CAISO also seeks stakeholder input as to whether each year should be weighted equally or if greater weigh should be applied to more recent years.

ELCC will establish UCAP values for wind and solar resources

CAISO will rely on the CPUC's ELCC methodology when applicable. Currently, the CPUC only applies this methodology to wind and solar resources, but could expand that to cover weather sensitive or variable output DR and storage technologies. The reason for the CAISO's reliance on the ELCC calculation is two-fold. First, as noted in Table 10 in the Appendix, other ISOs

equate wind and solar UCAP values with a statistical assessment of resources' output. Second, the ELCC already takes into account the probability of forced outages for wind and solar resources.[4] Therefore, these technologies already have their QCs derated for expected forced outages.

The CPUC's ELCC calculation has two challenges as applied for this purpose. First, the CPUC calculates the average ELCC for the wind and solar fleet. This means that some resources will perform better than average, while others will perform worse. If all wind and solar resources are shown for RA, then there is no problem. However, if only a subset of solar and/or wind resources are shown as RA, then the average ELCC value of the RA wind and solar fleet may differ from the average ELCC value of the entire fleet.

A second, but related issue, is the CPUC calculates a diversity benefit that relies on the portfolios of wind and solar resources. If the showings have a different ratio of wind and solar resources, then the diversity benefit may not be reflected in the RA fleet. Either of these issues can result in over or under-procurement depending on what resources are shown. However, CAISO is looking to remove disincentives for LSEs to show all procured RA capacity. If CAISO is successful in this effort, then all procured wind and solar will be shown and this issue can be eliminated. If there are still incentives to not show all procured RA then additional work may be needed.

CAISO notes that there are additional resource types for which CAISO is still assessing the applicability of the above proposed forced outage accounting or what other methods may need to be applied to develop UCAP values. CAISO continues to explore options for DR, hydro, QFs, and new resources and seeks additional stakeholder feedback on how to address development of UCAP methodologies for these resource types.

Removing Forced Outage Replacement and RAAIM application to forced outage periods

As stated above, a fundamental component of the CAISO's proposal is to account for forced outages in upfront capacity valuation and assessments. CAISO proposes to assess forced outages against resources' UCAP values and will no longer include forced outage replacement as an option for addressing forced outages. This change is intended to align the process with the new proposed paradigm of assessing resources' forced outage rates to provide transparency into the reliability and dependability of individual resources.

This removal of the option to provide replacement capacity is also interrelated to the CAISO's RAAIM provisions. CAISO will no longer have to assess resources for RAAIM during periods they have submitted a forced outage.

Forced Outage Rate Data

The first and primary input needed to calculate a resource's UCAP value is an accurate and appropriate forced outage rate. The specific forced outage rate for a resource is the key information necessary to calculate the expected value (in terms of MWs) of a capacity resources

[4] Forced outages are accounted for by using actual production data to inform the wind and solar production profiles in the ELCC modeling.

unforced capacity. To determine these forced outage rates, CAISO considered two potential data sources, CAISO's Outage Management System, and the NERC Generation Availability Data System (GADS).[5]

NERC's GADS compiles resource outage data for resources across the country. While fleet wide averages across NERC regions are readily and publically available, resource specific information is more difficult to access and compile. Additionally, GADS reporting is mandatory only for resources 20 MW and above. As small distributed resource penetration increases over time, GADS may miss a large number of resources and/or resource types. CAISO could propose to establish tariff requirements for the reporting of NERC GADS data for the purposes of data development for the CAISO's proposed UCAP concept. CAISO believes this could be problematic due to the limitations on size and resource types requiring potential exclusions or caveats. Furthermore, CAISO is concerned that the more universal outage reporting for GADS purposes may not always align with all of the potential CAISO forced outage nature of work cards that CAISO believes is a good area to focus on for defining the type/nature of outages that will be assessed against resource's forced outage rates – which is a vital issue to establish an accurate and fair forced outage rate definition. CAISO believes that the nature of work cards utilized currently provide a good basis for development of resource specific forced outage data.

Currently, CAISO has established numerous outage cards in the CAISO Outage Management System (OMS) designed to describe the nature of work for resource outages. These outage cards are also used to describe whether a resource is required to provide substitute capacity to avoid RAAIM charges, or if the outage is beyond the resource's control and therefore RAAIM exempt. A list of the current forced outage nature of work cards available in OMS is provided later in this section.

Given the challenges of establishing forced outage rates for individual resources and the growing number of distributed resources that would not be subject to the GADS reporting requirements, CAISO proposes to rely on the information reported in OMS to calculate resource specific forced outage rates. Although the data is reported at the resource level in OMS, CAISO has reviewed the current OMS outage cards and determined that they may not adequately cover the different types of forced outages or reflect the types of forced outages that would be exempt from forced outage calculations. This proposal requires that CAISO determine if there are any necessary modifications to the forced outage cards nature of work definitions. CAISO also needs to modify the requirements for what information is provided through CAISO OMS to provide the correct information to make accurate assessments of resource specific forced outage rates. Additionally, OMS will likely require some level of system modifications to accurately and automatically track resource outage data on a comparable basis.

Proposed Forced Outage Rate Assessment Interval

CAISO proposes to apply a 16-hour window between 5:00 AM and 9:00 PM as the assessment window for assessing resource specific forced outage rates. This interval is intended to cover

[5] https://www.nerc.com/pa/RAPA/gads/Pages/GeneratingAvailabilityDataSystem-(GADS).aspx

the periods when resources are most highly in demand to meet CAISO needs and will also simplify existing Availability Assessment Hours currently in use.

CAISO also considered a 24-hour assessment interval. However, using all hours reduces the impact of forced outages during peak needs by increasing the denominator in the forced outage calculation. The CAISO's proposed 16-hour assessment interval focuses on the hours of greatest need and, as discussed below, mirrors the convergence between the hours of system, local, and flexible capacity needs. Further, as noted below, using the same assessment intervals allows CAISO to calculate and utilize the same forced outage rate for both generic and flexible capacity.

Calculating Unit Forced Outage Rates

Forced Outage Rate Background

Conceptually, a forced outage rate performance index evaluates the total hours of full and partial forced outages for the purpose of estimating a unit's availability frequency. IEEE has established a standard methodology to calculate the generating unit's availability using GADS historical event and performance data (see standard equation below).[6]

The defined methods are commonly adjusted by system operators to accommodate for unique reliability needs, but generally the metric accounts for those hours and months of greatest demand and excludes planned or maintenance outages. Similarly, some RTOs and ISOs use the standard EFORd metric, but others such as MISO, use an adjusted calculation (referred to as XEFORd) which adjusts the EFORd metric to remove outages outside of management control. NYISO, PJM, and ISO-NE all use the net dependable capacity in lieu of the net maximum capacity. The standard EFORd availability metric formula is:

$$EFORd = \frac{FOHd + EFDGd}{FOHd + SH} \times 100\%$$

- EFORd = Equivalent demand forced outage rate: A measure of the probability that a generating unit will not be available due to forced outages or forced deratings when there is demand on the unit to generate.
- FOH = Forced outage hours: The phrase forced outage hours represents the number of hours a unit was in an unplanned outage state.
- EFDH = Equivalent forced derated hours: EFDH is the forced derated hours converted to equivalent hours. [7]
- SH = Service hours: The phrase service hours represents the number of hours a unit was in the in-service state.

[6] IEEE Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity, available at: https://www.nerc.com/docs/pc/gadstf/ieee762tf/762-2006.pdf

[7] The phrase equivalent hours represents the number of hours a unit was in a time category involving unit derating, expressed as equivalent hours of full outage at maximum capacity. Both unit derating and maximum capacity shall be expressed on a consistent basis, gross or net.

Initial proposal for CAISO Forced Outage Rate formulation

CAISO proposes using the standard IEEE formula as a basis for its proposed forced outage rate calculation. As noted above, the standard methodology to calculate the generating unit's availability using GADS historical event and performance data to determine unit specific equivalent demand forced outage rates. Because CAISO is proposing to asses forced outage rates during a 16 hour assessment window, the proposed approach CAISO is exploring is based upon a simplified Effective Forced Outage Rate or (EFOR). The formula proposed is a starting point to develop an EFOR determination for each unit with a NQC, which is as follows:

$$EFOR = \frac{FOH + EFDG}{FOH + SH} \times 100\%$$

CAISO proposes to apply this standard formulation to determine unit level EFOR rates as a starting point for the proposed inclusion of forced outages in RA capacity valuation and assessments. As noted above, the various other RTO/ISO regions that have incorporated these unit availability measures into their RA processes have all made various adjustments and necessary accommodations to apply this general formula to their particular market and region's needs and differences. Similarly, CAISO proposes to further develop this more general measure of forced outage rates into a CAISO specific approach.

One of the major concepts in other regions is the exclusion of outages considered "outside of management control", or OMC, from resources forced outage rates. OMC outage periods are commonly excluded in these regions and cover outage periods that are outside of a resource owner's direct control. For example, a transmission induced outage or a force majeure event such as a wildfire or flooding event that forces a unit outage should be considered outside of management control. CAISO proposes to incorporate a similar concept in the final EFOR formulation under this proposal. CAISO seeks stakeholder feedback on this concept and any input on the various types of modification or enhancements that should be considered for application to the initial IEEE standard availability metric calculation included in this proposal.

Outage Cards – Nature of Work classifications and categorization for forced outage rates

CAISO must calculate each unit's forced outage rate using clear, well defined outage definitions to establish their UCAP values. CAISO will clarify how each outage type and nature of work card will be assessed against a resource specific forced outage rate.

CAISO has also provided the following table of outage nature of work cards to develop the appropriate classification for each outage nature of work card and how it will be used in calculating resources' forced outage rates. CAISO proposes to assess outages against resource's forced outage rates for the nature of work outage cards as described in Table 2 below.

Table 2: Forced Outage Cards – Nature of Work

Outage Type	Nature of Work/Opportunity Status	Lowers resource's available UCAP?
Forced	Ambient Due to Temperature	Yes
Forced	Ambient Not Due to Temperature	No
Forced	Ambient due to Fuel insufficiency	Yes
Forced	AVR/Exciter	Yes
Forced	Environmental Restrictions	Yes
Forced	Short term use limit reached	No
Forced	Annual use limit reached	No
Forced	Monthly use limit reached	No
Forced	Other use limit reached	No
Forced	ICCP	Yes
Forced	Metering/Telemetry	Yes
Forced	New Generator Test Energy	No
Forced	Plant Maintenance	Yes
Forced	Plant Trouble	Yes
Forced	Power System Stabilizer (PSS)	Yes
Forced	Ramp Rate	Yes
Forced	RTU/RIG	Yes
Forced	Transitional Limitation	Yes
Forced	Transmission Induced	No
Forced	Technical Limitations not in Market Model	No
Forced	Unit Supporting Startup	Yes
Forced	Unit Testing	No
Forced	Off Peak Opportunity	No

Outage Type	Nature of Work/Opportunity Status	Lowers resource's available UCAP?
Forced	Short Notice Opportunity	No
Forced	RIMS testing	Yes
Forced	RIMS Outage	Yes

CAISO seeks stakeholder feedback on this initial classification of outage nature of work cards to define the outages that will included in calculating resource specific forced outage rates.

Unit Outage Rate Analysis Examples

CAISO has received feedback requesting analysis supporting the proposed inclusion of unit's forced outage rates for capacity valuation. CAISO has conducted some preliminary analysis to assess the proposal's potential impacts. However, at this time, CAISO has not identified a generally applicable method for converting OMS data into forced outage rates. As a result, CAISO has not conducted a fleet-wide forced outage analysis for the purposes of this proposal. However, based in CAISO's review of NERC GADS data for WECC provides a WECC-wide average approximately 8% forced outage rate for all resource types providing outage data. As an alternative, CAISO has analyzed a subset of unit outage data and provides some examples of the resulting analysis in the following figures.

CAISO made the assumptions and utilized the formulas below for determining the following example outage analyses.

Assumptions:

- For any Forced Outages lasting over 7 days, change to planned outage
- For overlapping forced outages, sum of all outages are accounted for in calculations

Calculation formulas:

$$Forced\ Outage\ Rate = \frac{\sum_{area} Pmax\ - \sum_{area} Forced\ Avail\ MW}{\sum_{area} Pmax}$$

$$Planned\ Outage\ Rate = \frac{\sum_{area} Pmax\ - \sum_{area} Planned\ Avail\ MW}{\sum_{area} Pmax}$$

$$Total\ Outage\ Rate = \frac{\sum_{area} Pmax\ - \sum_{area} Total\ Avail\ MW}{\sum_{area} Pmax}$$

Example Outage Analysis Results

The following figures provide the results of CAISO's outage analysis for two example resources to illustrate the magnitude of outages for these example resources over 2018 annual and

summer periods. The two example resources were selected in order to provide a viable illustrative example for discussion purposes. CAISO's analysis shows that resource availability related to forced outages varies over seasons and between resources. Significant variance among forced outage rates of resources is precisely the issue that CAISO's proposed UCAP modifications are intended to capture.

Figure 1: Example Unit #1 – Seasonal outage rate analysis: summer 2018

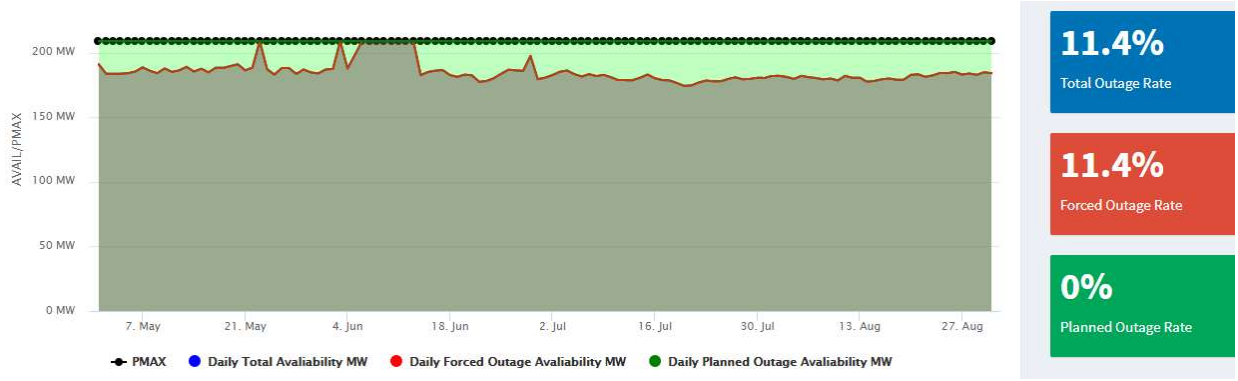


Figure 2: Example Unit #1 – Annual outage rate analysis: 2018

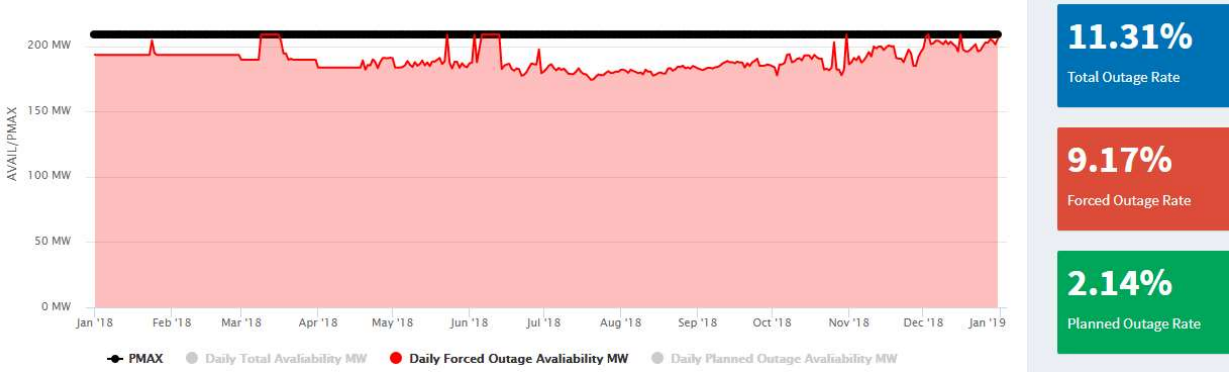


Figure 3: Example Unit #2 – Seasonal outage rate analysis: summer 2018

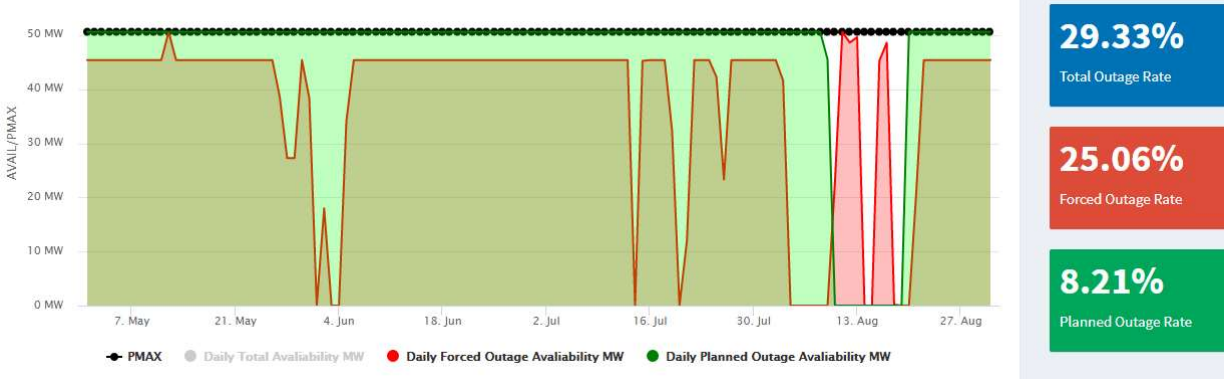
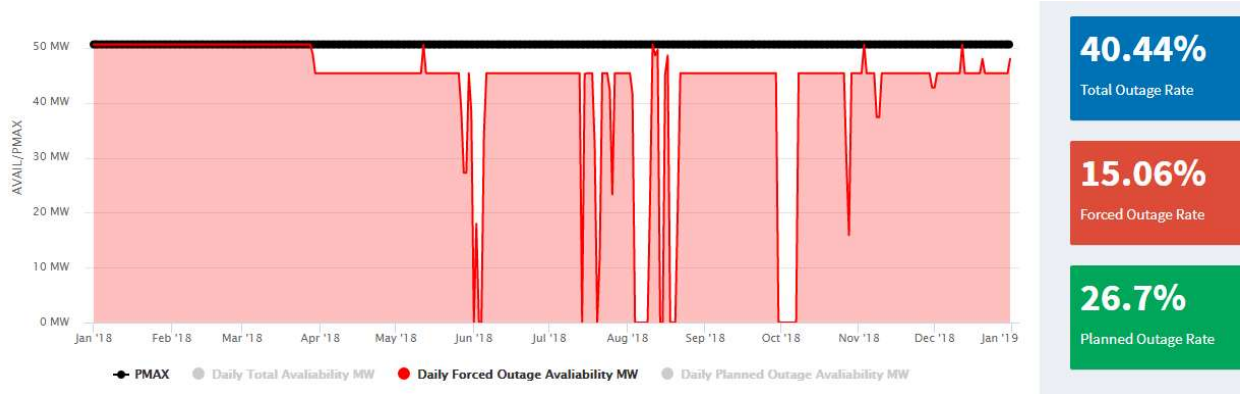


Figure 4: Example Unit #2 – Annual outage rate analysis: 2018



The example resource forced outage analysis included in the proposal is for illustrative purposes only and any final proposal will provide detailed calculation parameters and inputs. CAISO intends to further develop these aspects of the proposed forced outage rate calculations with stakeholder input.

Coordination of Proposed UCAP Concept with CPUC RA Program

CAISO has received stakeholder feedback that it must closely consider how its proposed UCAP concept will be coordinated with the current CPUC RA program. Some of the feedback received expressed concern that the CAISO proposal could create conflicting RA requirements, or otherwise undermine the System RA Planning Reserve Margin (PRM) established by LRAs. CAISO understands these valid concerns and commits to providing the coordination necessary to align with LRAs' RA programs. Ideally, LRAs would adopt similar counting rules and requirements to minimize administrative complexity. However, system RA requirements and PRMs based on installed capacity are not necessarily inconsistent with CAISO's proposal. Regardless, CAISO will work with LRAs to align RA programs with the current proposal. This collaborative effort includes proposing similar counting rules in the upcoming CPUC RA proceeding.

Some stakeholders expressed concerns that CAISO's proposal can result in over-procurement. CAISO's proposal for UCAP requirements recognizes that forced outages are accounted for in the counting methodology, therefore, a margin for forced outages is not included in the proposed system UCAP requirement. In other words, CAISO's proposed UCAP PRM would be lower than an installed-capacity-based PRM to avoid double counting of forced outages. CAISO believes that LRAs could maintain an installed capacity PRM. In fact, the CAISO will continue to post resource NQC values as it does today.

CAISO believes the proposal offers improved transparency with respect to the forced outage rates that could improve procurement and retirement decisions. Existing installed capacity measures reflect an expected fleet average outage rate. This can result in efficient procurement of resources on the low end of the forced outage distribution and more overall procurement than might be seen using UCAP values. CAISO believes that the UCAP requirement basis will

provide an appropriate target to guide forward procurement of resources with better forced outage rates and better reliability, compared to other resources of lower reliability quality.

As noted above, some stakeholders expressed concern that the CAISO's proposed UCAP concept could create two different system RA procurement targets. CAISO does not believe that the proposed UCAP requirement and UCAP counting rule concepts will create incompatible procurement targets for system RA. Rather, CAISO views the two concepts as interrelated, not problematic or incompatible. The proposed CAISO UCAP requirement will simply be a subset (or lower bound) of the LRA's established system RA PRM target. In other regions utilizing UCAP and PRM concepts, there are two established targets; one system PRM target, and one UCAP requirement that is also a subset of the system PRM target that simply removes the additional margin established to cover the forced outage component of the system PRM target.

CAISO seeks stakeholder input to identify any additional CPUC/LRA RA program issues or UCAP related concepts that should be included for consideration and coordination.

Availability Assessment Hours and RAAIM background

The current CAISO Resource Adequacy Availability Incentive Mechanism (RAAIM) provisions rely on different Availability Assessment Hours (AAHs) for determining the hours of greatest need for each capacity product, which adds significant complexity. The AAH for generic capacity is for the five peak load hours on non-holiday weekdays. The AAHs for flexible capacity differ in both hours and duration. Category 1 flexible capacity has a 17 hour assessment interval for all days designed to cover both the morning and evening ramps. Flexible capacity categories 2 and 3 have 5 hour assessment windows designed to cover the maximum net load ramp. Flexible capacity category 2 assessment hours covers all days and category 3 covers only non-holiday weekdays. The AAHs can change annually for both generic and flexible capacity.

The difference between the AAHs across generic and flexible capacity constructs has created confusion for market participants. Additionally, it complicates availability calculations since generic and flexible capacity products have different offer obligations. Finally, having different AAHs implies that flexible capacity and generic capacity needs differ significantly by day of the week or hours of the day. Although the needs differed at the onset of the flexible capacity program, this is simply not the case anymore. The peak load and the largest net load ramps are now occurring during the same hours. Additionally, the amount of uncertainty CAISO must address between day-ahead and real-time markets with flexible capacity does not appear to differ dramatically across day-light hours.[8]

The RA program is designed to ensure CAISO has sufficient capacity available to serve load reliably. Any resource providing RA capacity to CAISO has an obligation to offer that capacity into CAISO's markets. The Must Offer Obligations (MOO) for various RA and technology types are listed in the CAISO's Reliability Requirements BPM.[9] CAISO also relies on outage reporting

[8] See http://www.caiso.com/Documents/RevisedStrawProposal-DayAheadMarketEnhancments.pdf at p.37-38.
[9] See the Reliability Requirements BPM, pp. 77-82 for System and Local RA obligations and pp. 93-96 for flexible RA obligations.

to track whether or not resources are available at any given time. If there is sufficient notice given and capacity available, CAISO can grant outages without requiring replacement capacity. However, not all outages occur under those conditions, and CAISO developed RAAIM to address these instances in particular.

RAAIM is designed to provide an incentive for resources on outage to minimize the duration of the outage or to provide substitute capacity. Additionally, RAAIM provides an additional incentive payment to generation that is available over a predetermined measurement. RAAIM does not apply to all hours; it only applies during the Availability Assessment Hours. These hours and days differ depending on the RA product the resource is providing to CAISO. While RAAIM provides an incentive to provide substitute capacity, it also provides an incentive to only show the bare minimum RA capacity needed for each capacity type, because showing additional capacity exposes that capacity to RAAIM non-availability charges without providing any corresponding benefit to the LSE to which that resource is contracted.

The discussion above is a brief summary of the relationship between MOOs, RA substitution rules, and RAAIM. The reality of these relationships is that they combine to create a complex system of processes that differ vastly from other ISOs/RTOs. However, in light of CAISO's UCAP proposal, it is possible to eliminate these complex relationships in favor of a process that simply relies on upfront accounting for forced outages. Therefore, CAISO continues to explore modifications to remove or limit the application of RAAIM. CAISO also proposes to remove the current allowance for forced outage replacement, and instead will rely on the UCAP and EFOR concepts to the extent possible.

CAISO seeks stakeholder feedback on the need for any continued utilization of RAAIM beyond limited applications, and feedback on the proposed removal of allowance for forced outage replacement.

5.1.3. System RA Showings and Sufficiency Testing

CAISO will conduct two sufficiency tests for system capacity: An individual deficiency test and a portfolio deficiency test. These tests are designed to ensure there is both adequate UCAP to maintain reliability for peak load and that the portfolio of resources, when combined, work together to provide reliable operations during all hours. CAISO will also conduct tests for flexible and local capacity needs; those assessments are discussed in Sections 5.2**Error! Reference source not found.** and 5.3, respectively.

Individual Deficiency Assessments

CAISO will conduct an assessment of LSE RA showings and resource supply plans to ensure there is sufficient UCAP shown to meet the identified reliability need described above. Although CAISO will be assessing system capacity showings based on UCAP values, CAISO proposes that, as done today, LSEs and resource SCs need only submit and show resources' NQC. Once shown, CAISO will consider each resource's UCAP value to conduct its UCAP assessment.

Additionally, LSEs may not procure the "good part" of a resource (*i.e.*, LSEs cannot simply procure only the unforced capacity part of a resource and any amount shown for RA will be assessed considering the resource's forced outage rate). For example, an LSE could not claim to buy 90 MW of both NQC and UCAP from a 100 MW resource with a 10 percent forced outage rate. In comments to the straw proposal – part 2, several parties requested CAISO allow resources to sell and show only the UCAP value of the resource. There are two reasons CAISO cannot allow this. First, the UCAP accounting method relies on the probability that some resources will be out at various times. Allowing some resources to do so would likely require CAISO to maintain the same complicated substitution rules it is seeking to eliminate to maintain the desired level of reliability. Second, in CAISO's review of best practices in other ISO's such practices are not permitted.

Partial RA resources (shown for RA for only a portion of its capacity) will receive a proportional UCAP value reflecting the proportion shown for RA purposes (*i.e.*, A 100 MW resource with a 10 percent forced outage rate shown for 50 MW of NQC will be assessed as being shown for 45 MW of UCAP RA).

LSEs that fail to meet the UCAP requirement will be notified of the deficiency and provided an opportunity to cure. LSEs that fail to cure may be subject to backstop procurement cost allocation. Specific backstop procurement authority for this deficiency and cost allocation are discussed in greater detail in Section 5.4.

Individual RA Showing Incentive

CAISO also proposes to develop an individual LSE RA showing incentive. CAISO proposes to develop a new tool called the UCAP deficiency tool, which is intended to provide an incentive for LSEs to show above their UCAP obligations and to also prevent or discourage LSEs from failing to show RA at least equal to their UCAP requirement. The concept of the UCAP deficiency tool is to apply a penalty to LSEs that show less than (below) their UCAP requirement, and distribute those collected penalties to LSEs showing over (above) their UCAP requirements. This proposed tool and incentive is included in detail in Section 5.4, below. Examples and further discussion of this proposed concept are also provided in Section 5.4.3.

Portfolio Assessment

CAISO will also conduct a portfolio deficiency test of only the resources shown for RA to determine if the portfolio is adequate to serve load under various load and net load conditions during all hours of the day. The portfolio deficiency test will use only the shown RA fleet in a production simulation to determine if CAISO is likely to serve forecasted gross and net-load peaks, and maintain adequate reserves and load following. The need for this assessment is similar in concept to the collective deficiency test CAISO conducts for local RA. However, CAISO will only conduct this assessments on monthly RA showings because they are the only showing that provides 100 percent of the system, local, and flexible RA capacity requirements. The increased penetration of energy and availability-limited resources and the reliance on these resources to meet RA needs means that some resource mixes provided to meet RA requirements may not be able to ensure the reliable operation of the grid during all hours of the day across the entire month. Similar to the local assessments, CAISO is looking to maintain a

consistent definition for capacity to facilitate transacting a homogeneous product. However, CAISO must assess how the shown RA fleet works collectively to meet system needs.

The objective of a portfolio analysis is to assess if CAISO can serve load with the shown RA fleet. Because year ahead system RA showing requirements are currently only 90 percent for the five summer months for CPUC jurisdictional entities, CAISO will only conduct this assessment for monthly RA showings.

CAISO has considered three general approaches to conducting this model. These options are included in the following table.

Table 3: Portfolio Assessment Modeling Options

Modeling Approach Option	Iteration[10]	Load	Wind/solar	Other Generators
Net Load Deterministic	One	Known	Known	a) A generator forced outage schedule determined randomly prior to the assessment, or b) Model all resources at UCAP value
Generator Stochastic	One or several	Known	Randomly determined for each iteration with fixed installed capacity	A generator forced outage schedule determined randomly prior to each iteration
Full stochastic	Several	Random draws	Randomly determined for each iteration with fixed installed capacity	A generator forced outage schedule determined randomly prior to each iteration

There are relative pros and cons with respect to each of the above testing options. For example, the net load deterministic model can run relatively quickly when compared with the other options. However, this speed comes at the expense of performing numerous draws and the robust statistical results that can be derived from a full stochastic production simulation. The net load deterministic and the full stochastic models basically have inverse pros and cons (*i.e.*, one runs fast but does not provide the same volume of information, the other takes longer but produces more information), while the generator stochastic model falls somewhere in between.

[10] One iteration is defined a predetermined interval. This is interval can be a single day, a week, or a full month.

Additionally, CAISO must determine the best platform for conducting this test. CAISO believes that any platform used to conduct this assessment should reasonably reflect that actual CAISO system. Therefore, CAISO explored three primary platforms:

- Market Optimization based model – An offline version of CAISO market optimization software
- Integrated Optimal Outage Coordination (IOOC) tool – A tool used by CAISO's Operations Engineering group to test planned transmission and generation outages, similar to the market optimization tool in terms of resource commitment and optimization
- Summer Assessment Plexos model – A Plexos model used to conduct CAISO summer assessment. Models many constraints, but not all.

All of the above options are complex, time-consuming simulations. The Summer Assessment model is capable of running more quickly than the other two, but lacks the detail offered by the other two.

In balance, having assessed the time constraints, complexity, and data output, CAISO favors the net load deterministic model using the IOOC at this time. CAISO will be required to conduct this assessment and provide feedback to market participants within 10 days of receiving RA showings; therefore, processing time is critical. CAISO will be the first ISO or RTO to conduct such an assessment, regardless of turnaround time, making it reasonable to start with the less complicated option and learn to walk before we run. Additionally, although the Summer Assessment Plexos model runs faster, it does not model all CAISO constraints and warrants relying on one of the other two models. Given the IOOC offers the ability to include planned outages, CAISO believes it will yield the most reliable results.

Finally, CAISO must establish the proper metric to determine the adequacy of the portfolio. Each of the above approaches may provide different metrics. These different metrics can be interpreted differently in evaluating whether the RA portfolio meets CAISO's operational needs. CAISO has explored two primary metrics for the portfolio deficiency test: Serving load and loss-of-load expectation. Given that CAISO will initially conduct a production simulation that is largely deterministic, there is insufficient information to generate a meaningful LOLE. Therefore, CAISO proposes to use the portfolio's ability to serve forecasted load for the upcoming month. The portfolio must ensure CAISO can maintain load, Ancillary Services, and load following [11] requirements for all days and all hours in the portfolio deficiency test. If any of these requirements is not met, CAISO will identify a portfolio deficiency.

CAISO will model only RA resources in this portfolio analysis. Any additional energy provided in CAISO's day-ahead or real-time markets represent energy substitutes in those markets, but are not needed in the portfolio assessment to determine if the RA fleet is adequate. Additionally, CAISO must establish baseline inputs into the portfolio assessment. CAISO will rely on CEC 1-in-2 hourly load forecast. Because the analysis is run on hourly blocks, CAISO will also include load following requirements. The wind and solar production profiles will be generated prior to

[11] Load following is needed because the production simulation is run at an hourly granularity and does not fully capture intra-hour ramping needs.

running the production simulation. These profiles represent maximum potential output from these resources. These profiles will not be considered must take capacity and actual use of wind and solar resources in the production simulation may be lower than the profile. Generator availability will be determined through Monte Carlo draw using resource forced outage rates.

If the portfolio is adequate then no additional actions will be taken. If the portfolio is unable to serve load under given load or net load conditions, then CAISO will declare a collective deficiency, provide a cure period, and will conduct backstop procurement using the CPM competitive solicitation process to find the least cost solutions to resolve the deficiency if left uncured. The specific details regarding CPM designations and cost allocation is provided in Section 5.4.1.

CAISO considered additional assessments of individual RA showings, however, CAISO believes it is not feasible to adequately develop individual LSE load profiles and determine that a specific LSE's RA portfolio contributed to the collective deficiency and, therefore, subject to LSE specific cost allocation.

5.1.4. Must Offer Obligation and Bid Insertion Modifications

Must Offer Obligations

The RA program is designed to ensure CAISO has sufficient capacity available to serve load reliably all hours of the year. Any resource providing RA capacity to the CAISO has an obligation to offer that capacity into the CAISO market. Currently, CAISO tariff contains provisions regarding must offer obligations, bidding, and bid insertion rules. Resources providing RA capacity will continue to have a must offer obligation for that capacity under RA Enhancements. Additionally, at this time, CAISO is developing the imbalance reserve product in the Day-Ahead Market Enhancements initiative. As these two stakeholder processes evolve, the CAISO continues to assess the need for a real-time RA must offer obligation or if there is sufficient commitments and capacity reservations made in the day-ahead markets. At this time, the specific details of the imbalance reserves are not sufficiently developed to make a determination on these issues at this time. At this juncture, CAISO is preserving the real-time RA must offer obligation, until and if a change is warranted. Regardless, CAISO will align any RA must-offer obligations with the policies and needs identified in the Day-Ahead Market Enhancements.

CAISO proposes, consistent with the practice in certain other ISOs, that a resource's must offer obligation must be consistent with the resource's NQC value.[12] More specifically, if a resource is shown for 100 MW of NQC, it must bid 100 MW of capacity into CAISO's markets. This bidding rule is required to ensure the underlying UCAP availability is met. As an example, the UCAP requirement is set with the expectation that some portion of the RA fleet is on forced

[12] See https://www.aeso.ca/assets/Uploads/CRA-AESO-Capacity-Market-Design-Report-03302017-P1.pdf at p. 22. "In all the reviewed markets except California and ISO-NE, the capacity of these facilities is procured and settled as UCAP. In California and ISO-NE, the capacity obligation is denominated as installed capacity (ICAP). Notwithstanding that, in most markets, capacity is procured and settled as UCAP, the resulting performance obligation on conventional controllable generation is to offer all of the ICAP except on recognized outages."

outage. Assume that unit with 100 MW of NQC had a UCAP value of 80 MW, reflecting that it is available 80% of the time. If that unit were only required to bid its UCAP value of 80 MW, then during the showing period, on average, CAISO would only receive 64 MWs of dependable capacity from that unit.

Setting must offer obligations at the UCAP means that all forced outages would require substitute capacity to ensure reliability. Alternatively, and as proposed here, setting the must offer obligation at the shown NQC value allows CAISO to dramatically simplify forced outage substitution. By establishing a UCAP-based RA construct with an associated must offer obligation at the NQC value, the RA fleet effectively provides its substitute capacity upfront, eliminating the need for complex resource substitution rules. For this reason, CAISO is exploring eliminating the existing RA forced outage substitution rules in favor of UCAP-based resource RA counting and NQC-based resource bidding. This concept is addressed in greater detail below.

CAISO has performed a comprehensive review of must offer obligations for all resource types in the tariff and Reliability Requirements BPM and believes the current must offer obligations can be simplified to provide market participants more clarity when determining the must offer obligations for different resources. As a way to simplify the must offer obligations, CAISO proposes a standard must offer obligation that would apply to all resources unless specified by CAISO under an exemption by resource type.

As outlined in Table 4, the standard must offer obligation would require 24 by 7 bidding into the day-ahead market for all resources and 24 by 7 bidding into the real-time market for all resources committed in the day-ahead or that can be committed in the Short-Term Unit Commitment (STUC) horizon.[13] STUC is the most forward looking real-time market process and can commit resources available to CAISO in real-time. Any unit with a startup time greater than the STUC horizon is unable to be committed in the real-time market; therefore, it would not be required to bid into the real-time market if they have not already been committed in the day-ahead market.

[13] Tariff Definition of STUC, p. 175: http://www.caiso.com/Documents/AppendixA-MasterDefinitionSupplement-asof-Apr1-2019.pdf

Table 4: Standard Must Offer Obligation for System and Local RA Capacity

DA MOO	RUC MOO[14]	RT MOO
Economic bids or self-schedules for all RA capacity for all hours of the month resource is not on outage	RUC availability bid for all RA capacity for all hours of the month the resource is not on outage	Economic bids or self-schedules for any remaining RA capacity from resources scheduled in IFM or RUC. Economic Bids or Self-Schedules for all RA capacity that can be committed within the STUC horizon

Bid Insertion

As part of this RA enhancements initiative, CAISO is proposing revisions to the bid insertion rules. Although CAISO currently requires RA resources to economically bid or self-schedule into the market, it also supplements those bidding obligations with bid insertion provisions for non-use limited resources. CAISO has considered two potential options for revising bid insertion rules:

1. Apply bid insertion to all non-use-limited resources and resources registered as use-limited under Commitment Cost Enhancements – Phase 3 (CCE3) policy, or;
2. No bid insertion for any resource but either apply RAAIM to RA resources or treat all intervals without bids as forced outages for the purposes of the UCAP calculation.

At this time, CAISO proposes to pursue adoption of option 1. CAISO has recently implemented the CCE3 policy that allows resources with certain use limitations to include approved opportunity costs in their market bids. The policy is designed to ensure the more effective and efficient use of resources in the market and to facilitate regular and consistent market participation from resources with certain use limitations.

Applying bid-insertion to non-use-limited resources and resources registered as use-limited under CCE3 policy would ensure that resources have bids in the market and would need to report outages to avoid the market dispatching the resource, enhancing the CAISO's ability to identify forced outages. Additionally, this option would not create a disincentive to show RA capacity, unlike option 2.

[14] CAISO currently requires a $0 RUC availability bid for all RA capacity. This policy is being changed as a part of the Extension of the Day-Ahead Market (EDAM) initiative. With the implementation of EDAM, all energy imbalance market (EIM) entities can voluntarily bid into the CAISO's day-ahead market. Under that paradigm, maintaining $0 RUC availability bids would result in the commitment of California RA resources to serve load outside of the California area. Considering this is not the purpose of the California resource adequacy program, CAISO is proposing to remove the $0 requirement for RUC availability bids in EDAM. The correlation between RA Enhancements, Day-Ahead Market Enhancements (DAME), and EDAM will be discussed in the CAISO's Day-Ahead Vision document, which will be published in the late summer of 2019.

CAISO is seeking stakeholder input regarding this proposed modification to bid insertion rules.

Exemptions to Standard Must Offer Obligation

CAISO recognizes that not all resource types are physically capable of adhering to the proposed standard must offer obligation, and therefore proposes a list of exemptions to the standard must offer obligation outlined in Table 5. Resource types that are defined by CAISO as having an exemption will still be subject to must offer obligations. These must offer obligations will be defined by CAISO based on the characteristics of the resource type.

CAISO also recognizes the need to define specifically the bid insertion rules for resources that fall outside the categories of non-use-limited or registered use-limited. For example, it may not be appropriate to apply bid insertion to resources with variable output or limitations that cannot be modeled through an opportunity cost. Therefore, CAISO also includes bid insertion exemptions listed in Table 5. If a resource is exempt from bid insertion, CAISO would not insert bids for these resources in the event that required amounts of RA capacity are not offered into the respective markets unless there is a RUC Availability Bid or RUC Schedule for a resource without a corresponding Economic Bid or Self-Schedule.

CAISO initially proposes to generally define the following exemptions based on resources type and seeks stakeholder feedback on this list, including modifications or additions.

Table 5: Exemptions to Standard Must Offer Obligation and Bid Insertion Proposal

Exemption Type	DA MOO	RUC MOO[15]	RT MOO	Bid Insertion
Eligible Intermittent Resource	May, but not required to, submit Bids in the Day-Ahead Market	No requirement to submit RUC Availability Bids	Must be available consistent with the resources forecast for RA Capacity	No
NGR (Non-REM)	Standard DA MOO plus MOO should reflect charge and discharge capabilities	RUC Availability Bids are to be submitted for all RA Capacity for all hours of the month the resource is not on outage. MOO should reflect charge and discharge capabilities	Standard RT MOO plus MOO should reflect charge and discharge capabilities	No

[15] *Id.*

NGR (REM)	Economic Bids or Self-Schedules are to be submitted for regulation for all hours of the month resource is not on outage. MOO should reflect charge and discharge capabilities	RUC Availability Bids are to be submitted for all RA Capacity for all hours of the month the resource is not on outage. MOO should reflect charge and discharge capabilities	Economic bids or self-schedules for any remaining RA capacity from resources scheduled in IFM or RUC. Economic Bids or Self-Schedules for all RA capacity that can be committed within the STUC horizon. MOO should reflect charge and discharge capabilities	No
Non-Dynamic Resource Specific Imports	Standard DA MOO	Standard RUC MOO	Economic Bids or Self-Schedules for any remaining RA Capacity from resources scheduled in IFM or RUC. No RTM Bids or Self-Schedules are required for resources not scheduled in IFM or RUC	DA-Yes RT- Yes, up to RA amount if any portion of the resources is scheduled in IFM or RUC
Non-Dynamic, Non-Resource Specific Imports	Economic Bids or Self-Schedules are to be submitted for all RA Capacity consistent with inter-temporal constraints such as multi-hour run blocks or contractual	Standard RUC MOO	Economic Bids or Self-Schedules for any remaining RA Capacity from resources scheduled in IFM or RUC. No RTM Bids or Self-Schedules are required for resources not	DA-Yes RT- Yes, up to RA amount if any portion of the resources is scheduled in IFM or RUC

	limitations (e.g. 6 X 16)		scheduled in IFM or RUC	
PDR[16]	Economic Bids are to be submitted for RA Capacity that the market participant expects to be available per supply plan[17]	Standard RUC MOO	Standard RT MOO	No
Pumping load	Economic Bids or Self-Schedules are to be submitted for all available energy up to RA Capacity quantity	No requirement to submit RUC Availability Bids	Economic Bids or Self-Schedules are to be submitted for all available energy up to remaining RA Capacity	No
RDRR	May, but not required to, submit Bids in the Day-Ahead Market	N/A	Bid 95 -100% of the bid cap in real-time for all available energy up to RA capacity quantity	Real-time only
Regulatory Must Take (RMT)	Must be available consistent with the resource's availability plan for all RA capacity up to the RMT amount, standard DA MOO for any RA capacity above the RMT amount	No requirement to submit RUC Availability Bids	Must be available consistent with the resource's availability plan for all RA capacity up to the RMT amount, standard RT MOO for any RA capacity above the RMT amount	No

[16] CAISO is considering potential modifications to must offer obligations for variable-output DR in the ESDER 4 stakeholder process. ESDER Stakeholder Initiative Webpage: http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_DistributedEnergyResources.aspx

[17] PDR bidding requirements are specified in CAISO tariff Section 30.6.1 – Bidding and Scheduling of PDRs

This proposal includes several modifications to the current must offer and bid insertion rules. Namely, CAISO proposes that for resources participating under the NGR, the must offer obligation should reflect both the charge and discharge capabilities of the resource such that CAISO can fully optimize the resource. To do so, the CASIO must have bids available for the unit's full capability. Bidding full charge and discharge capability would allow CAISO to ensure fuel sufficiency for the resource. At this time, the CASIO sees this proposal applying well for battery storage resources participating under the NGR model and is considering how it would apply to other technology types that may participate under NGR in the future.

Additionally, CAISO proposes to apply bid insertion for RDRR resources in the real-time. RDRR resources only have an obligation to bid into the real-time market and are only utilized after the CASIO declares a warning or emergency. These bids must be 95-100% of the bid cap.

CAISO proposes that for Regulatory Must-Take (RMT) resources, the must offer obligation for the portion of the resource that is RMT should be consistent with availability. CAISO initially proposes that RMT resources submit an availability plan 45 days prior to the RA month for the portion of the resource that is RMT. The corresponding must offer obligation would be for the MW amount specified on the availability plan. If a portion of the resource is not RMT and provides RA, that portion of the resource would fall under the standard must offer obligation.

CAISO believes the proposed must offer obligations and bidding rules provide clearer requirements for market participants to follow when determining when they must bid into CAISO market. CAISO welcomes stakeholder feedback on the proposals for the standard must offer obligations and list of exemptions.

5.1.5. Planned Outage Process Enhancements

CAISO considered modifications to its current planned outage provisions that will be needed to correspond with the proposed modifications to its RA counting rules and assessments. CAISO's proposed changes to its planned outage provisions are provided in the following section, as well as relevant background on the current provisions.

Background

CAISO currently uses the Planned Outage Substitution Process Obligation (POSO) for planned outages. The POSO provisions are provided in CAISO tariff at sections 9.3.1.3 and 40.9.3.6. RA resources currently enter planned outages into CAISO Outage Management System (OMS). CAISO's Customer Interface for Resource Adequacy (CIRA) system runs a daily POSO report with determination for a planned outage need for substitution. The POSO process is currently conducted on a first-in-last-out basis,[18] therefore resources submitting planned outages earliest will have the greatest likelihood of being approved to take their planned outages without

[18] CAISO will first request the resource providing RA Capacity with the most-recently-requested outage for that day to provide RA Substitute Capacity and then will continue to assign substitution opportunities until the ISO has sufficient operational RA Capacity to meet the system RA requirement for that particular day.

substitution requirements. The POSO process compares the total amount of operational RA capacity to the total system RA requirement.

As noted previously, system RA requirements are established by LRAs based upon CEC monthly peak forecasts and are updated 60 days prior to the start of each delivery month. If, after removing all planned outages, available capacity is less than the RA requirement, CAISO assigns substitution obligations for resources seeking to take planned outages during those short timeframes.

Objectives and Principles

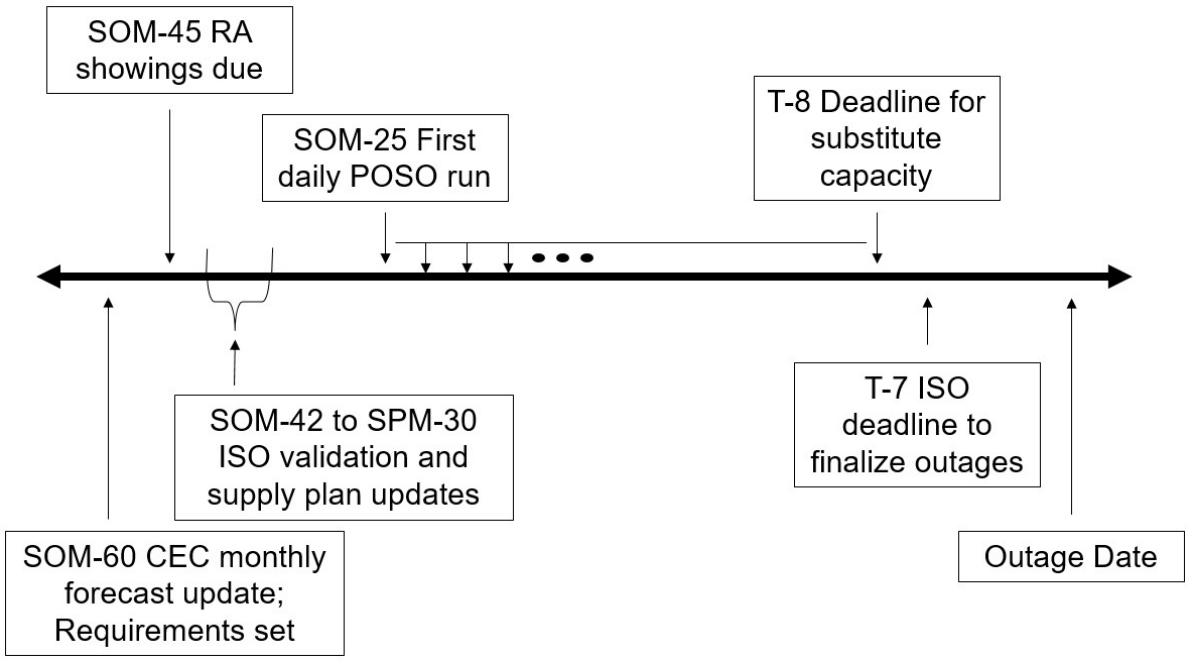
CAISO provides the following objectives and principles to guide the development of modifications to the planned outage provisions. Modifications to CAISO planned outage provisions should:

- Encourage resource owners to enter outages as early as possible,
- Generally avoid cancellation of any approved planned outages to the extent possible,
- Identify specific replacement requirements for resources requiring replacement,
- Allow owners to self-select, or self-provide, replacement capacity, and;
- Include development of a CAISO system for procuring replacement capacity.

Current Planned Outage Substitution Obligation Timeline

The current POSO timeline is provided in **Figure 5** below. The current timeline provides the first POSO assessment at T-22, or 22 days prior to the start of the RA delivery month, for all outages submitted prior to T-25. This is the first instance when resource owners are provided with indication of any POSO replacement obligations. Resource owners are allowed to provide replacement capacity through the T-8 timeframe and CAISO finalizes replacements and outages at T-7.

Figure 5: Current POSO timeline



Proposed Modifications to the Planned Outage Substitution Obligations Tool

CAISO is proposing several changes to the existing planned outage provisions and Planned Outage Substitution Obligation (POSO) tool. CAISO proposes to redesign the POSO tool to base substitution requirements on system UCAP targets rather than traditional NQC targets. This proposed change is intended to align with the counting rules and RA assessments proposal to incorporate forced outage rates in capacity valuation and assess resource adequacy on a UCAP basis, as detailed in Section 5.1. The proposed modifications include:

- Development of a planned outage calendar
- Requiring comparable substitute capacity
- Development of a substitute capacity bulletin board
- Revisions to CAISO planned outage substitution process

Each of these elements are described below and in greater detail with examples and justification in the subsequent sections.

Planned Outage Outlook transparency

CAISO proposes to offer greater visibility into available resource adequacy compared to requirements. The goal is to provide resources greater transparency regarding available capacity well in advance of planning outages. Specifically, CAISO proposes to develop a calendar that shows, on a daily basis, the potential availability of additional system RA headroom in advance. This RA headroom should allow resources to identify potential calendar dates with RA headroom in advance to request planned outages to mitigate replacement

obligations while helping the CAISO maintain adequate available capacity. If the calendar shows no available headroom, then any RA resource requesting a planned outage will be required to show substitute capacity.

Outages will continue to be approved and denied through the outage tool. Outages and substitute capacity will continue to be evaluated, accepted, the outage calendar adjusted on a first-in-last-out basis. This means that resources submitting first will be assessed first and less likely to have their outage denied or require substitute capacity than later requesting resources. Resource owners with resources taking outages requiring replacement will continue to be allowed to self-select (self-provide) substitute capacity for any outages requiring replacement. Resources requesting planned outages during periods when CAISO does not have excess capacity above the RA requirements will be required to procure sufficient UCAP substitute capacity, or have their outage period assessed against their forced outage rate.

Figure 6 demonstrates the conceptual planned outage outlook calendar. CAISO proposes to publish this type of calendar including daily MW values for UCAP headroom in excess of system RA requirements.

Figure 6: Example substitution availability calendar

2 Headroom: 25 MW	3 Headroom: 205 MW	4 Headroom: - MW	5 Headroom: - MW	6 Headroom: - MW	7 Headroom: 350 MW	8 Headroom: 7 MW
9 Headroom: 30 MW	10 Headroom: 712 MW	11 Headroom: 145 MW	12 Headroom: 320 MW	13 Headroom: 200 MW	14 Headroom: - MW	15 Headroom: - MW

Requirements for Comparable Resource Substitution for Planned Outages

CAISO proposed to assess the shown RA fleet through the portfolio analysis discussed in Section 5.1, because the CAISO system is transitioning to a decarbonized fleet with greater reliance on variable, and availability and use-limited resources. Due to this new reality, CAISO believes that it is important to reflect these new operational constraints in related RA topics, including the planned outage substitution obligation requirements.

CAISO believes it may be necessary to place additional constraints on the type of replacement resources that will qualify for meeting the planned outage substation obligation requirements of particular resource types. In other words, CAISO believes it is necessary to propose that POSO requirements ensure like for like replacement obligations, for example – a resource that is available during all hours of the day, with no use or availability limitations, that faces a replacement obligation would be required to replace with a similar resource that was not use or availability limited.

Only certain resources will be acceptable substitution for other resources seeking to take planned outages with replacement obligations. CAISO proposes to adopt an approach to ensure comparable resources are provided for planned outage substitution. CAISO is focused on availability and capabilities, not technology or fuel types. Specifically, CAISO proposing to explore requirements to provide comparability related similarities such as location, use limitations, availability limitations, run time duration limits, and Ancillary Services certification/capabilities.

Table 6: Comparability Categories

Comparability Categories	Issues Considered in CAISO Review
Location	TAC area, Local area
Use Limitations	ULR status
Availability Limitations	Availability Limitations: # of starts per day, # of consecutive days of operation
Ancillary Services certification/capabilities	AS categories: Spin, Non-Spin, Regulation Up, Regulation Down
Run time duration limits	Equal or greater run time duration (at Pmax or full NQC output)

CAISO has identified these categories of comparability for the planned outage substitution obligation as an initial proposal for stakeholder consideration. CAISO will review all planned outages requiring substitution to ensure they are comparable and reliability can be maintained with the substituted resource offered. An example planned outage substitution obligation bulletin board concept is provided below. This example substitution bulletin board includes the potential comparability categories proposed to illustrate how this requirement would be effectuated.

CAISO seeks feedback on the proposed categories (location, use limitations, availability limitations, run time duration limits, and Ancillary Services certification/capabilities). CAISO will explore the implementation feasibility of this proposal for further development in future straw proposal iterations.

Additional issues related to planned outage provisions

Local constraints will continue to be enforced in CAISO's outage planning, and CAISO may deny outages if local reliability issues arise. Self-selected substitute resources (within the same local area) may reduce instances of CAISO denying outages for local reliability issues.

CAISO will retain its authority to deny any outage for reliability reasons, even those that have provided substitute capacity. CAISO will also retain its ability to procure additional capacity through backstop tools for reliability after the planned outage timeframe, as necessary.

Planned Outage Substitution Capacity Bulletin Board

CAISO proposes to develop a bulletin board for resources to match planned outages requiring substitution with substitute capacity resource sellers. The intent of this planned outage substitution bulletin board is to make it easier for resources to connect with potential substitute supply. Resources not shown as RA resources or with additional available UCAP may voluntarily offer that capacity to provide substitute capacity. The resource SC will be able to list resources and a specified price for use of that substitute capacity. Resources looking for substitute capacity can use this bulletin board to find the comparable capacity needed to take the planned outage.

CAISO will provide daily granularity. Resource owners looking for substitute capacity will have visibility into resources offering substitute capacity. Results will be filtered to only substitute capacity suitable for substitution (per replacement comparability requirements). Accepting capacity through this tool will automatically match resources on outage with substitute capacity.

Table 7: Example for a substitution bulletin board

Resource	Use-Limited or Availability - Limited	Run-time duration limit at NQC	A/S Certified	Fuel Type	MWs (NQC UCAP)	Offer ($/kW-Month)
A	Yes (avail-limit)	4 hours	Yes – Reg Up / Down	Battery Storage	20 NQC 18.0 UCAP	$8
B	No	None	Yes – Spin	Gas	50 NQC 44.3 UCAP	$6
C	Yes (starts per day)	24 hours	Yes – Spin	Gas	50 NQC 36.6 UCAP	$5
D	Yes (avail-limit)	2 hours	Yes – Reg Up / Down	Battery Storage	10 NQC 9.2 UCAP	$5
E	No	N/A	Yes – Spin + Reg Up	Gas	100 NQC 94.9 UCAP	$4.5
F	Yes (VER)	N/A	No	Solar	10 NQC 10 UCAP	$2
G	Yes (VER)	N/A	No	Wind	10 NQC 10 UCAP	$2
H	No	16 hours	Yes – Spin	Gas	30 NQC 17.5 UCAP	$2

New planned outage process will be similar to the current process with timing changes

CAISO provides the following figures to show the intended modifications to the planned outage process. The modified process with continue to look and feel similar to the current process, but will include the changes proposed above and the new timeline is described below ("SOM" – start of month).

Figure 7: Planned outage process illustrated

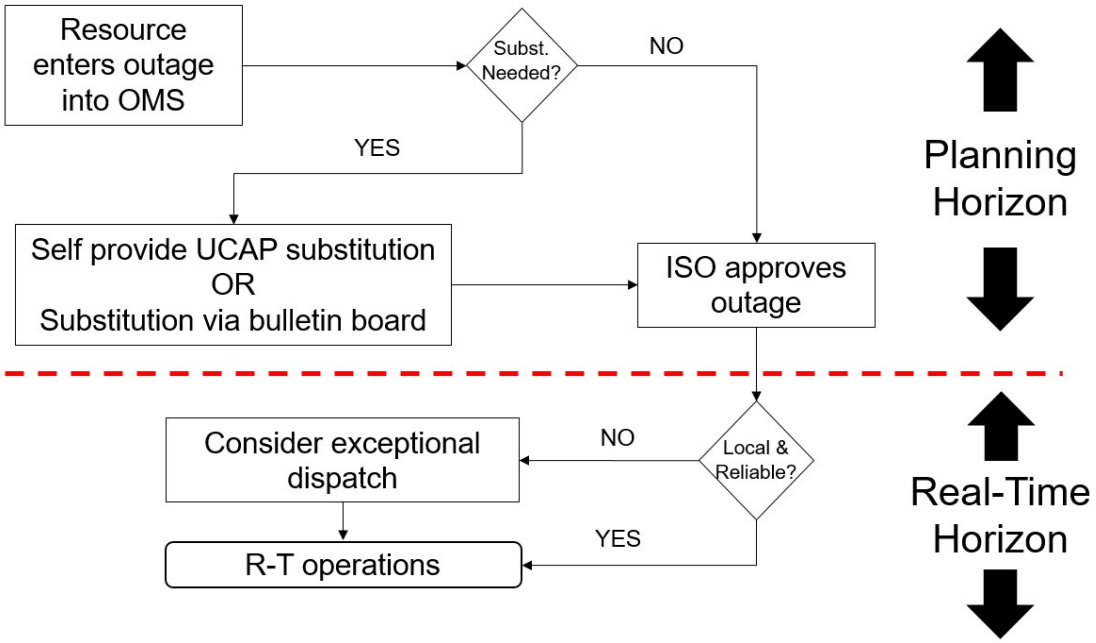
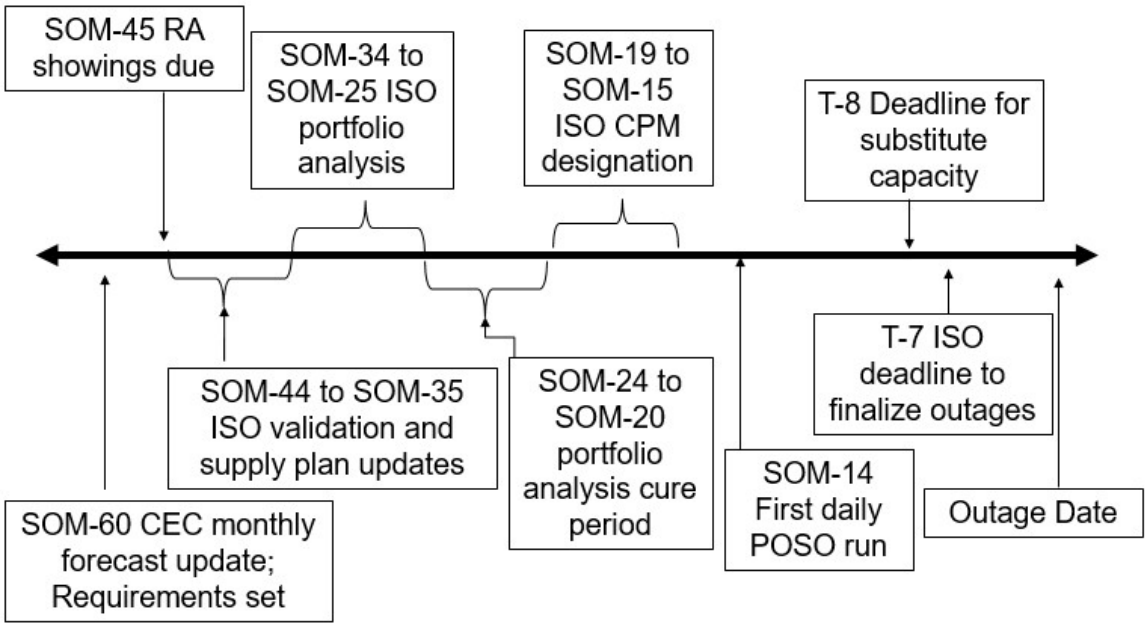


Figure 8: Proposed planned outage obligation process timeline



5.1.6. RA Import Provisions

CAISO has reviewed import RA rules and provisions in this initiative. This review includes an assessment of the requirements and rules for the sources behind RA imports. CAISO provides analysis and an initial proposal for modifications to the RA imports provisions in the following section. Please note that price caps for RA import bid submissions are out of scope of this initiative.

Background

LSEs can meet system RA requirements with a mix of RA resources, which can include imports from outside the CAISO balancing authority area. Import RA resources were used to meet an average of around 3,600 MW (or around 7 percent) of system RA requirements during the peak summer hours of 2017. In the summer of 2018, this increased to an average of around 4,000 MW (or around 8 percent) of system resource adequacy requirements. [19] Thus, the quantities are not insignificant and impact the RA program and its ability to ensure reliability.

Today, RA import resources are not required to be resource specific or to represent supply from a specific balancing area. RA import resources are only required to be shown, and make offers as shown, at a specific intertie point into the CAISO's system. Import RA can be bid at any price below the offer cap and does not have any further obligation to bid into the real-time market if not scheduled in the day-ahead integrated forward market or residual unit commitment process.

Some stakeholders previously expressed concerns with current RA import provisions potentially undermining the integrity of the RA program and threatening system reliability. Additionally, CAISO's Department of Marking Monitoring (DMM) expressed similar concerns in their September 2018 DMM special report on import RA. In that report, DMM explained that the existing rules could allow for some portion of resource adequacy requirements to be met by import RA that may have limited availability and value during critical system and market conditions. For example, import RA could satisfy their RA must offer obligation by routinely bidding significantly above projected prices in the day-ahead market to help ensure they do not clear the market, relieving them of any further offer obligations in real-time. [20]

Clarification of concerns and issues under review

CAISO agrees it is important to consider concerns related to the current import RA provisions. CAISO believes it is useful to clarify the problem statement and objectives for this issue in this revised straw proposal. CAISO is primarily concerned with understanding if the current RA import provisions could cause reliability concerns and determining how any potential concerns can be mitigated. CAISO has previously identified two areas of potential concern related to the current RA import provisions that are explained below.

[19] 2017 CAISO DMM Annual Report, p. 259:
http://www.caiso.com/Documents/2017AnnualReportonMarketIssuesandPerformance.pdf
[20] DMM Special Report: Import Resource Adequacy, September 10, 2018:
http://www.caiso.com/Documents/ImportResourceAdequacySpecialReport-Sept102018.pdf

Potential concerns related to current RA import provisions:

1. Double counting of RA import resources:

CAISO's RA import provisions should ensure the CAISO can certify that import resources shown for RA are not also being used by the resource's native BA to serve native load, sold to a third party, or being used to meet capacity needs of other areas in addition to CAISO load. CAISO cannot be sure whether RA imports are being double counted or not under current provisions.

2. Speculative RA import supply being used on RA showings:

CAISO's RA import provisions should foreclose (or at a minimum, discourage) the potential for speculative RA import supply. Speculative RA import supply occurs when RA imports shown on RA supply plans have no physical resource backing the showing or no firm contractual delivery obligation secured at time of the showing.

CAISO has described this speculative RA import supply concern previously, and has noted DMM's similar concerns above. Previously CAISO indicated this may be a significant concern due to initial evidence of relatively high priced DA bidding by Non-Resource Specific RA imports, which could be a potential bidding strategy to avoid a subsequent RT MOO or actual RT energy award and resulting delivery obligation. CAISO also notes that this initial analysis was not conclusive and has undertaken further analysis efforts in attempt to better define this issue's possible magnitude and validity.

Objectives

CAISO provides the following objectives that are intended to help guide any potential RA import rule modifications.

- Create more comparable treatment to internal RA resources for RA imports. The current provisions provide less rigorous requirements for RA imports.
    - There is currently no RT MOO for RA import MWs that have not been awarded in the CAISO's IFM.
    - CAISO has no emergency recall ability for non-resource specific RA imports and there is no assurance that external non-resource specific RA imports will respond to CAISO operator's Exceptional Dispatches.

- Consider other aspects of RA Enhancements proposals for incorporating forced outage rates.
    - Ensure fair and comparable treatment to the extent possible for RA imports and specifically non-resource specific RA imports as related to the proposed Unforced Capacity counting and assessment modifications proposed above.

- Ensure coordination with any related modifications being proposed through CAISO's extended EIM and DAME initiatives. Correlation between the RA Enhancements initiative, the Day-Ahead Market Enhancements (DAME) initiative, and the Extension of

the Day-Ahead Market to the EIM (EDAM) will be discussed in CAISO's Policy Vision document. CAISO anticipates posting this document in late summer 2019.

RA imports analysis

CAISO completed related import analysis in the summer of 2018 as a part of the Intertie Deviation Settlement initiative.[21] The Intertie Deviation Settlement initiative investigated why awarded import resources are not delivered, the magnitude of non-delivery that occurs, and a proposal to mitigate non-delivery of import resources. The RA Enhancements effort leverages the Intertie Deviation Settlement analysis to determine if there is a problem with non-delivery of import RA when awarded in the CAISO real-time market. The description below describes this analysis effort.

To determine delivery patterns and behavior for import RA resources, CAISO has analyzed three data sets: import RA showing, HASP schedule for import RA resources, and RA delivered quantity. This enables CAISO to identify if the resource was awarded in the real-time market but failed to deliver, did not deliver because the scheduling coordinator failed to bid, or actually delivered a MWh quantity greater than the RA showing.

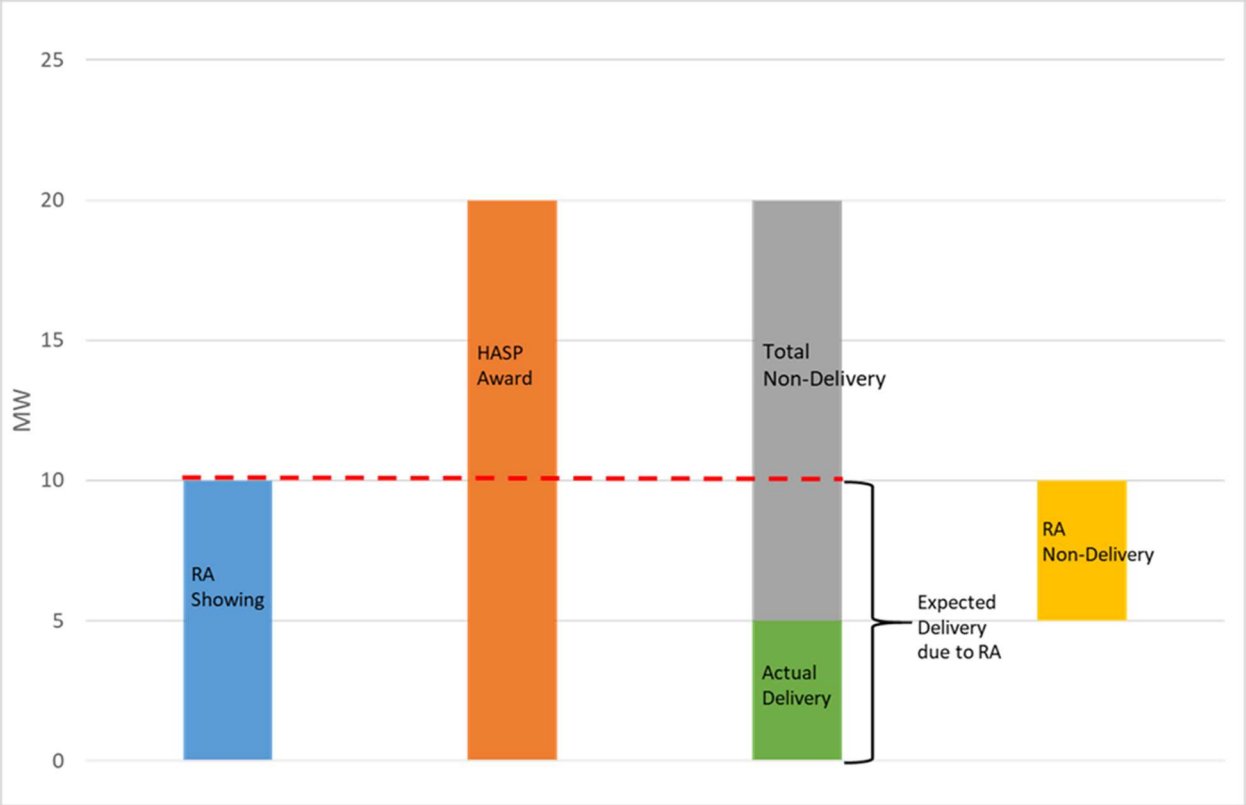
CAISO defines "non-delivery" as the MWh quantity that did not meet the real-time schedule. Because RA imports are scheduled hourly, the non-delivery quantity is determined by comparing the HASP schedule to the RA delivery quantity. It is important to compare these values to the RA showing. Specifically, an RA import resource's Resource ID is not limited to bidding only the amount of MWs that have been shown for RA, and CAISO has observed many instances when bidding and awards for RA import Resource IDs exceed the amount of MWs shown for RA. CAISO attempts to illustrate this issue with a hypothetical example below. Additional analysis to better quantify the potential for any reliability concerns related to RA import non-delivery is also included in the hypothetical example below.

Illustrated in the chart below, 10 MW was shown for import RA and the HASP schedule was for 20 MW during a specific hour. When comparing the HASP schedule to the market dispatch we determine that only 5 MW was delivered. Therefore, 15 MW can be classified as not delivered. This quantity is depicted in the grey colored bar.

To determine how much of this non-delivery can be attributed to import RA, CAISO has assumed the total amount of RA that was expected to be delivered would be the same as the import RA showing. In this example, the non-delivery due to RA imports can be assumed to be 5 MW. While the total amount of non-delivery can be considered a reliability concern, it is particularly concerning that 5 MW of RA was not delivered. This may indicate a potential of speculative RA. This 5 MW that is not delivered is a potential reliability concern.

[21] Information on the Intertie Deviation Settlement initiative can be found here: http://www.caiso.com/informed/Pages/StakeholderProcesses/IntertieDeviationSettlement.aspx

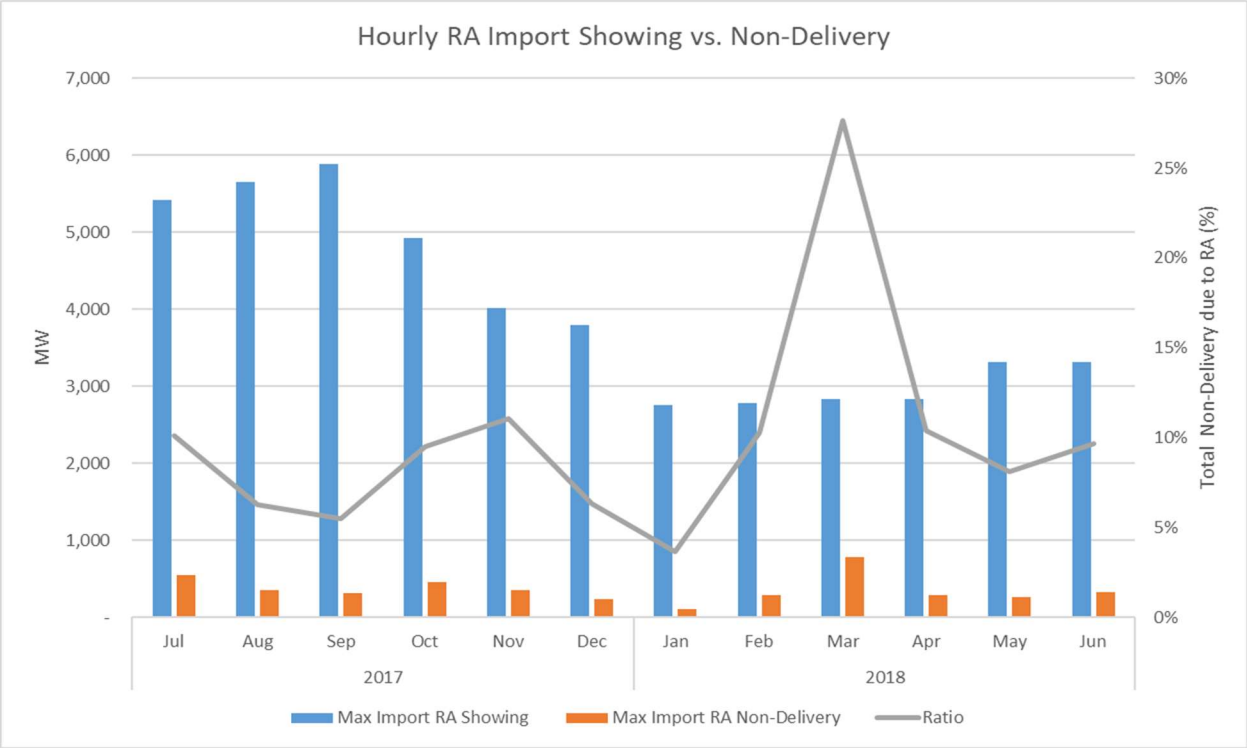
Figure 9: Clarifying potential concerns related to RA import delivery



CAISO has applied the approach described in the hypothetical example above to the initial RA enhancements analysis, previously presented in the CAISO straw proposal on this issue, to ensure that the actual stated magnitude of non-delivery of RA imports provided through this analysis is more accurate and appropriate.

Looking at actual data from July 2017 to June 2018, CAISO observed that in any given hour the maximum amount of import RA classified as RA import non-deliveries does not exceed more than 1,000 MW. When comparing this value to the maximum hourly import RA showings, the amount of non-delivery is a relatively small fraction of the RA imports the CAISO anticipated. The data shows that the worst case scenario for every month (the one hour of the month with the most non-delivery of RA imports), is approximately 10% of the RA showing (*i.e.*, maximum monthly non-delivery observed in a single hour averages approximately 10%). This analysis is shown in the figure below.

Figure 10: Observed undelivered RA import resources accounts for less than 10% on average of hourly RA showings



CAISO notes that the actual non-delivery results after considering the modification to its analysis described above shows a maximum monthly non-delivery of RA imports to be around 10% on average over the study period. Observations of around 10% average non-delivery of RA imports is comparable to WECC-wide average forced outage rates. For this reason, CAISO believes the potential reliability impact of RA import non-delivery may be less a concern than previously thought.

The analysis indicates that non-delivery of RA is not a significantly large or overly concerning magnitude, and therefore may not represent as substantial a reliability concern as CAISO's initial analysis had suggested. The updated analysis is more accurate in this assessment. Saying this, CAISO believes internal RA resources are held to a higher standard than RA imports and CAISO intends to pursue modifications to the current import RA provisions to bring the treatment of RA imports in-line and comparable with internal system RA resource provisions to the extent possible and appropriate. The speculative supply concerns may have some market impacts that could be important, and CAISO is currently undertaking the intertie bidding cost justification initiative to address these related issues.

Additionally, it is important to note CAISO is addressing all non-delivery (regular imports and RA imports) with the Intertie Deviation Settlement proposal. The proposal is scheduled for fall 2020 implementation, and will impose an additional charge on intertie resources that are scheduled in the HASP process but are not delivered. This new charge will incentivize delivery of awarded intertie resources. When comparing the Intertie Deviation Settlement proposal to the RA rules, CAISO believes Intertie Deviation Settlement proposal provides an incentive for RA import

delivery and therefore CAISO does not believe it is necessary to impose to the UCAP concept for non-resource specific RA imports.

Proposed RA Import Rule Modifications

CAISO proposes to require specification of the Source BA for all RA imports on RA and Supply Plans for monthly showings. CAISO also proposes to adopt and codify provisions similar to current CPUC RA program rules and regulations for RA imports to provide firm monthly delivery in CAISO's tariff to ensure similar treatment among all LSEs. These modifications are described in further detail below.

Specification of RA Import Resource Balancing Area Source

The CAISO's current RA provisions allow for Non-Resource Specific Resources to qualify to provide System RA. As noted above, RA import resources are not required to be resource specific or to provide any greater certainty they represent supply from a specific Balancing Area. Instead they are only required to be shown as sourced on a specific intertie into CAISO's system.

Because of tighter supply in the West, CAISO has expressed increasing concerns about the potential for Non-Resource Specific RA import resources to be double counted for reliability. This may occur when a resource is shown to the CAISO as RA while also being concurrently relied upon by other regions or Balancing Areas (BA) to meet capacity or energy needs. CAISO is proposing modifications to specify the source of RA imports to ensure all RA import resources are fully available and dedicated to CAISO for reliability. This is an increasingly important matter as CAISO considers extending the day-ahead market to EIM entities, ensuring that resources outside of CAISO's BA are not double counted for meeting resource sufficiency requirements.

CAISO proposes to require specification of the Source BA for all RA imports on RA and Supply Plans for monthly showings. With the extension of the day-ahead market to EIM entities, CAISO believes that, at minimum, RA import resources must specify the source Balancing Area. The proposed modification would allow CAISO to ensure that RA imports are not double counted for EIM entities' resource sufficiency tests. CAISO believes that requiring a designation of the source Balancing Area ("Source BA") will be sufficient to assist in ensuring that RA imports are not being double counted for EIM resource sufficiency tests.

CAISO has also discussed a potential modification to require "resource-specific" designations as a qualification to provide RA imports with stakeholders. As noted above, CAISO believes that the additional analysis provided supports a determination that it is not necessary to propose a resource-specific requirement for RA imports at this time.

Incorporating CPUC RA program RA imports rules and regulations in CAISO's tariff

CAISO has had ongoing discussions with CPUC staff regarding current CPUC RA provisions for RA imports. An area of mutual concern is the potential for unspecified imports being used to meet Resource Adequacy (RA) requirements that may not be firm and supported by spinning reserves.

Prior CPUC decisions have specified the CPUC's qualifying capacity rules require that there are sufficient physical resources – both energy and operating reserves – behind imports used to meet RA requirements. Specifically, D.04-10-035, adopted the following methodology:

> *"The qualifying capacity for import contracts is the contract amount if the contract (1) is an Import Energy Product with operating reserves, (2) cannot be curtailed for economic reasons, and either (a) is delivered on transmission that cannot be curtailed in operating hours for economic reasons or bumped by higher priority transmission or (b) specifies firm delivery point (i.e., is not seller's choice)."* [22]

The CPUC's RA program allows for non-unit specific imports to qualify to meet RA requirements as long as they meet import deliverability requirements and have sufficient physical resources associated with them (i.e., spinning reserve and firm energy delivery to a certain point). The CPUC's Decision D.05-10-042 specifically states that:

> *"Firm import LD contracts do not raise issues of double counting and deliverability that led us to conclude that other LD contracts should be phased out for purposes of RAR. We note that firm import contracts are backed by spinning reserves. Accordingly, we approve the exemption of firm import LD contracts from the sunset/phase-out provisions applicable to other LD contracts as adopted in Section 7.4."* [23]

To ensure that import rules are followed both in form and substance, the CPUC requires that LSEs provide documentation in their current RA compliance filing that reflects that the unspecified imports being submitted to meet RA requirements have firm energy delivery and operating reserves behind them. The CPUC has specified that this documentation can be in the form of contract language or an attestation from the import provider that confirms the import is supported by firm energy and operating reserves.

CAISO believes it is appropriate to incorporate similar provisions for RA imports in its tariff. Therefore, CAISO proposes that all LSEs must submit supporting documentation that any non-specified RA import resource being shown on annual and monthly RA and Supply plans have firm energy delivery. Similarly to the CPUC requirements, the support documentation that CAISO will also require can be in the form of contract language or an attestation from the import provider that confirms the import is supported by firm energy and operating reserves.

[22] See CPUC Decision D.04-10-035 Workshop Report at 21, available at http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/REPORT/37456.PDF
[23] See CPUC Decision: D.05-10-042 at 68.

No Longer Proposing Real-Time Bidding Requirements for All RA Imports

Currently, RA imports have a day-ahead must offer obligation, but only have a real-time must offer obligations if they receive a day-ahead award. The real-time must offer obligation for these RA import resources is only for the amount of MWs awarded in the day-ahead market. CAISO previously proposed to extend the must offer obligations for RA imports into the real-time markets, including all shown RA capacity, not only for resources/MWs scheduled in IFM or RUC. One reason for this previous proposal was to provide CAISO access to RA imports for reliability through real-time, and also in hopes to further mitigate the potential for suppliers and LSEs to provide RA showings that may include speculative supply.

However, after reviewing stakeholder feedback and considering the related consequences of extending RA import bidding requirements into real-time, CAISO does not believe it is appropriate to pursue a full real-time bidding requirement for all RA import MWs regardless of their day-ahead awards. Therefore CAISO is proposing to maintain the current bidding rules for RA imports and only MWs that have received day-ahead awards will be required to bid in real-time.

Feedback provided by the CPUC on this issue provided its rationale for exempting non-resource specific RA imports from a real time bidding obligation:

> *"…in D.06-12-067 the Commission exempted imports, supported solely by non-dynamic system resources (non- resource specific), from the real time must offer obligation, stating that they cannot be preferentially called upon during congestion conditions to meet the CAISO's needs even if they are subject to a real-time obligation." Parties' argued that a real-time obligation is unworkable because imports do not have transmission priority under FERC's open access rules."* [24]

CAISO believes that this aspect of the RA imports proposal should continue to align with the current CPUC rules regarding bidding obligations for non-resource specific resources. This will maintain alignment of CAISO tariff provisions with current CPUC rules for RA imports on this issue as well.

Additional justification for maintaining the current rules for non-resource specific RA import bidding in real-time is to continue allowing for release and use of the transmission capability associated with these RA imports. The current provisions provide greater ability for the most efficient utilization of transmission capability because when the non-resource specific imports do not clear the day-ahead market for some or all of their shown RA capacity, the associated transmission can be released for use in the real-time market by economic energy imports. CAISO believes this impact to potential efficient utilization of the transmission system is important to consider regarding this issue.

Requiring a real-time bidding obligation for all non-resource specific RA imports could have a negative impact on the efficient utilization of the transmission, potentially increasing overall

[24] http://www.caiso.com/Documents/CPUCComments-ResourceAdequacyEnhancements-StrawProposalPart1.pdf

costs to serve load. This could occur if an RA import resource's bid in the real-time was priced at a level that would not clear the market, precluding the utilization of that reserved transmission capability. In this potential scenario a lower cost energy import that may have cleared the real-time market could be precluded from being awarded and overall costs to serve load could be increased in comparison. For these reasons, CAISO believes it is appropriate to maintain the current real-time bidding rules for non-resource specific RA imports.

No Longer Proposing Changing RA Import Must Offer Obligations to 24 by 7

CAISO has also considered expanding MOO requirements for RA imports to 24 hours, 7 days a week in prior iterations of this initiative. The potential for changing the RA import MOO to a 24 by 7 requirement was intended to ensure resource availability during all hours of the day to meet reliability needs that can occur at any time, not just during peak periods. Following CAISO review of stakeholder feedback and considering the related consequences of this change, CAISO does not believe it is appropriate to pursue a 24 by 7 bidding obligation for all RA imports at this time.

CAISO understands that such an extension of the bidding obligations would fully preclude any sub-set of hours import contracts for firm energy delivery from qualifying to meet RA requirements. While there are some benefits of the potential change, considering the updated analysis on RA imports described above, this change and resulting impact of removing qualification of some helpful resources does not appear justified at this time. Sub-set of hours contracts for firm energy delivery RA imports may also assist in meeting peak needs in future periods that could present challenges as the system begins to experience tightening supply across the west.

CAISO also intends to conduct additional analysis and explore relevant events to determine if the current proposal continues to be appropriate. CAISO seeks stakeholder feedback on the proposed RA import provisions modifications.

5.1.7. Maximum Import Capability Provisions

Each year, CAISO establishes maximum import capability (MIC) values for import paths. CAISO's tariff defines maximum import capability to mean "a quantity in MW determined by CAISO for each Intertie into CAISO Balancing Authority Area to be deliverable to the CAISO Balancing Authority Area based on CAISO study criteria." [25] Once these values are calculated, the capacity is allocated to scheduling coordinators for LSEs in the CAISO BAA for resource adequacy purposes.

CAISO received requests from stakeholders regarding the need to review both the MIC calculation and allocation provisions. Some stakeholders have indicated that CAISO should consider alternative calculation methods, and have also asserted that there are numerous challenges presented by the current 13-step Import Capability Assignment process. In response to stakeholder input and feedback, CAISO is conducting a comprehensive review of

[25] See Appendix A to CAISO tariff.

the CAISO's Import Capability provisions, including; calculation methodologies, allocation process, and reassignment/trading provisions.

Import Capability Background

CAISO assesses the deliverability for imports using the MIC calculation methodology. CAISO calculates the MIC MW amount mainly based on a historic methodology that utilizes the actual schedules into the CAISO's BAA for highest imports obtained simultaneously during peak system load hours over the last two years. CAISO examines the prior two years of historical import schedule data during high load periods. Sample hours are selected by choosing two hours in each year, and on different days within the same year, with the highest total import level when peak load was at least 90% of the annual system peak load. CAISO then calculates the historically-based MIC values based on the scheduled net import values for each intertie, plus the unused Existing Transmission Contract (ETC) rights and Transmission Ownership Rights (TOR), averaged over the four selected historical hours. This concept is an important fundamental principle of the MIC framework, intended to ensure that existing ownership rights and pre-existing RA commitments and contracts should be recognized and honored.

MIC values for each intertie are calculated annually for a one-year term and a 13-step process is used to allocate MIC to LSEs. MIC allocations are not assigned directly to external resources, rather LSEs choose the portfolio of imported resources they wish to elect for utilization of their MIC allocations. This is also an important principle underlying the MIC framework. The reason that MIC is allocated to LSEs is the fundamental concept that LSEs pay for the transmission system so they should receive the benefits from it, and this is the reason that MIC is allocated to LSEs and not all market participants. Once the allocation process is complete, LSEs can use their MIC allocations on each intertie to support their procurement of RA capacity from external resources. The 13 step import capability allocation process is detailed further below.

RA showings designating import MWs to meet RA obligations across interties using either Non-Resource-Specific System Resources, Pseudo-ties, or Dynamically Scheduled System Resources are required to be used in conjunction with a MIC allocation and are considered a firm monthly commitment to deliver those MWs to CAISO at the specified interconnection point with the CAISO system.

Maximum Import Capability Calculation Review

For most interties, CAISO calculates MIC values based on historical usage of a given intertie. This historically-based MIC methodology establishes a baseline set of values for each intertie. As noted above, this calculation is based on the maximum amount of simultaneous energy schedules into CAISO BAA, during select CAISO coincident peak system load hours over last two years. CAISO also performs a power flow study in the CAISO's TPP to test MIC values to ensure each intertie's MIC can accommodate all state and federal policy goals; if any intertie is found deficient, CAISO establishes a forward looking MIC for that intertie and plans the system to accommodate this level of MIC in the TPP and RA.

Some stakeholders provided feedback indicating they believe the MIC calculation methodology should be modified to be a forward looking approach for all MIC values, in contrast to continuing to use only the forward looking MIC approach that is currently utilized in limited circumstances along with the current historic methodology used for most interties. CAISO has observed declines in MIC values determined in recent years that are reflective of the historic import data during the selected study period. The data provided in **Table 8: Historic MIC data**Table 8, below, provides relevant MIC values calculated over time using the current methodology.

Table 8: Historic MIC data

MIC RA Year	2014	2015	2016	2017	2018	2019
Maximum Import Capability (MWs)	17,486	16,228	15,755	15,221	14,852	15,208
ETC and TOR held by non-CAISO LSEs (MWs)	4,090	4,090	4,090	4,211	4,511	5,015
Available Import Capability for CAISO Resource Adequacy purposes (MWs)	13,396	12,138	11,665	11,310	10,341	10,193
Total Pre-RA Import Commitments & ETC (MWs)	6,047	5,426	5,256	4,736	4,628	4,306
Remaining Import Capability - less all ETC and TOR (MWs)	7,348	6,712	6,409	6,574	5,713	5,888

The CAISO's initial review of the MIC calculation process indicates that the current MIC calculation methodology is still appropriate. CAISO believes the calculation methodology is still working as intended without significant impact to reliability or LSEs' ability to utilize imports for RA purposes. As such, CAISO is not proposing to make any modifications to the calculation methodology at this time.

CAISO is open to additional feedback on the MIC calculation methodology position and seeks input on potential analysis or alternative calculation methodology proposals for further review.

Available Import Capability Assignment Process Background

CAISO assigns the total Available Import Capability on an annual basis for a one-year term to LSE SC serving Load in CAISO's BAA and, in limited circumstances, to Scheduling Coordinators representing Participating Generators or System Resources, through the 13 step allocation process detailed in the CAISO tariff, Section 40.4.6.2.1, Available Import Capability Assignment process.

This multi-step assignment process of import capability does not guarantee or result in any actual transmission service being assigned, and it is only used for determining the import capability that can be credited towards satisfying the Reserve Margin of a LSE under CAISO

tariff Section 40. Following the 13 step Available Import Capability allocation process, LSEs have the opportunity to trade their assigned Import Capability with other entities bilaterally. This trading opportunity is detailed in the CAISO tariff Section 40.4.6.2.2, Bilateral Import Capability Transfers and Registration Process.

The following table lists the 13 steps of the Available Import Capability Assignment Process. This process is also described in further detail in the appendix.[26]

Table 9: Available Import Capability Assignment process overview

Step	Process description
Step 1	Determine Maximum Import Capability (MIC)
	- Total ETC
	- Total ETC for non-ISO BAA Loads
Step 2	Available Import Capability
	- Total Import Capability to be shared
Step 3	Existing Contract Import Capability (ETC inside loads)
Step 4	Total Pre-RA Import Commitments & ETC
	- Remaining Import Capability after Step 4
Step 5	Allocate Remaining Import Capability by Load Share Ratio
Step 6	CAISO posts Assigned and Unassigned Capability per Steps 1-5
Step 7	CAISO notifies SCs of LSE Assignments
Step 8	Transfer [Trading] of Import Capability among LSEs or Market Participants
Step 9	Initial SC requests to ISO to Assign Remaining Import Capability by Intertie
Step 10	CAISO notifies SCs of LSE Assignments & posts unassigned Available Import Capability
Step 11	Secondary SC Request to ISO to Assign Remaining Import Capability by Intertie
Step 12	CAISO Notifies SCs of LSE Assignments & posts unassigned Available Import Capability
Step 13	SCs may submit requests for Balance of Year Unassigned Available Import Capability

Available Import Capability Assignment Process issues under consideration

Considering the issues and concerns raised by some stakeholder's, CAISO is considering potential enhancements to the Import Capability Assignment process. The following concepts have been discussed with stakeholders in previous iterations of the RA enhancements initiative:

- Incorporate an auction or other market based mechanism into the Available Import Capability Assignment process

[26] Also see Section 40.4.6.2.1 of CAISO Tariff.

- Allow for the release and reallocation of unused import capability after initial monthly RA showings
- Enhance the provisions for reassignment, trading, or other forms of sales of Import Capability among LSEs

CAISO has developed two different auctions mechanism options. These options are detailed below. In regards to the second and third concepts, CAISO is not offering detailed proposals at this time because the any policy to address release/reallocation and trading/reassignment will directly depend on the viability of the proposed auction mechanism. However, CAISO offers additional thoughts on those topics as well.

Available Import Capability Assignment Process modification options

Some stakeholders asked CAISO to incorporate an auction or other market based mechanism into the Available Import Capability Assignment process. They assert that doing so will provide alternatives or additional opportunities for procurement of import capability by LSEs that may need to secure more than their pro rata load ratio share of MIC on any given branch group/intertie to support a particular RA contract. Alternative mechanisms could allow for more efficient procurement of import capability by those LSEs that place a greater value on the Import Capability for various reasons. CAISO could allocate all, or only a portion of the remaining Available Import Capability through a mechanism similar to the current process but CAISO could retain all, or a portion of the remaining Available Import Capability, to be auctioned or otherwise procured by LSEs. Additional auction revenues could potentially be used to reduce the TAC Transmission Revenue Requirement, or allocated back to LSEs on a pro rata load share basis.

CAISO proposes to develop and include an auction mechanism in the Available Import Capability Assignment Process. CAISO believes that incorporating an auction into the Available Import Capability Assignment Process is the best approach to address stakeholder concerns and efficiency issues related to the import capability assignment process.

As a starting point, CAISO presents an initial auction design concept for consideration and discussion purposes. CAISO will consider the level of stakeholder support, implementation feasibility, and economic market design principles in decisions for future proposal direction on this preliminary import capability auction design.

CAISO proposes to develop an auction mechanism to sell and allocate all Remaining Import Capability to LSEs, following current Step 4 (after CAISO has protected for all ETCs, TORs, and Pre-RA commitments in the current process through Step 4). The proposed auction mechanism would be included in the process to replace current Steps 5 through 13.

- The proposed auction mechanism will provide LSEs an opportunity to procure intertie-specific import capability rights for all of the Remaining Import Capability
- Following Step 4 of the current process, CAISO would keep all of the Remaining Import Capability unassigned and make it all available through this auction process.
- An auction allows LSEs to determine the value they place on import capability on any branch groups. LSEs can then bid for the import capability they need. Import capability will be allocated according to LSE bids.

- 100% of the Remaining Import Capability will allocated based upon bids to buy on specific interties, with each intertie becoming a specific a product.
- Any auction revenues could potentially be used to reduce the TAC Transmission Revenue Requirement or allocated back to LSEs on a pro rata load share basis. CAISO seeks feedback on these options for auction revenue allocation.

CAISO believes the proposed auction mechanism can provide the greatest responsiveness to the stakeholder concerns related to fairness, and the potential for hoarding, or underutilization of assigned import capability by some LSEs. The auction mechanism provides a more equitable solution than today by ensuring that import capability is allocated to those entities that value it most, instead of simply allocating to LSEs based on their load share ratio. This inequity driven by the comparative size of LSEs is inherent in the current process and CAISO hopes to provide some solutions to mitigate its impacts. CAISO also notes that the proposed auction mechanism may address many of the concerns raised regarding the current process; however, due to the inherent inequity caused by the relative size of LSEs, and how much each LSE's customers pay to meet their relative portion of overall TAC charges, the proposed auction mechanism may also still result in some inequitable outcomes and issues related to potential inefficient outcomes.

Current practices related to the import capability allocation process are particularly troubling given the fact that almost half of the total allocated import capability goes unused in during most months. The proposed auction mechanism also attempts to address potential hoarding or underutilization concerns by encouraging LSEs to only bid for import capability on interties that they truly need import capability on to meet their procurement plans. CAISO believes this design may be helpful to discourage LSEs from attempting to win import capability awards above their true procurement needs. CAISO seeks stakeholder feedback on this proposed auction design.

CAISO also notes that under any potential auction design, CAISO will continue to ensure that the total amount of MIC allocated to LSEs on each specific intertie branch group is within the studied value for each intertie.

Other Import Capability Allocation Process issues

As noted above, the manner in which CAISO addresses release/reallocation and trading/reassignment concerns will directly depend on the viability of an auction mechanism and the version selected. However, at this time, CAISO offers these additional thoughts on those topics:

- Modifications to allow for the release and reallocation of unused import capability after initial monthly RA showings:
    - CAISO is considering if it is appropriate to subject some or all of LSEs' unused import capability to a release mechanism. Stakeholders suggested that intertie capability not used to support an RA contract within a respective RA procurement timeframe should be released and made available to other LSEs and market participants to support RA contracts. Stakeholders expressed efficiency and fairness

concerns related to the current provisions, stating views that some LSEs may potentially hoard assigned import capability without utilizing it on RA plans and showings. These stakeholders claim this is unfair to smaller LSEs and may underutilize the available import capability, resulting in inefficiencies.

- For any changes to this aspect it is important for CAISO to ensure that it is also able to maintain the fundamental principle that entities that fund the costs associated with intertie facilities, *i.e.*, internal LSEs that pay the Transmission Access Charge ("TAC") should have priority access to the use of import capability to support their own RA contracts, similar to the current process. In other words, the entities funding the embedded cost of CAISO interties should be given the first opportunity to use that intertie capacity to support an RA contract in each RA procurement timeframe.

CAISO did not develop this change in the current proposal. The initial concept was suggested by some stakeholders to address efficiency concerns, but CAISO has not identified a workable approach to incorporate any import capability release provisions or requirement. CAISO remains open to the possibility of this option, however, CAISO believes that the proposed auction options included below may be able to address the related concerns expressed by stakeholders.

- Enhance the provisions for reassignment, trading, or other forms of sales of Import Capability among LSEs:
  - Modification of this aspect of the process may still be needed to provide alternative approaches to bilateral transfers to better facilitate the transfer of Import Capability among LSEs and improve the efficient utilization of Import Capability if described above are not pursued.

CAISO remains open to changes that enhance the facilitation of trading import capability. However, at this time, CAISO has not proposed any specific enhancements and believes the proposed auction mechanism options discussed may address the concerns and issues with the current trading options.

5.2. Flexible Resource Adequacy

CAISO will seek to close certain gaps by developing a new flexible RA framework that more deliberately captures both CAISO's operational needs and the predictability (or unpredictability) of ramping needs. Changes to the flexible capacity product and flexible capacity needs determination should closely align with CAISO's actual operational needs for various market runs (*i.e.*, day-ahead market and fifteen-minute market).

Background

In 2014, CAISO filed, and FERC approved, tariff revisions to implement CAISO's FRACMOO proposal. CAISO developed the original FRACMOO proposal and accompanying tariff provisions through an extensive stakeholder process in collaboration with the CPUC, municipal utilities, investor-owned utilities, generators, environmental groups, and other market

participants. The FRACMOO proposal was a first step toward ensuring that load serving entities procured and offered resources to CAISO that would ensure CAISO had sufficient flexible capacity to reliably operate the transforming grid that was growing more reliant on distributed and variable energy resources. The tariff provisions resulting from that effort provided CAISO with a flexible capacity framework. Specifically, the FRACMOO tariff provisions established:

- A study methodology for determining flexible capacity needs and allocating those needs to local regulatory authorities;
- Rules for assessing the system-wide adequacy of flexible capacity showings;
- Backstop procurement authority to address system-wide deficiencies of flexible capacity; and
- Must offer obligations to ensure CAISO has the authority to commit and dispatch flexible resources through its markets.

When CAISO filed the tariff revisions to implement the FRACMOO proposal with FERC, CAISO stated:

> This simplified initial approach provides a smooth transition to establishing durable flexible capacity requirements. CAISO has committed to re-evaluating the effectiveness of the flexible capacity requirements in 2016 to consider, among other matters, whether enhancements are needed to meet system flexibility needs or to allow resources that are dispatchable on a fifteen-minute basis to fulfill a portion of the flexible capacity needs.[27]

The original FRACMOO proposal was a first step toward ensuring that adequate flexible capacity was available to the CAISO to address the needs of a more dynamic and rapidly transforming grid. The FRACMOO proposal also represented the first ever flexible capacity obligation in any ISO market, recognizing that a resource adequacy program should include both the size (MW) of resource needs and the attributes of the resources providing them (*e.g.*, dispatchability and ramp rate). CAISO anticipated making enhancements to the original FRACMOO tariff provisions once it had experience with a flexible capacity paradigm and better understood the system's flexible capacity needs, especially in light of CAISO's operational needs and the transforming grid.

Subsequently, CAISO initiated the FRACMOO2 stakeholder process. The objective of that initiative was to make changes to the existing flexible capacity to address fundamental gaps between CAISO's markets and operational needs the current flexible RA product. Although the FRACMOO2 initiative was placed on hold, the objectives and work from that initiative have been integrated into the present initiative.[28]

[27] Transmittal letter at p. 19.
[28] At this time, CAISO is closing the FRACMOO stakeholder process.

5.2.1. Identifying Flexible Capacity Needs and Requirements

Flexible capacity needs

In an effort to define a flexible RA capacity requirement, CAISO reviewed the drivers of flexibility on the system. This assessment sought to identify reasons CAISO would need to move resources from a fixed schedule. The goal of this assessment was not to expand the requirement definitions for flexible RA, but to more clearly identify how CAISO can access flexibility, then determine if an identified flexibility need required forward procurement to ensure adequate capacity is available to the CAISO. Although flexibility is required in all intervals to satisfy CAISO operational needs, not all types of flexibility are required in all hours. CAISO identified multiple drivers of CAISO need for flexibility, including:

- Forecasts (i.e. load, VER, BTMs) improve between market runs
- Timing granularity differs between market runs (1 hour, 15 min, 5 min)
- Deviations from dispatch
- Shaping around prescribed delivery of interties (Hourly blocks and industry ramp blocks)
- Net-load ramps are non-linear

CAISO defines its flexible capacity needs into the following three categories based on dispatch, controllability, and the response required in certain time horizons:

- Primary – Frequency Response (Impacted by secondary and tertiary)
- Secondary – Regulation and AGC (Impacted by tertiary)
- Tertiary – Market flexibility needs

CAISO requires all three types of flexibility, but not all must be procured through a resource adequacy construct. For example, primary flexibility is a requirement embedded in the resource interconnection process. Secondary flexibility needs ensure CAISO has sufficient regulation. At this time, CAISO has sufficient regulation capability incentivized and procured through the CAISO market to address this flexibility need.

Finally, tertiary flexibility, i.e. ensuring the market has sufficient flexibility reserved to address day-to-day operational needs has numerous benefits that may not be fully realized absent express procurement in the forward planning horizon. Examples of benefits from forward planning for tertiary or market flexibility needs include:

- Realization of full EIM benefits
- Predictable and economic retirement of resources
- Facilitate state environmental policy at lowest cost
- Mitigate random price spikes
- Provide for lower cost, more reliable dispatches
- Ensures CAISO can maintain reliability during highly variable weather conditions

As a result, CAISO's flexible capacity needs are to ensure:

- Markets have sufficient economic bid range to dispatch around load and resource variability (or inflexibility), manage significant net load ramps, address uncertainty and differences in market granularity (i.e. hourly vs. fifteen minute) between market runs,
- CAISO always has sufficient flexible capacity to pass its own EIM ramp sufficiency tests
- Flexible resources have a path to economic viability relative to inflexible resources (i.e. leads to more rational retirement)

CAISO reviewed the day-to-day operational system needs pertaining to flexible capacity. CAISO observes the need for two categories of flexible capacity:

1) Predictable: known and/or reasonably forecastable ramping needs, and

2) Unpredictable: ramping needs caused by load following and forecast error.

These two types of flexible capacity needs ─ predictable and unpredictable ─ drive different forms of flexible capacity procurement needs. Predictable and reasonably forecastable ramping needs require a set of resources economically bidding into CAISO's day-ahead market to properly shape the day-ahead market to meet forecastable ramps. This allows CAISO to create a feasible market dispatch in the day-ahead market without relying on penalty parameters or exceptional dispatches. However, once CAISO produces a day-ahead dispatch solution CAISO must rely on real-time market dispatches to account for unpredictable ramps caused by uncertainty.

CAISO's flexible capacity framework is based on connecting these two ramping needs into a single framework. The remainder of this section describes each type of ramping need.

Predictable and forecastable ramping needs

The current flexible RA needs determination is based on the largest forecasted three-hour net load plus 3.5 percent expected peak load.[29] The greatest net load ramps are largely driven by the sunset during the non-summer months. Numerous stakeholders questioned the need for a specific RA requirement predicated on ramps that are largely predictable. CAISO agrees these ramps are largely forecastable on a day-to-day basis; however, this does not mean forward procurement to meet these ramps is not important for continued reliable operations. Setting up a fleet of resources with economic bids to meet day-ahead net load ramps allows CAISO to better shape day-ahead commitments. Specifically, a deeper pool of resources that are flexible in the day-ahead market through day-ahead economic bids will improve the efficiency of CAISO dispatch and management of renewable resources.

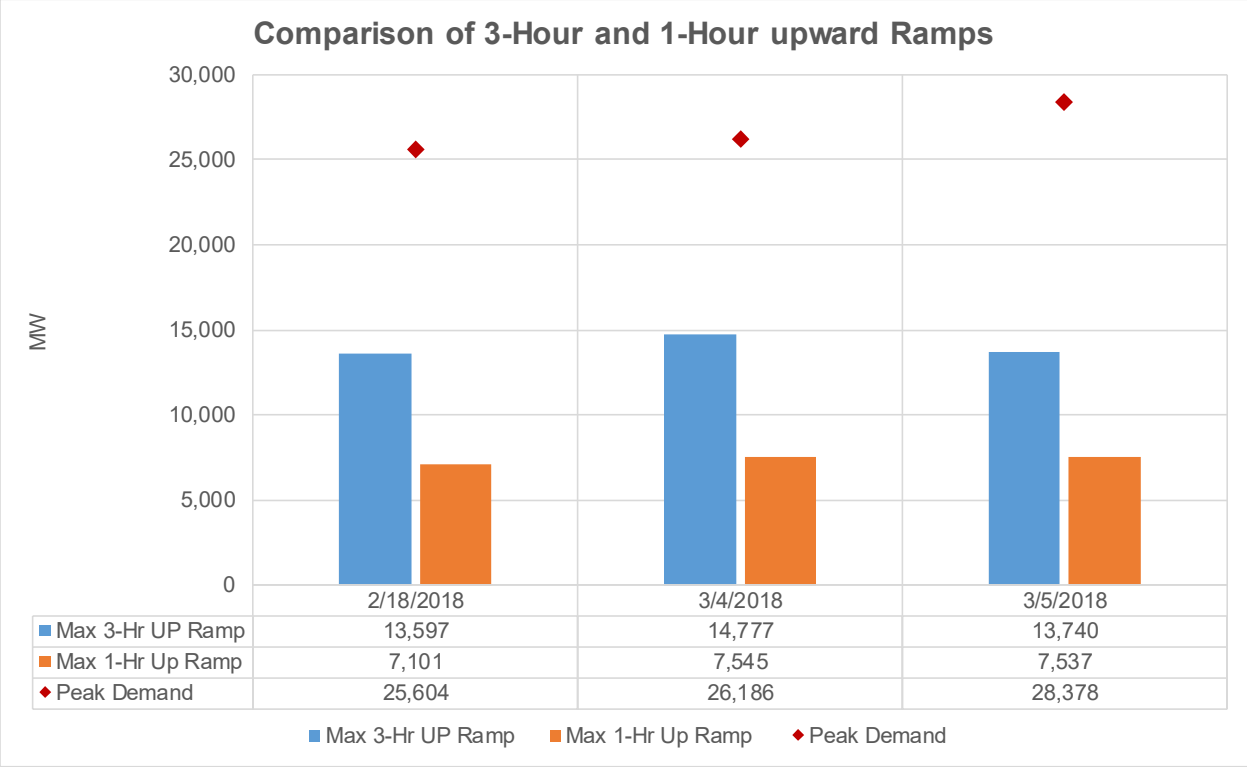
To date, CAISO manages most resource commitments through the day-ahead market process. CAISO does not expect this to change. However, CAISO expects net load ramps to grow and minimum net load to decrease over time with the growing penetration of solar resources. This

[29] The 3.5 percent portion of this equation was originally established to address overlap between flexible RA provisions and contingency reserves. However, the basis for determining the quantity of contingency reserves needed has since been revised.

will likely lead to ramp constraints within the RA fleet and require additional exceptional dispatches if not addressed through forward planning. As such, CAISO proposes to maintain a requirement for, and assessment of, flexible capacity that ensures there is sufficient bid range to cover the forecasted maximum three-hour net load ramps. CAISO envisions that this requirement will provide the resources CAISO needs to shape day-ahead market awards and commitments based on market solutions and should mitigate the need for exceptional dispatches and Capacity Procurement Mechanism (CPM) designations.

The three hour net load lamp is not a linear ramp, it is logistic. This means there is a segment within the three hour net load ramp that requires a much faster ramp rate than the rest of the net load ramp. Currently, 3-hour upward ramps are over 50% of daily peak demand. As shown Figure 11, the largest 1 hour net load ramps can be more than 50 percent of the three hour net load ramp indicating need for faster ramping resources.

Figure 11: Comparison of three hour and one hour net load ramp



CAISO will develop flexible capacity requirements to address both of these needs.

Unpredictable and uncertain ramping needs

With the continued expansion of VERs and behind-the-meter solar photovoltaic systems, both load and generation output will continue to create greater uncertainty between the day-ahead and real-time markets. Under the current ISO market rules, no additional long-start resources are committed after the day-ahead market closes and RUC awards are made. All remaining uncertainty, including both load following and forecast error, must be addressed by resources

previously committed in the day-ahead market or faster starting resources available for commitment in the real-time market.

CAISO's first full market run is its day-ahead market. This market is currently run with hourly granularity using a forecast between 14 to 36 hours ahead of actual operations. Given the large time gap between the day-ahead market run and the 15 minute market, there can be significant differences between the two market iterations based on forecast error and time granularity. This is particularly true during sun rise and sun set.

CAISO is developing market rules to procure imbalance reserves as part of its Day-Ahead Market Enhancements stakeholder initiative.[30] The objective of imbalance reserves is to ensure the day-ahead market has sufficient resources awarded with upward and downward ramping capabilities to address real-time imbalances. Resources that receive an imbalance reserve award will have a must offer obligation in the real-time market. The energy bids associated with the imbalance reserve award will enable the real time market to address uncertainties that materialize between the day-ahead market and real-time market through economic bids.

CAISO proposes to develop flexible resource adequacy capacity requirements to align with the proposed imbalance reserves to address uncertainty needs between the day-ahead and fifteen minute markets. While the benefits of having sufficient ramping capabilities to address the three-hour net load ramp were addressed in great detail through the initial FRACMOO process, the challenges with uncertainty in the forward planning horizon did not receive comparable attention. Therefore, CAISO provides additional details and descriptions about the challenges and magnitude of issues to be addressed.

5.2.2. Identifying Flexible RA Requirements

The current flexible RA capacity requirements are divided into three categories, differentiated primarily by resource eligibility and the must-offer obligation for each category. Generally, eligible resources can provide flexible capacity for the amount of capacity it can produce over three hours. However, this structure fails to adequately differentiate and value the capability to move more quickly over shorter time intervals. Given the flexible capacity needs identified above, CAISO will develop new flexible capacity requirements that incorporate shorter interval ramping capabilities. CAISO will sunset the existing flexible capacity products once these new requirements are developed and implemented.

To address the above flexible capacity needs, CAISO proposes three flexible capacity requirements:

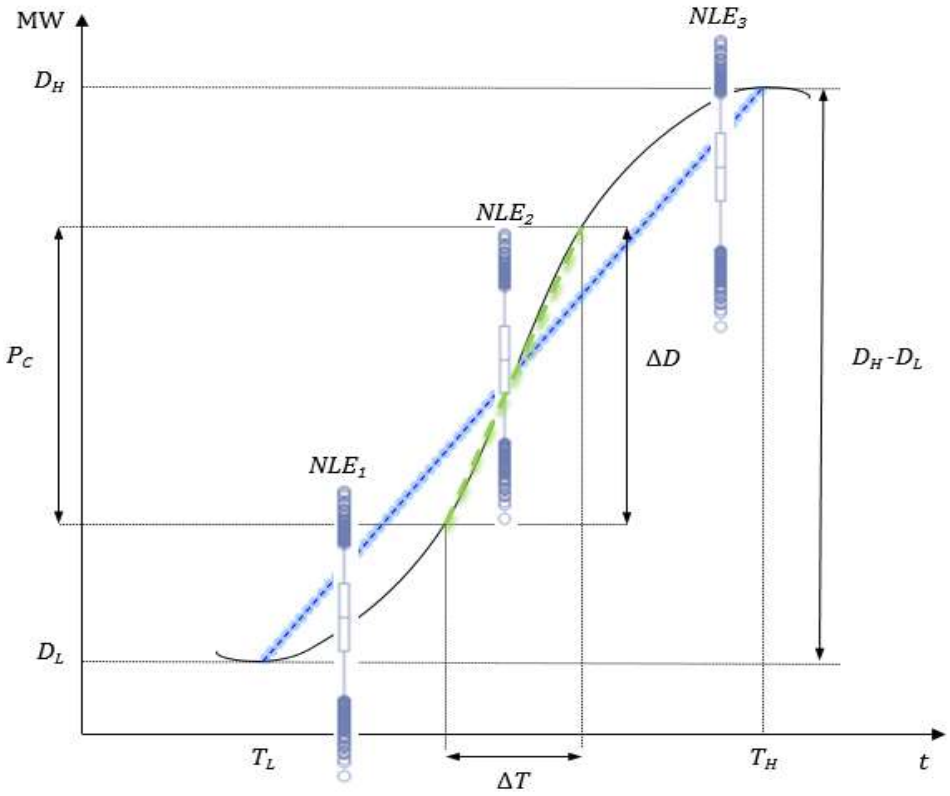
- **Uncertainty Ramp:** Historic forecasted net load error between IFM and FMM
- **Fast Ramp:** Steepest section requiring highest ramp rate ($\Delta D/\Delta T$) over typically one hour

[30] The Day-Ahead Market Enhancements straw proposal is available at: http://www.caiso.com/Documents/RevisedStrawProposal-DayAheadMarketEnhancments.pdf

- **Long ramp:** From a low net demand (D_L) to a high net demand (D_H) over a time period ($T_H - T_L$), typically three hours

CAISO seeks stakeholder input on these flexible RA capacity requirement definitions.

Figure 12: Graphic representation of CAISO's proposed flexible capacity requirements



As with the existing flexible capacity requirement, any new flexible RA capacity requirements should meet basic criteria. These criteria include:

- Easily procurable bilaterally
- Each requirement is clearly defined and quantified
- Resources' ability to meet each requirement is known and quantified
- Mitigates regulatory risks for procuring LSEs

The existing flexible RA capacity requirement met these objectives. However, CAISO will modify the existing flexible capacity product to simplify counting, eligibility rules, and the must offer obligations to the greatest extent possible.

5.2.3. Setting Flex RA Requirements

The current flexible capacity needs assessment provides a tested process that can be used for determining the flexible capacity needs for both the long and fast ramping flexible RA capacity needs. However, CAISO proposes to make some important changes to this study process and

needs determination for the long ramping requirement. Once these changes are made, the process will also produce the data needed for the short ramping requirement.

Long ramping requirement

CAISO believes maintaining the existing flexible capacity needs determination using the maximum forecasted three-hour net load ramp plus contingency reserves should continue serving as the preliminary starting point for the long ramping requirement. The interplay between contingency reserves, which are flexible resources that must be reserved for contingency dispatch, and flexible capacity identified in the original FRACMOO process still exists. However, with the modifications to the NERC standard on calculating contingency reserve, "WECC Standard BAL-002-WECC-2a "Contingency Reserve", the means for determining the quantity of contingency reserves has changed. Contingency Reserve is determined by the greater of either:

- The amount of Contingency Reserve equal to the loss of the most severe single contingency;
- The amount of Contingency Reserve equal to the sum of three percent of hourly integrated Load plus three percent of hourly integrated generation.

Based on the new requirement, the Operating Reserve – Spinning is approximately 50% of the Contingency Reserve requirement. As such, CAISO will modify the existing 3.5 percent expected peak load portion of the flexible capacity requirement to be consistent with the revised standard. Specifically, CAISO proposes to change the flexible requirement formula to the following:

Max Forecasted 3-Hour ramp + ½ Max (MSSC, 6% of the monthly expected peak load[31]) + ε

Finally, since the inception of the flexible capacity product there has been an increase in CAISO dispatches of VER resources, both through economic bidding and curtailed self-schedules. This makes forecasting the three-hour net load ramp more challenging. As a result, the CAISO will enhance its forecasting study to account for these dispatches. Therefore, CAISO will reconstruct overall available wind and solar output and include this quantity into the formulation of the three-hour net load ramp. This eliminates the concerns of double counting VERs towards meeting flexible capacity needs. This double counting would occur if the observed three hour net ramp is mitigated by the curtailment (i.e. reduced overall need) and then again by allowing the resources to provide flexible capacity. CAISO will modify how wind and solar resources are considered in meeting the flexible RA requirements. CAISO's proposed changes to the treatment of wind and solar resources for Effective Flexible Capacity (EFC) are discussed in greater detail below.

Combining all off these elements yields an overall flexible capacity needs determination of:

[31] 6% of the monthly expected peak load is approximately equivalent to the sum of three percent of hourly integrated load plus three percent of hourly integrated generation.

Max Forecasted 3-Hour ramp (including reconstituted renewable curtailments) + ½ Max (MSSC, 6% of the monthly expected peak load) + ε

Fast ramping requirement

The current flexible capacity needs assessment produces minute by minute net load data. This data allows the CAISO to determine the largest daily forecasted one-hour net load ramps. As with the three hour net load ramp, CAISO proposes to set the fast ramping flexible RA capacity need based on the largest forecasted net-load ramp in each month. At this time, CAISO is seeking stakeholder input regarding what should be given for operating reserves when making the fast ramping needs determination. Specifically, CAISO is contemplating if it should include an additional quantity of the fast ramping requirement to account for the overlap between flexible RA capacity or is this overlap sufficiently addressed by long-ramping procurement.

Uncertainty requirement

CAISO is currently exploring different options for determining the requirements for uncertainty. At this juncture, CAISO is proposing to use three years of historic data to determine both the maximum difference between the day-ahead and fifteen-minute market forecasts and the rate that difference is changing. CAISO will combine the identified needs from the calculated forecast error with and expected growth in wind and solar (including behind the meter solar) as submitted by LSEs in the CAISO's annual flexible capacity needs assessment survey. CAISO will then use those data points to extrapolate the need for the uncertainty requirement for the upcoming RA year. Once there is sufficient data available from the imbalance reserves market, CAISO can reexamine this practice and consider establishing this need based on imbalance reserves procurements. CAISO seeks stakeholder input on this approach to determining the requirements for uncertainty.

5.2.4. Establishing Flexible RA Counting Rules: Effective Flexible Capacity Values and Eligibility

To ensure each LSE can demonstrate it has procured sufficient flexible RA capacity to meet its share of a flexible capacity requirement, CAISO, as it does today, will publish a list annually showing all resources' EFC values. Each resource will receive an EFC value for each month for each flexible RA requirement it can meet. The remainder of this section details the eligibility and counting rules for meeting each requirement. CAISO notes that the eligibility and counting rules look to remain technology agnostic. The goal is to ensure any resource contributing to a given flexible capacity requirement, regardless of technology, provides comparable attributes to any other resource providing that same service.

Internal resources

Under the existing flexible capacity eligibility rule, section 40.10.3.2 of CAISO tariff, resources are required to meet various criteria to be eligible to provide flexible capacity. Many of these criteria are proving to be extremely difficult to validate. CAISO is looking to simplify the eligibility criteria. At this time, CAISO is proposing a very basic set of eligibility criteria. However, CAISO

recognizes that this list will result in numerous unresolved issues. CAISO will identify these issues and seek additional stakeholder feedback for ways to resolve them.

Eligibility criteria

For resources internal to CAISO BAA to be eligible to provide forecastable requirement (i.e. long and fast ramping flexible RA capacity) the resource must meet all of the following criteria:

- Either be a non-use limited resource or a use-limited resource with a use limitation CAISO can model in its energy market or through an opportunity cost adder
- Be a dispatchable resource
- Not be a Conditionally Available Resource
- Not be a regulation energy management resource [32]

For resources internal to CAISO BAA to be eligible to provide uncertainty flexible RA capacity, the resource must meet all of the following criteria:

- Meet the qualifications to provide the forecastable requirements
- Meet the definition of a short start resource
- Be dispatchable in at least 15 minute increments
- Must be able to reasonably control fuel source

Although these eligibility criteria provide much cleaner eligibility criteria than those originally provided under the existing flexible capacity eligibility criteria, they also leave two primary issues unresolved. The first is how the eligibility criteria accounts for energy limitations. At some level, the EFC counting rules ensure the resource is capable of producing energy for a given time period. However, these eligibility criteria do not address other concerns such as the ability of the resource to have available energy when needed. Similarly, the above eligibility do not contain requirements for starts or ramping frequency. For example, the current Base Ramping flexible RA capacity product requires two starts or two ramps per day. CAISO is not proposing minimum start or ramp requirements here, but this issue requires further discussion.

CAISO recognizes that these two unresolved issues risk having resources receiving commitments that change from day-ahead to real-time that could result the resource no longer being able to meet its day-ahead commitment. This can occur for resources with one start per day receiving a day-ahead award for an evening start and then being committed in the morning of the operating day. A similar scenario can exist for storage resources that are not able to recharge during the day. CAISO is seeking stakeholder input about how, or if, flexible RA capacity eligibility criteria should address these concerns. Additionally, CAISO seeks stakeholder feedback regarding the proposed eligibility rules as well as any additional criteria that should be considered.

[32] As noted above, flexible capacity needs are defined by energy needs and the overlap with operating reserves. Regulation needs are not currently considered as part of the flexible RA capacity needs

EFC Counting Rules

The EFC for internal resources providing the long ramping requirement will be calculated using a resource's ability to ramp over a three hour period. However, CAISO proposes to modify the existing calculation to be more universally applicable than the existing calculation. CAISO proposes to use a similar methodology to calculate the EFC values for all resources ramping capabilities, but will change the interval of assessment. The long ramp EFC will be calculated over a three hour interval, the fast ramp interval will use a one hour interval, and the uncertainty requirement will be assessed over a 15 minute interval. EFC values will only be calculated for resources that are eligible to meet the given requirement(s).

The current EFC counting methodology includes an accounting for Pmin as well as a weighted average ramp rate for the resource. CAISO will no longer consider those elements. Instead, CAISO will calculate the EFC for the long ramping process as the largest range a resource can move over three hour interval capped at the resource's UCAP.[33] Exceptions to this rule are discussed below. This calculation will not include a minimum start time for Pmin to count towards the EFC. However, the Pmin of the resource cannot be split. This means that the Pmin for a resource is either completely included or excluded from a resources EFC. CAISO will calculate resources from cold start, and will consider the full range of the resource from its lowest operating limit to max output.

At this time, CAISO proposes to use the above counting rule for all technologies, with two exceptions: Solar and non-generator resources (NGR). For solar resources, their NQC values, particularly in non-summer months, do not reflect their ability to provide fast and long ramping. Solar resources' ability to reduce net load ramps comes from their willingness to *not* generate *prior* to net load ramping events. However, solar resources' NQC is determined by its ability to serve load, or generate. As such, CAISO proposes to calculate solar resources EFC as a function of the resource's historic output. Specifically, solar resources' EFC would be calculated as a percent of their peak output for a month or season. This calculation recognizes that solar production, or lack of production, is a significant contributor to net load ramps. When there is high solar production, there are large net load ramps. When there is lower solar production, there are smaller net load ramps. Therefore, CAISO believes solar EFC should be a high percentage of historic output. CAISO seeks stakeholder feedback on high to determine that percentage.

Consistent with current practices, CAISO recognizes that NGR resources can help balance net load ramps by lifting the net-load in some intervals by charging and providing generation output during other intervals. Therefore, CAISO proposes to count NGR resources EFC based on the resource's ability to provide generation (positive and negative) over a three hour, one hour, or fifteen minute period. This allows NGR resources to potentially receive EFC values that include their full charge and discharge ranges.

[33] CAISO is currently exploring EFC deliverability studies as part of its transmission planning process. CAISO will also use this process to inform the current process in determining if resources can be EFC only resources (i.e. not require to have an NQC to receive an EFC).

Flexible RA from Imports

Currently, import resources are not eligible to provide flexible capacity. However, during net load ramps, CAISO has found that import capacity is capable of providing significant ramping capabilities. Therefore, CAISO will allow imports to provide flexible RA capacity.

Eligibility criteria

Import resources may not be tied to a specific resources like internal flexible RA capacity.[34] As noted above, CAISO will continue to allow for non-resource specific imports to provide RA, but has provided additional clarity about the requirements for doing so. For import resources providing flexible RA capacity, including EIM and non-EIM capacity, resources must meet the same firm energy standard applied to system capacity. The LSE must demonstrate that it has adequate MIC to use the import resource to provide flexible RA capacity.

As with system RA capacity, any LSE using an import resource for flexible capacity must demonstrate it has sufficient MIC capacity to provide flexible RA capacity from an external resource. The MIC capacity is how LSEs demonstrate that the resource's output, and therefore flexibility, is deliverable to the CAISO. While the MIC ensures the flexible capacity is deliverable, CAISO will still need to ensure the flexible capacity is credited to CAISO balancing area authority for purposes of the EIM sufficiency tests. Therefore, the resource must identify the capacities BAA of origin and the interconnection point with CAISO system. CAISO will then change all EIM sufficiency tests to credit CAISO with any flexible RA capacity from resources based in an EIM BAA shown as flexible RA capacity and remove the resources from any EIM entity's sufficiency tests.

Imports will not be eligible to provide uncertainty requirement. However, they can provide both the long and fast ramping requirements. To provide flexible RA capacity imports must:

- Demonstrate all of the above requirements
- Be 15-minute dispatchable resources

EFC Counting Rules for Imports

Imports do not have the same defined ramp rates or minimum operating levels as internal resources. Imports have no Pmin and high ramp rates in Masterfile. Given these parameters, CAISO is not able to calculate an EFC in the same way it does for internal resources. However, this simply means that the LSEs and resource owners must determine how much flexible capacity they wish to procure from imports. As such, CAISO will allow imports to provide EFC up to the UCAP of the resource.

[34] However, dynamic and pseudo-tied resources are connected to specific resources. Their counting rules will be the same as internal resources.

5.2.5. Flexible RA Allocations, Showings, and Sufficiency Tests

Each LSE must demonstrate it can meet its proportionate share of each of the requirements. CAISO will provide each LRA its jurisdictional LSEs' contribution to each of the three flexible capacity requirements. LRAs can then determine its own allocation of each of the requirements. If the LRA does not provide CAISO with an allocation, then CAISO will allocate to each LSE based on CAISO's allocation methodology.[35]

For the forecastable flexible RA capacity requirements, CAISO will use similar methods to those used today. Specifically, CAISO will assess the five largest three hour and one hour forecasted net-load ramps and determine each LRA's contribution based on changes in load wind and solar. One change CAISO proposes is to ensure that load, wind, and solar values all come from the same intervals.[36] Additionally, CAISO continues to work to assess the best metric for allocating these relative changes. In past flexible RA needs assessments, CAISO found that some days with small changes in load that have a high percentage attributed to a single LRA has caused disproportionate impacts on flexible capacity needs allocation to some LRAs. Therefore, CAISO is seeking stakeholder feedback about how to develop an appropriate weighting and allocation process for the forecastable flexible RA capacity needs. Also, consistent with current practices, Load-Following, Metered Sub-System LRAs will not receive an allocation for any forecasted flexible RA capacity needs attributable to changes in load.

CAISO is currently considering allocating the uncertainty flexible RA capacity requirements to LRAs. First, CAISO is considering an allocation based on each LRAs' proportional share of peak load, and MW of wind and solar. This allocation reflects that these factors, although not the only drivers, are the major drivers of uncertainty. However, CAISO is seeking stakeholder input on this option as well as any other options that should be considered.

Each LSE will be required to meet 100 percent of its flexible capacity requirements in both the year ahead and month ahead RA showings. Showings should be submitted in terms of EFC for each requirement. CAISO will assess the showings for each showing for each requirement independently. In other words, CAISO will assess the long-ramp showings independent of the fast-ramp showings. This means that an LSE can have a resource on one, two, or all three of its flexible RA capacity showings.

Once CAISO receives flexible RA capacity showings, it will do two things. First it will notify all LSEs if they have provided adequate flexible capacity in each category and notify the LSE if it was at risk of potential backstop procurement cost allocation. Second, CAISO will assess the adequacy of each requirement at a system level. If CAISO has received enough flexible RA in each requirement at system level, it will not undertake any additional action with respect to flexible RA capacity. If CAISO finds a deficiency in any flexible RA capacity requirement, it will assess individual showings and notify LSEs of the system deficiency. LSEs will be provided an opportunity to cure the deficiency. This cure period will align with the cure period for other RA

[35] CAISO is not looking for LRAs to provide an allocation methodology, instead, the LRA should provide CAISO with each of its jurisdictional LSE's allocation.
[36] Currently, the change in load can come from different days than the wind and solar changes.

requirements. Once the cure period closes, CAISO will proceed with the remaining validation processes. These process are provided in greater detail in Section 5.4, below.

5.2.6. Flexible RA Must Offer Obligation Modifications

The current flexible RA capacity products have different must offer obligations based on the category of flexible capacity a resource provides. These different offer obligations have created a significant amount of confusion for market participants. Therefore, CAISO is looking to simplify the must offer obligations for flexible capacity. As noted above, in Section 5.1, CAISO is clarifying must offer obligations for system and local capacity. Further, as noted in the same section, CAISO has proposed to assess resource forced outage rates over a 16-hour window between 5:00 AM and 9:00 PM. Lastly, CAISO data shows the uncertainty tends to be higher during the same 16 hour window.

CAISO's proposal aims to strike a balance between having multiple must offer obligations for flexible capacity requirements with ensuring CAISO has sufficient capacity available during the intervals of need and aligning flexible capacity and generic capacity rules.[37] This balance is particularly important because CAISO expects that many resources providing flexible RA capacity will contribute to multiple flexible RA requirements and system or local capacity. However, as noted above, CAISO is still trying to address the concern that changes between day-ahead and real-time needs may necessitate different must offer obligations for the different products.[38] Therefore, CAISO seeks stakeholder input regarding how it might balance these concerns when developing flexible RA capacity must offer obligations.

As a starting point to, CAISO proposes that any resource providing any flexible capacity must submit economic bids to the CAISO's markets from 5:00 AM to 9:00 PM for all shown flexible RA capacity. Solar and wind resources should submit economic bids for the minimum of their forecast or their shown EFC value. This bidding requirement is consistent with allowing solar resources to provide EFC greater than their NQC and differs from the current practice of allowing solar resources to bid a proportionate amount of their EFC to NQC value. NGR resources must submit economic bids to cover both the charge and discharge range of shown EFC.

[37] As noted above, all RA must offer obligations, including flexible RA capacity must offer obligations will align with the Day-Ahead Market Enhancements policy.
[38] As noted above real-time RA must offer obligations will align with the Day-Ahead Market Enhancements policy

5.3. Local Resource Adequacy

5.3.1. Local Capacity Assessments with Availability Limited Resources

As a part of California's RA program, CAISO performs studies to ensure adequate capacity is procured in local areas to mitigate potential local reliability issues in those areas. As California transitions to a decarbonized grid, CAISO will likely depend more heavily on clean, variable and distributed energy resources that have certain availability limitations, such as limitations on fuel availability, run-time duration, and or event calls. It is important CAISO enhance its processes to ensure the RA program considers these limitations when determining the amount of procurement required in local capacity areas.

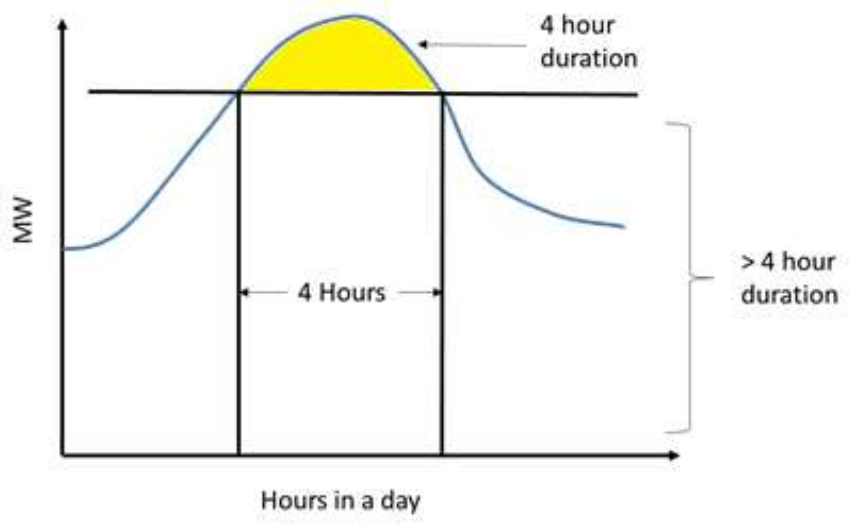
CAISO proposes to define availability-limited resources as those that have significant dispatch limitations such as limited duration hours (e.g., per year, season, month, or day) or event calls (*e.g.*, per year, season, month or consecutive days) that would limit the resources' ability to respond to a contingency event within a local capacity area. This proposed definition is limited to resources that count towards meeting a local capacity area or sub-area need.[39] As these resources make up an increasingly greater portion of CAISO's resource mix, CAISO believes it is important to evaluate local capacity needs considering these resources' availability limitations to help guide the effective procurement of local resource adequacy resources.

The Local RA program is currently based on meeting a peak capacity requirement in a locally constrained area defined in MWs without full consideration of resource availability needs, like resource duration or event calls. For example, today, availability-limited resources have a minimum duration requirement of four hours to qualify for resource adequacy. Under the current RA program, a 10 MW resource that is capable of producing for 4 hours, or 40 MWhs has the same resource adequacy capacity value as a 10 MW resource capable of producing for 8 hours, or 80 MWhs. However, if a local capacity area requires 10 MW of capacity for an eight hour period during a contingency event, only the latter is capable meeting this reliability need. Yet, from an RA perspective, these hypothetical resources are valued the same because the current RA program does not consider the availability limitations of the resources when determining RA capacity values. This has the potential for CAISO to be sufficient in MWs to meet peak demand needs in a local capacity area, but insufficient in MWhs to meet energy needs across all hours of the day and year.

Figure 13 demonstrates how CAISO can use availability-limited resources to meet the peak, but may need resources with a longer duration to meet energy needs in other hours of the day. The black vertical lines reflect a four hour minimum availability threshold. Below the black horizontal line is load that will need to be served with resources with greater than four hours of availability.

[39] See CAISO Track 2 Testimony Chapter 6: Availability Limited Resources: http://www.caiso.com/Documents/Jul10_2018_RAProceedingTrack2Testimon-Chapter6-AvailabilityLimitedResources_ProposalNo5_R17-09-020.pdf

Figure 13: Hourly Load Shape with Four Hour Minimum Availability Threshold



Each year, CAISO conducts its local capacity technical study to determine the minimum amount of local capacity area resources needed to address local area contingencies. In performing the study and setting local capacity requirements, the current process does not consider hourly load and resource analysis. However, in recent transmission planning studies, specifically the Moorpark and Santa Clara studies, CAISO developed and performed detailed hourly load and resource analyses to determine whether there were binding availability limits in the local capacity sub-areas.[40] This allowed CAISO to determine local capacity procurement needs more precisely by evaluating both the capacity and energy needs in those local areas. These studies show that availability-limited resources with a four-hour minimum duration were insufficient in meeting the energy (*i.e.*, total MWhs) required to fully address the contingency events identified in the local capacity criteria.

Local Capacity Technical Studies

Each year, CAISO conducts its Local Capacity Technical Study (LCT Study), to determine the minimum amount of capacity needed in each local capacity area to ensure compliance with the LCT criteria. As part of this study process, CAISO reviews the study criteria, methodology, assumptions, and study results with stakeholders and receives stakeholder input. CAISO's LCT studies look out one and five years forward each year, and ten years forward every other year. The study results for year one determine the local RA requirements as required by ISO Tariff section 40.3. The long-term studies aide local regulatory authorities and LSEs in long-term procurement decisions.

[40] CAISO, Moorpark Sub-Area Local Capacity Alternative Study, August 16, 2017, http://www.caiso.com/Documents/Aug16_2017_MoorparkSub-AreaLocalCapacityRequirementStudy-PuentePowerProject_15-AFC-01.pdf; and Santa Clara Sub-Area Local Capacity Technical Analysis, June 18, 2018, http://www.caiso.com/Documents/2023LocalCapacityTechnicalAnalysisfortheSantaClaraSub-Area.pdf

The current study process determines the amount of capacity in MW, based on a 1-in-10 peak load forecast, required to mitigate local reliability problems. Moving forward, CAISO plans to enhance its study process to include consideration of availability limitations such that CAISO can ensure sufficient energy (MWh) is available in addition to MW of capacity. In future years, CAISO will include hourly load and available resource data within its existing Local Capacity Technical Study reports to guide resource procurement.

After load serving entities procure local capacity resources, CAISO will validate the annual RA showings based on power flow modeling to consider reactive power and locational impacts of the procured resources. CAISO will also validate that the RA resources provided have enough energy to meet the needs for each individual area and sub-area. If provided RA resources do not have enough energy or otherwise failed to meet these needs, CAISO will use the existing process to allow load serving entities to cure any deficiencies. CAISO plans to incorporate the hourly load and available resource data into the one, five, and ten year study reports.

CAISO plans to maintain the existing LCT Study process with certain changes described below to determine availability needs in each local area and sub-area. CAISO will continue to conduct its annual LCT study to determine the capacity requirements (in MW) for each local capacity area and sub-area, but the hourly load and available resource data will provide additional information regarding energy availability needs in each local capacity area.

Additional Inputs for Hourly Load and Available Resource Data

Additional inputs that are included in the current LCT study include:

A. **Projected hourly load data** for each local capacity area and sub-area for each year of analysis. The projected load data should include the impact of behind-the-meter PV to determine the net-load shape. It should exclude the impact of supply-side demand response resources.

B. **Voltage stability or thermal area load limit** for the critical contingency for each local capacity area and sub-area, for each year of analysis. In the determination of the limit, CAISO will assume all resources that have not announced retirement will be available throughout the resource adequacy horizon. Voltage collapse or thermal overloads for contingency events are typically the most limiting condition and often set the local area requirements.

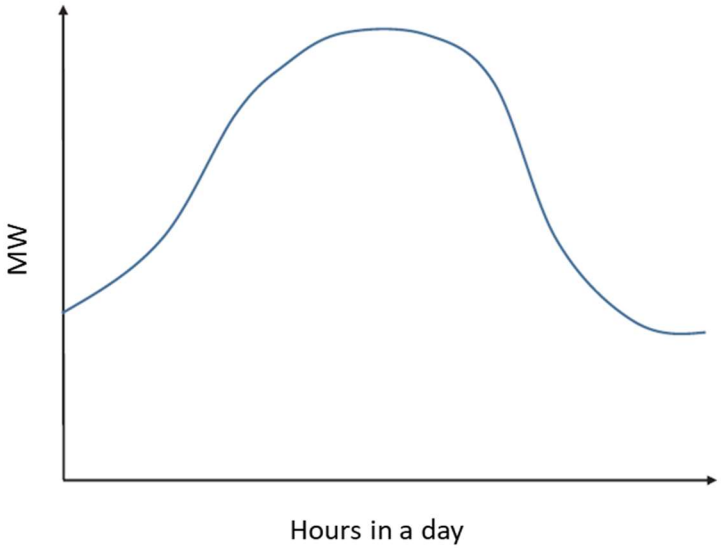
C. **Actual resource output at the time of the area or sub-area net peak** is required to evaluate if a resource is effective in mitigating the reliability needs.

Steps in Providing Hourly Load and Available Resource Data

Using the additional inputs and information available from the current LCT study (such as existing and expected online resources in each local area and sub-area), CAISO will provide hourly load and available resource data for each local capacity area and sub-area. CAISO will perform the following steps as part of the hourly load and available resource data.

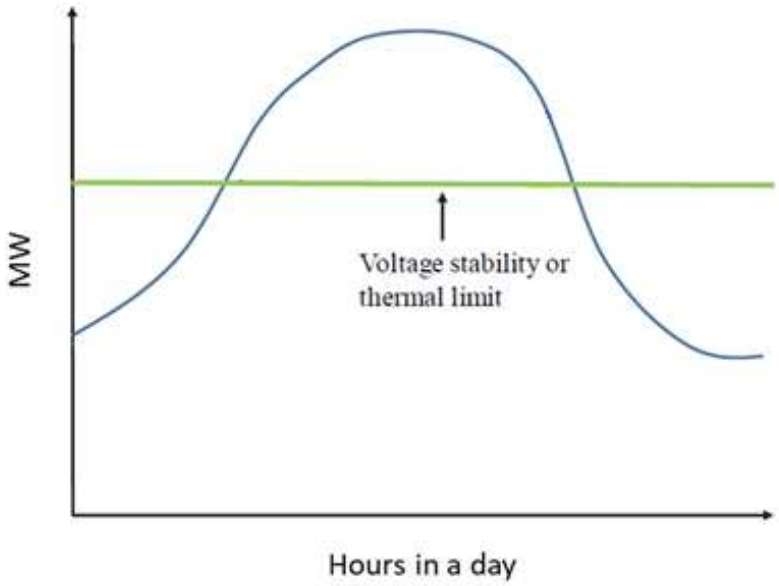
1. **Determine the hourly net load shape for each year of analysis** based on the hourly load forecast and output data from behind the meter solar PV within the local area or sub-area.

Figure 14: Illustrative Hourly Net Load Shape



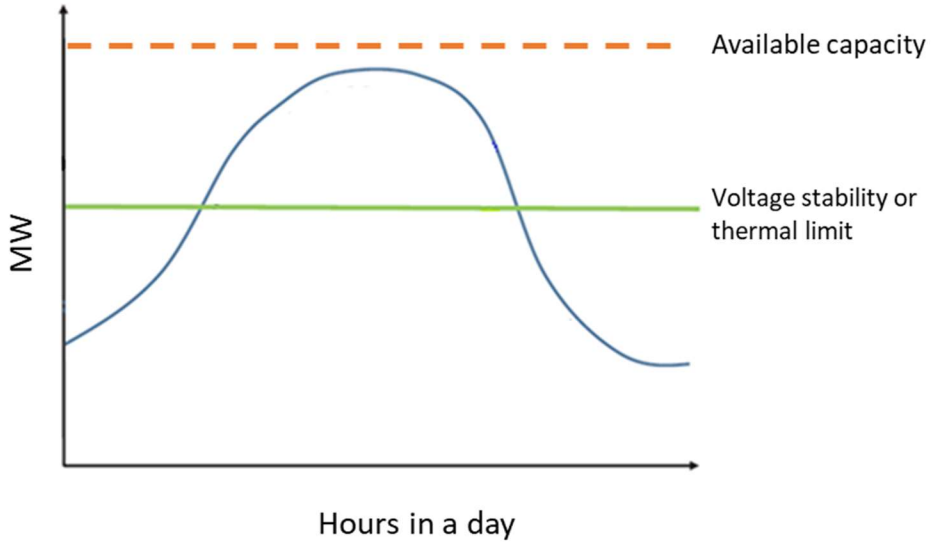
2. **Subtract the voltage stability or thermal area limit (from input analysis) to derive the remaining load that may be served by local capacity area resources.** In Figure 15, this area is bounded by the voltage stability or thermal area load limit (green horizontal line) and the hourly net load. The area below the voltage stability or thermal area load limit represents load that can be served by generation outside the local area. The area above the voltage stability or thermal area load limit represents load that must be served from resources within the local area.

Figure 15: Voltage Stability or Thermal Area Limit



3. **Determine the available MWs of capacity from all resources in the local area** using generation expected to be online during the study period.

Figure 16: Available Capacity in the Local Area



This analysis enhances the RA program by allowing load serving entities to make procurement decisions for the upcoming year based on the quantity of capacity (in MW) *and* energy (in MWhs) that will need to be served by generation located within the local capacity area. Additionally, CAISO can inform longer term procurement and investment decisions by providing greater transparency into CAISO's duration needs multiple years out. Starting this year, CAISO has incorporated this analysis into the Local Capacity Technical Study process to guide resource procurement that is aligned with operational needs.

CAISO will continue to coordinate with stakeholders when setting local RA requirements. To ensure procurement of resources with sufficient availability, CAISO will provide this data when setting local resource adequacy requirements, and will enforce them during the RA showings validation process. Additional detail is provided in Section 5.4.1 regarding actions CAISO may take if the resources procured in a local area do not meet energy needs as identified through the hourly load and resource analysis. These enhancements to the local study process will enable resource procurement that is better aligned with local capacity area needs by including the duration resources must be available to ensure local capacity area reliability. In providing this data, CAISO can ensure that sufficient resources are procured to meet operational needs in all hours of the year.

5.3.2. Meeting Local Capacity Needs with Slow Demand Response

For reliable operation of the grid, CAISO depends on adequate supply from resources in local areas to meet load. Demand response resources can help manage the system in local areas by reducing load when the local area is constrained. However, the characteristics of certain demand response resources lead to potential challenges that impact how CAISO can use them to respond to a contingency. Specifically, "slow" demand response cannot respond to dispatch

instructions provided by CAISO within 20 minutes for CAISO to reposition the system within 30 minutes of the contingency occurring, due to the additional notification time required for the resource to perform after it receives a dispatch instruction from CAISO.

While many demand response resources can quickly deliver energy at a scheduled time, demand response resource operators may require longer lead times to know specifically when to deliver that energy. CAISO's market system issues instructions to each resource to operate at specific operating levels every five minutes. Resource operators must increase or decrease their resource's output to match these five minute instructions. Once online, conventional resources are prepared and ready to follow varying five-minute dispatches from the market. However, some demand response resource operators require longer notification times before they can perform and, therefore, cannot deliver energy following a varying five minute dispatch. To address this need, CAISO introduced block bidding options within the Energy Storage and Distributed Energy Resources Phase 3 (ESDER 3) initiative to provide longer notification times and extended real-time dispatch intervals, as discussed in the following sections.

CAISO and the California Public Utilities Commission (CPUC) have been working to ensure both "fast" and "slow" demand response resources are capable of meeting local reliability requirements.[41] For the purposes of this paper, CAISO defines slow demand response as demand response resources that cannot respond to an ISO dispatch instruction within 20 minutes. After a contingency occurs or when the system enters an N-1 insecure state (loss of a single critical element), CAISO must dispatch resources to return the system to an N-1 secure state within 30 minutes to minimize the risk the next contingency poses on the reliability of the system, accounting for a small amount of time for ISO operators to perform their real-time assessment and react to the contingency condition. After the contingency and real-time assessment, CAISO is left with approximately 20 minutes for resources to provide generation and load drop within the 30 minute timeframe.

Based on the need to reposition the system within 30 minutes, CAISO generally has three options:

1. Post-Contingency Dispatch: By assessing the system, issuing dispatch instructions, and having a response within 20 minutes of a contingency;
2. Pre-Contingency Dispatch: By dispatching resources pre-contingency so as to have sufficient energy (or load reduction) available before the contingency occurs to keep the system in a secure state if a potential contingency occurs;
3. Pre-Contingency and Post-Contingency Dispatch: Using a combination of pre- and post-contingency dispatch.

In 2017, CAISO performed a study to assess the availability requirements of slow-response resources, such as demand response, to count for local resource adequacy.[42] The study found that at current levels of availability limited resources on the system, most existing slow DR

[41] https://www.caiso.com/Documents/BPMChangeManagementAppealsCommitteeDecision-PRR854.pdf
[42] CAISO-CPUC Joint Workshop, Slow Response Local Capacity Resource Assessment: https://www.caiso.com/Documents/Presentation_JointISO_CPUCWorkshopSlowResponseLocalCapacityResourceAssessment_Oct42017.pdf.

resources appear to have the required availability characteristics needed for local RA if dispatched pre-contingency as a last resort, with the exception of minimum run time duration limitations. As discussed in the prior section, CAISO will address duration limitations through the annual Local Capacity Requirements stakeholder process through hourly load and resource analysis. As the resource adequacy landscape transitions to one that relies more heavily on availability limited resources to meet its local RA needs, resources such as DR that count for local RA may be relied on more frequently than they have been historically. This concept is described in further detail in section 5.3.1.

CAISO initiated the Slow DR effort to operationalize slow demand response resources so they can be eligible to provide local resource adequacy capacity and be used by CAISO when needed for local reliability. Slow demand response resources that cannot respond within appropriate timeframes following a system event, due to the need for longer notification times, can still be useful in maintaining system reliability in local areas. In this revised straw proposal, CAISO presents a methodology for allowing slow demand response resources to be economically dispatched through the market as a preventive measure in preparing for a possible contingency using the policy frameworks proposed in the CAISO's ESDER 3 and Contingency Modeling Enhancements (CME) initiatives. ESDER 3 will provide PDRs hourly and 15-minute block bidding options. The CME proposal will introduce a preventive-corrective constraint into the market optimization such that it produces a pre-contingency dispatch that keeps the post-contingency system conditions within safe operating limits.

Under these proposals, the market will economically consider slow PDRs and dispatch them within a timeframe that will help resolve local reliability issues when the preventive-corrective constraint is enforced. The market will use these resources to provide local reliability by dispatching them pre-contingency for energy in the real-time market to prepare for potential post-contingency reliability concerns.

Additionally, this revised straw proposal includes an alternative solution for dispatching slow demand response resources on a pre-contingency basis to be used until, or as an alternative to, the market based solution. While the market based solution leverages policies planned for implementation in the future, it is important CAISO has the ability to utilize these resources for local area reliability concerns in the interim when and where needed. As detailed below, CAISO will develop a tool to dispatch slow DR post-day-ahead (either before the operating day or before the real-time market) as a way to dispatch slow demand response on a pre-contingency basis. CAISO is currently examining both the market based and post-day-ahead solution to determine the best approach for targeting local reliability needs.

Finally, this revised straw proposal introduces qualifiers for resources to qualify for local RA, such that CAISO can ensure these resources can be used to mitigate local area contingencies.

Scope of Policy Examination

CAISO is examining avenues to facilitate the dispatch of slow demand response prior to a contingency in order for these resources to qualify for local RA. CAISO is focusing on market mechanisms to operationalize this pre-contingency dispatch as a long term solution. CAISO is

also considering interim solutions that allow these resources to be used in local area reliability situations, such that CAISO can re-position the system within the appropriate time constraints.

The scope of this effort will include:

- The market-based solution, including block bidding options proposed in ESDER 3 and the preventive-corrective constraint proposed in CME,
- A post-day-ahead solution to dispatch slow DR resources prior to the operating day or before the real-time market,
- Resource qualifications for local RA eligibility.

Market-based Solution

As part of CAISO's ESDER 3 initiative, CAISO introduced real-time bidding options for PDR similar to the real-time bidding options for interties, including hourly block and 15-minute bidding options. CAISO incorporated these bidding options in its ESDER 3 initiative to provide longer notification times and extended real-time dispatch intervals to proxy demand resources (PDRs). CAISO believes that by providing these bidding options, PDR that requires notification time will be able to participate more effectively in the market by leveraging the market timelines and advance dispatch notice these new bidding options provide.

With the hourly block bidding option, the SC submits a day-ahead market bid for the entire hour. In the real-time market, the resource will submit an economic bid and be scheduled during HASP. The resource will be settled at the 15-minute market prices, making the resource a "price taker" for the full hour. The binding real-time hourly block schedule is communicated at 52.5 minutes before the flow of energy.

With the 15-minute bidding option, the SC submits bids into the day-ahead market in hourly increments. In the real-time market, if the 15-minute bid is economic, it will be dispatched and receive a binding schedule at the fifteen-minute market price. The dispatch notification is communicated at 22.5 minutes prior to the flow of energy.

CAISO conducted the CME effort to explore ways the CAISO can more effectively address the need to reposition the system after a contingency within 30 minutes. These enhancements introduced the preventive-corrective market optimization model that considers post-contingency system conditions and co-optimizes both pre-contingency dispatches and post-contingency dispatches to meet reliability needs. To ensure the market has adequate resources available to reposition the system after a contingency, CME introduced a new market product, corrective capacity, so that the market can reserve capacity on resources to be used in the event of a contingency. The preventative-corrective model will reserve corrective capacity on resources with the ramping capability and the ability to respond to mitigate contingencies within the required timeframe. When a contingency occurs, corrective capacity is dispatched for energy to return the system to normal operating levels within 30 minutes.

CAISO could leverage the new real-time bidding options available to PDR to pre-contingency dispatch slow responding DR for energy above their Pmin when it is economic to do so using

the preventative-corrective market optimization model. Using these tools will enable slow responding DR to qualify as local RA capacity and more effectively respond to contingencies in local capacity areas.

Post-Day-Ahead Solution

As an alternative, CAISO is also exploring a post-day-ahead solution that could be used to dispatch slow DR after the day-ahead markets runs, either before the operating day or on the operating day before the real-time market by assessing local area load and available resources in local areas that operators identify potential reliability needs.

Along with the study on slow response local capacity resources and the real-time block bidding options, CAISO introduced the Minimum Online Commitment (MOC) Constraint as a mechanism for pre-contingency dispatching slow DR.[43] MOC constraints are market mechanisms enforced in the day-ahead market used to ensure sufficient unit commitment is available that is effective in addressing specified contingencies. The MOC ensures real-time reliability by committing resources in the day-ahead market to ensure system reliability following a contingency in real-time. Currently, MOC constraints are defined by engineering analysis to identify the minimum generation capacity requirements within local areas. MOCs then commit resources to their Pmin to meet these requirements.

CAISO believes the MOC, as it currently exists, is insufficient to operationalize slow DR for two reasons. First, the MOC would commit DR resources to their Pmin, which is often zero for DR resources. Once committed, the DR resource must submit bids into the real-time market, and they may be dispatched by the market above their Pmin without the notification time they require. Second, there is currently no constraint in the real-time market to enforce the pre-contingency dispatch of slow DR. While the MOC on its own cannot operationalize slow DR for local needs, its logic can still be useful in identifying when slow DR is needed. Therefore, CAISO proposes a tool that can commit resources above their Pmin and maintain their schedule from day-ahead through real-time.

As a mechanism to dispatch slow DR for local needs, CAISO proposes to use the MOCs to define the amount of slow DR that is needed. CAISO plans to maintain existing day-ahead market processes and dispatch slow DR after the completion of these day-ahead market processes if a need is identified through the MOC. CAISO will define MOCs in local areas with slow demand response. The MOC requirement will determine when to commit long start units that cannot be committed in real-time. The MOC requirement will be determined as follows:

MOC Requirement = Local Area Load – Import Capability – Available Generation, where:

- MOC Requirement = A MW value of slow DR the needs to be dispatched prior to a contingency occurring as a preventive measure
- Local Area Load = Day-ahead load forecast of local capacity area load

[43] CAISO-CPUC Joint Workshop, Slow Response Local Capacity Resource Assessment: https://www.caiso.com/Documents/Presentation_JointISO_CPUCWorkshopSlowResponseLocalCapacityResourceAssessment_Oct42017.pdf.

- Import Capability = Import capability into the local capacity area
- Available Generation = MWs bid into the day-ahead market from generation within the local capacity area

When the MOC requirement is greater than zero, CAISO will first meet the MOC requirement by committing long start resources. If CAISO cannot meet the entire MOC requirement with available long start resources in the local area, CAISO will dispatch slow DR to meet the MOC insufficiency. CAISO will dispatch resources for energy, rather than only committing them to Pmin, based on their bids into the day-ahead market and their ability to resolve the local area need. CAISO is also exploring the potential for performing this assessment on the operating day closer to hours of reliability need to better reflect real-time conditions, including local area load and resource availability.

Because CAISO will dispatch slow DR before a contingency occurs, as a preventive measure, the dispatches provided to slow DR must be binding through real-time to preserve the pre-contingency dispatch. This allows slow DR resources to know prior to the operating day the hours and the amount they are required to reduce load. These dispatches will not be cancelled if no contingencies occur in real-time, because CAISO does not have the ability to predict for certain whether or not a contingency will occur. As such, slow responding resources must be positioned ahead of time (i.e., dispatched on a pre-contingency basis) to prepare the system for a potential contingency.

Qualifications for Local RA Eligibility

Operationalizing Slow DR Resources through Block Bidding Options

As CAISO assesses the most appropriate tool to dispatch slow DR pre-contingency, CAISO may continue to count resources that require day-ahead notice as local RA if CAISO provides dispatches to slow demand response resources prior to the beginning of the operating day. However, CAISO believes it is important to transition such that only slow demand response resources that are dispatchable in real-time through the hourly or fifteen-minute block bidding options will be eligible for local RA. Resources that require a day-ahead notification of a binding dispatch should not be eligible for local RA once CAISO implements the ESDER 3 bidding options and has a tool in place to dispatch resources pre-contingency during the operating day. Under the existing market timelines, CAISO provides unit commitments (*i.e.*, starts) and schedules in the day-ahead but generally does not dispatch units in the day-ahead. Additionally, extending pre-contingency dispatches beyond the existing real-time market time horizons limits CAISO's the ability to adjust resource output in response to changes between day-ahead and real-time system conditions.

The block bidding options allow the market to access the resource in the day-ahead and real-time market, while also giving the resource extended notification time. Additionally, the block bidding options ensure that the resource receives a binding dispatch instruction in the fifteen minute market, and will not be re-dispatched in the five minute market. Because the market adjusts a resource's scheduled output for each market run, slow DR must use the hourly or 15-minute block bidding option to ensure it is not re-dispatched in the five-minute market intervals. Therefore, once the slow DR receives a hourly block or fifteen-minute energy award, the award

is binding, the resource will not be re-dispatched in RTD, and it must perform according to its RTUC energy award in real-time.

Slow Reliability Demand Response Resources

As discussed in previous comments submitted to the CPUC's RA proceeding, slow Reliability Demand Response Resources (RDRR) are not able to be dispatched on a pre-contingency basis due to its unique dispatch limitations, and as such, should not be eligible to count as local RA.[44] While PDRs participate in CAISO market and offer their services when they are economic, RDRR resources are not eligible for dispatch in real-time unless CAISO declares a Warning or Emergency. Upon this declaration, CAISO operator may choose to activate the software flag that allows these resources to be dispatched.[45]

Because RDRR is a reliability resource and only dispatched after CAISO calls a Warning or Emergency, CAISO must exclude slow responding RDRR (*i.e.*, those resources that cannot respond to contingencies within 20 minutes) from qualifying for local RA. CAISO cannot declare Warnings or Emergencies pre-contingency in anticipation of an emergency to access RDRR. Therefore, CAISO cannot depend on the pre-contingency dispatch of slow RDRR to address local contingencies.

While slow RDRR cannot provide local RA, fast responding RDRR, or RDRR that can respond within 20 minutes post-contingency, is eligible to count towards local area capacity because it can receive a dispatch and preform in the appropriate time after a contingency occurs, given CAISO declares a warning or emergency in response to the contingency.

Resource Availability

In addition to the more concretely defined requirements outlined above, CAISO urges the Commission and other stakeholders to consider the impacts on resource availability given changing resource adequacy landscape. Eligibility for local RA is subject to requirements determined by CAISO and the CPUC for availability-limited resources. CAISO is refining local capacity assessments to include an assessment of the impact of availability-limited resources on local capacity needs within the Local Capacity Requirements stakeholder process.[46] As identified in section 5.3.1, ISO planning studies have indicated that, at current levels of availability-limited resources, slow demand response resources possess adequate availability such that they can meet our local capacity needs, given the ability to utilize them within the defined time horizons. However, given the changing landscape of the resource adequacy fleet, it is reasonable to assume slow DR will be dispatched more frequently than it has been dispatched historically for two reasons. First, because slow DR must be used to pre-position the system, not just curtail after a contingency occurs, CAISO must make certain assumptions regarding real-time conditions that may or may not materialize. Second, local capacity requirements are set based on the minimum quantity of local capacity necessary to meet the

[44] CAISO Comments on Resource Adequacy Proposals, September 28, 2017. Page 4: http://www.caiso.com/Documents/Mar7_2018_Comments-ResourceAdequacyProposals_R17-09-020.pdf
45 CAISO BPM for Market Operations Section 7.1
[46] Local Capacity Requirements Stakeholder Initiative Webpage: http://www.caiso.com/informed/Pages/StakeholderProcesses/LocalCapacityRequirementsProcess.aspx

LCR criteria. When slow DR is relied upon as a local capacity resource, it may need to be used more frequently, especially if other local resources go on outage or local resources without availability limitations are displaced by new resources and retire. If these resources are utilized such that their availability limitations are reached, CAISO may be required to take alternative actions to ensure system reliability in local areas.

5.4. Backstop Capacity Procurement Provisions

In this initiative CAISO is: (1) proposing new authority to make CPM designations, (2) flagging potential changes to the RMR performance mechanism if changes to RAAIM are considered, and (3) proposing a new tool to encourage load to procure resources up to full UCAP requirements and dis-incentivizing entities from leaning on other LSEs.

CAISO proposes new CPM authority to procure resources in the following three scenarios: (1) system UCAP deficiencies through the RA process, (2) inability to serve load in the portfolio deficiency test, and (3) an identified need to procure local RA after an area fails a local portfolio deficiency test. These three needs will be extensions to the existing CPM authority and are closely aligned with proposals outlined in this paper.

This proposal includes a new tool called the UCAP deficiency tool, which incentivizes entities to show at or above their UCAP requirements and will dis-incentivize leaning between entities during the RA showings. This tool will penalize entities that show UCAP below requirements and allocate these payments to entities that show above requirements.

5.4.1. Capacity Procurement Mechanism Modifications

The capacity procurement mechanism is the tool that CAISO uses to backstop the RA program. Specifically, when there is insufficient capacity shown in the RA process to reliably operate the grid, CAISO may make CPM designations to procure resources that have not been shown in the RA process so that enough capacity is available to reliably operate the system. RA is shown on a year-ahead and a month-ahead basis and CPM can be used to backstop in either timeframe or in a more granular timeframe. Resource owners with additional capacity can participate in the competitive solicitation process (CSP) for their bids to be considered when and if CAISO makes a CPM designation. Generally, in any timeframe CAISO makes a designation, all options for procurement are reviewed and the least cost option that meets the reliability need is selected. Additionally, when CAISO makes CPM designations, information about the designation and supporting documentation outlining why CAISO needs the resource is provided publicly.

Authority to make CPM designations for capacity currently includes the following designation types:

1. System annual/monthly deficiency – Addresses insufficient system RA capacity in year-ahead or month-ahead RA showings;
2. Local annual/monthly deficiency – Addresses insufficient local RA capacity in year-ahead or month-ahead RA showings for one specific entity making showings;

3. Local collective deficiency – Addresses insufficient local RA capacity in year-ahead RA showings to meet the reliability needs for one specific local area;
4. Cumulative flexible annual/monthly deficiency – Addresses insufficient flexible RA capacity in the year-ahead or month-ahead showings for system needs;
5. A "Significant Event" occurs on the grid;
6. CAISO "Exceptional Dispatches" non-RA capacity; or
7. Capacity is at risk of retirement that is needed for reliability in a future year.[47]

CAISO proposes modifications to its existing CPM authority to procure additional capacity in the following three scenarios: (1) system UCAP deficiencies through the RA process, (2) inability to serve load in the portfolio analysis test, and (3) an identified need to procure local RA after an area fails a local portfolio deficiency test. In each case, CAISO would procure to retain resources that are needed to reliably operate the system.

CAISO will seek additional CPM authority to procure capacity based on system UCAP deficiencies. CAISO will not make these designations merely because LSEs are deficient, but instead will only make such designations when there are overall system deficiencies based on RA showings. To make these designations, CAISO will compare all UCAP shown in RA showings to the total requirements for UCAP, and may make additional designations based on that difference. This authority will work similar to the CAISO's existing authority to procure for system deficiencies, which are based on total shown NQC values. This new authority will be based on shown UCAP and will apply in the year-ahead and month-ahead timeframe. Similar to other existing authority, CAISO will alert entities with shortfalls and provide these entities a chance to cure any shortfall. CAISO backstop procurement only will occur after this cure period closes.

CAISO is not seeking authority to procure additional backstop capacity if any individual entity shows less capacity than their requirement. CAISO procurement based on individual LSE shortfalls could result in CAISO procuring more capacity than was necessary for reliability if other LSEs over-procure. By procuring only for system UCAP shortfalls, CAISO will ensure that it receives enough UCAP to reliably operate the grid but will not procure excessive amounts. This approach is consistent with other categories of CPM procurement, where CAISO only procures if there is a cumulative deficiency. However, procurement in this manner could result in entities '*leaning*' on other entities that show capacity in excess of their individual UCAP requirement. Because of these incentives, CAISO also proposes to implement a UCAP incentive mechanism, discussed further below.

[47] In the RMR-CPM enhancements initiative, CAISO proposed to remove the capability to use CPM for capacity at risk of retirement, and to effectively transfer that capability to RMR authority. Currently, FERC has not responded with a decision on this RMR-CPM enhancements initiative. http://www.caiso.com/Documents/Apr22-2019-TariffAmendment-RMR-CPMEnhancements-ER19-1641.pdf.

Section 5.1.3, above, provides details about the portfolio analysis CAISO will conduct to determine if the resources procured through the RA process will be sufficient to meet the energy needs for an entire month, in addition to the peak needs during that period. If CAISO determines it is unable to meet energy needs while performing this analysis, CAISO can designate additional capacity using the CPM tool, to pass the analysis. CAISO will use this authority at the same time it undertakes month-ahead designations for other CPM backstop designations. If CAISO identifies an issue through the portfolio analysis, CAISO will continue to allow a period for entities to cure the deficiency, before CAISO makes any backstop designation. CAISO also proposes additional CPM authority to procure capacity when it identifies a need identified from the portfolio analysis.

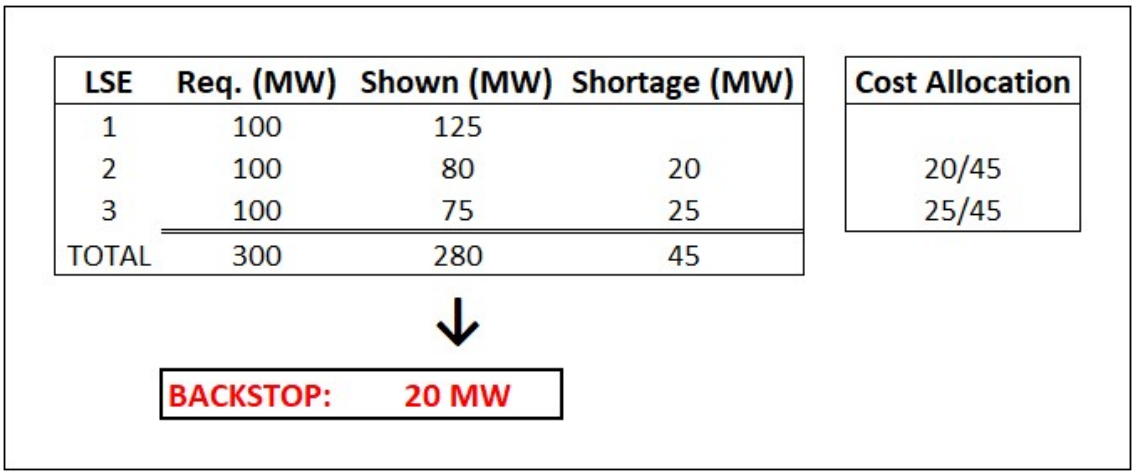
Finally, CAISO proposes additional backstop authority if there is a local need identified through the CAISO's local capacity technical study in the year-ahead timeframe. This authority will be similar to the authority CAISO is proposing for the portfolio analysis. It will evaluate if procured local resources can meet energy needs in the upcoming year. If CAISO identifies an energy shortfall, CAISO will provide a cure period for entities to clear any deficiencies before exercising its backstop procurement authority.

EXAMPLE: UCAP Deficiency

CAISO provides the following brief example to explain a scenario where CAISO could make a potential CPM designation for deficient UCAP procured in the RA process, after the cure period.

Assume in this example that there are three load serving entities, each with a requirement to show 100 MW of UCAP. The first entity shows 125 MW, or 25 MW above the requirement, while the second and third entities show 80 MW and 75 MW respectively, or 20 MW and 25 MW below requirements, respectively. In aggregate, at the system level the RA process procures 280 MW and does not meet the 300 MW requirement for UCAP. This indicates a 20 MW shortfall at the system level, for which CAISO could undertake backstop procurement. If CAISO procures backstop capacity, it will allocate costs for that backstop to the entities that were deficient, in this case entities 2 and 3, per the LSE's share of the overall deficiency. In this case, entity 2 will be assigned 44% (20/45) of the costs and entity 3 will be assigned 56% (25/45) of the costs to procure the additional capacity for this designation. CAISO provides additional discussion, below, about how LSE 1's showing can result in incentive payments for its 25 MW of excess capacity.

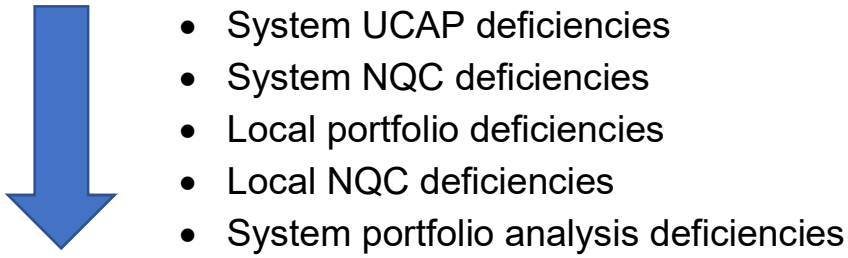
Figure 17: UCAP Deficiency CPM Backstop



CPM Designation Order

Today if CAISO makes multiple CPM designations for any single planning horizon, it first allocates costs and credits to individual entities that are deficient, then to all applicable LSEs that are collectively deficient. CAISO intends to maintain the similar paradigm with the new authority. Going forward, CAISO will first allocate the costs to system UCAP deficiencies, then to traditional NQC system deficiencies, then to local portfolio deficiencies, then to local NQC deficiencies, and finally to system portfolio deficiencies. This order is illustrated in Figure 18 below. As with current practice, if CAISO were to consider multiple designations in one timeframe, CAISO would make designations that meet all of the necessary reliability needs at the least cost. This Figure may be used to determine cost and credit allocation, if CAISO makes multiple CPM designations using different CPM authority.

Figure 18: CPM Designation Order



5.4.2. Reliability Must-Run Modifications

This initiative is considering whether to make changes to or eliminate RAAIM. RAAIM is the primary tool used to ensure that RMR resources are bidding into the market, but any changes to RAAIM would not necessarily preclude using the RAAIM tool as the performance mechanism for RMR resources in the future. The RMR-CPM enhancements initiative, recently filed by CAISO

at FERC, proposed that the RAAIM tool be used for the performance mechanism for RMR resources. CAISO is mindful that this measure was discussed at length in the RMR-CPM enhancements initiative.

5.4.3. UCAP Deficiency Tool

As noted above, CAISO is not planning new CPM authority to make designation when a specific entity shows less UCAP than individual requirements as long as the system as a whole is adequate. However, CAISO is planning to develop a new tool, called the UCAP deficiency tool that will impose penalties on entities with deficient UCAP showings. This tool would be designed to prevent entities from leaning and to incentivize entities to show above individual UCAP requirements.

The concept of the UCAP deficiency tool is to apply a penalty to resources that show less than their UCAP requirement, and distribute those collected penalties to resources showing above their requirements. Without this tool, a situation could exist where one or more entities could choose to not procure their full UCAP requirement because they suspect that showings at the system level system will be sufficient to meet aggregate requirements or that the ISO will not make a backstop designation and no additional costs will be allocated. This concept is known as *leaning*.

Ideally, these proposed rules for the UCAP deficiency tool would result in a streamlined and straightforward mechanism, where any entity that shows less than their requirements would be charged a penalty price for the amount of capacity the entity is short. This proposal includes specifications that the penalty price will be set at the CPM competitive solicitation soft offer cap, which is currently $6.31/kW-year. All revenue collected will be distributed to entities that show above their UCAP, in proportion to the total amount shown above requirements for all entities.

The examples below include several scenarios that step through the details for how the UCAP deficiency tool could work in practice.

EXAMPLES: UCAP Deficiency Tool, with no CAISO backstop

This set of examples presents three scenarios where CAISO would use the UCAP deficiency tool, but not make any CPM designation. The first scenario shows procurement above the UCAP requirements and therefore no CPM designation. In this example LSEs 1 and entity 2 show 10 MW and 15 MW above their 100 MW month-ahead requirements, respectively, and entity 3 shows 10 MW below its 100 MW requirement. Because there is no system shortfall for capacity, CAISO will not make a CPM designation, but because the showing from LSE 3 is below the requirement, the UCAP deficiency will trigger, and LSE 3 is assessed a charge for 10 MW * $6.31/kW-month, or $63,100. This charge is then allocated to LSE 1 and LSE 2, where entity 1 receives 10/25 = 40% or $25,240 and entity 2 receives 15/25 = 60% or $37,860.

Figure 19: UCAP Deficiency Tool, no Backstop

LSE	Req. (MW)	Shown (MW)	Shortage (MW)	Penalty	Payment
1	100	110			$25,240
2	100	115			$37,860
3	100	90	10	$63,100	
TOTAL	300	315	10	$63,100	$63,100

The second scenario shows a system shortfall, but CAISO does not issue a CPM designation. In this example LSE 1 and LSE 2 show UCAP below their 100 MW requirements, at 10 MW and 15 MW respectively, and LSE 3 shows 5 MW above their 100 MW requirement. In this scenario the CAISO could potentially procure backstop capacity to cure the 20 MW system UCAP deficiency, but does not make such a designation. In this case, the two LSEs that are short are assessed a charge for the capacity matching the UCAP deficiency. Because LSE 1 is 10 MW short it is assessed a penalty of $63,100 and LSE 2 is assessed a penalty of $94,650. Because LSE 3 is the only entity showing above the requirements, all of the collected charges are allocated back to that LSE, in this case the total amount allocated is $157,750.

Figure 20: UCAP Deficiency Tool, with Aggregate Shortfall

LSE	Req. (MW)	Shown (MW)	Shortage (MW)	Penalty	Payment
1	100	90	10	$63,100	
2	100	85	15	$94,650	
3	100	105			$157,750
TOTAL	300	280	25	$157,750	$157,750

In the third example LSE 2 and LSE 3 both show below their 100 MW month-ahead requirements, and LSE 1 shows exactly at its 100 MW requirement. In this scenario the aggregate amount of UCAP shown is below the aggregate amount of UCAP required for the UCAP requirements. In this case, CAISO could potentially procure backstop capacity to cure the system UCAP deficiency. Irrespective of any CPM designation, CAISO will not charge any market participants for the shortfall, as there is no entity to allocate those charges back to.

Figure 21: UCAP Deficiency Tool, no Award Recipients

LSE	Req. (MW)	Shown (MW)	Shortage (MW)	Penalty	Payment
1	100	100			
2	100	80	20		
3	100	95	5		
TOTAL	300	275	25	$0	$0

EXAMPLE: UCAP Deficiency Tool with CAISO backstop

In this example LSE 1 and LSE 2 both show below their 100 MW month-ahead requirements, and LSE 3 shows above the 100 MW requirement. In this scenario LSE 1 is again short 10 MW and LSE 2 is short 15 MW. Additionally, because LSE 3 only procures 5 MW above its requirement, there is a shortage between the aggregate amount of UCAP shown and the aggregate requirement. This shortfall triggers a CAISO CPM designation, for the 20 MW deficiency. CAISO then allocates 8 MW of the CPM procurement to LSE 1 and 12 MW to LSE 2. The shortfall persists even with the adjustment for the CPM allocation, and the shortfall equals 5 MW or exactly the capacity that that LSE 1 showed above its requirement. Therefore, the remaining shortfall, inclusive of the CPM allocation, is 2 MW for LSEs 1 and 3 MW for LSE 2, which is then subject to the UCAP deficiency tool penalty. Penalties assessed are for $12,620 for LSE 1 and $18,930 for LSE 2. The $31,550 of the collected revenues are then credited to LSE 3.

Figure 22: UCAP Deficiency Tool, with Backstop

LSE	Req. (MW)	Shown (MW)	Shortage (MW)	CPM Alloc (MW)	Adj Short (MW)	Penalty	Payment
1	100	90	10	8	2	$12,620	
2	100	85	15	12	3	$18,930	
3	100	105					$31,550
TOTAL	300	280	25	20	5	$31,550	$31,550

↓

BACKSTOP: 20 MW

6. Implementation Plan

CAISO is currently targeting a 2021 implementation for this initiative, meaning application to the 2022 RA compliance year. CAISO understands this is challenging and comprehensive initiative. CAISO seeks stakeholder feedback about how these policies must roll out and an appropriate and feasible implementation schedule once the policy details are further understood and developed.

7. EIM Governing Body Role

For this initiative, CAISO plans to seek approval from CAISO Board only. This initiative falls outside the scope of the EIM Governing Body's advisory role because the initiative does not propose changes to either real-time market rules or rules that govern all CAISO markets. This initiative is focused on CAISO RA planning, procurement, and performance obligations. This process applies only to LSEs serving load in CAISO BAA and the resources procured to serve that load, and does not apply to LSEs outside CAISO balancing authority area. CAISO did not receive any initial feedback from stakeholders regarding the initial proposed EIM classification for this initiative. CAISO continues to seek stakeholder feedback on this proposed decisional classification for the initiative.

8. Next Steps

CAISO will discuss this revised straw proposal with stakeholders during a stakeholder meeting on July 7-8, 2019. Stakeholders are asked to submit written comments by July 24, 2019 to initiativecomments@caiso.com. A comment template will be posted on the CAISO's initiative webpage here: http://www.caiso.com/informed/Pages/StakeholderProcesses/ResourceAdequacyEnhancements.aspx

9. Appendix

9.1. Review of Counting Rules in other ISOs and RTOs

NYISO

NYISO is responsible for managing its capacity market, which is known as the Installed Capacity Market. Each year, the New York State Reliability Council determines the annual Installed Reserve Margin necessary for the NYISO to sufficiently fulfil its Resource Adequacy criteria. The NYISO then determines the Minimum Installed Capacity Requirement (ICAP) for each LSE to meet their system and local needs which is the sum of the forecasted control area peak load in addition to the reserve margin plus 1. This ICAP value is adjusted for historic availability by multiplying the Minimum Installed Capacity Requirement times one minus a rolling monthly average Effective Forced Outage Rate of Demand (EFORd)[48] value which translates to the Minimum Unforced Capacity Requirement (UCAP) for each capacity zone.

PJM

The centralized capacity market PJM relies on is called the Reliability Pricing Model (RPM). The process for estimating the Installed Capacity requirement and the use of an auction to procure capacity is similar to NYISO's ICAP market. First a Loss of Load Expectation (LOLE) study is used to determine the Installed Reserve Margin (IRM) which sets the ICAP requirement expressed as a reserve percent (*e.g.*, 15%) based on historic peak load. The EFORd ratio is then applied to the ICAP obligation to establish the Forecast Pool Requirement (FRP) measured as an UCAP value (*i.e.*, FRP = (1 + IRM)*(1 – Pool Wide Average EFORd). The FRP multiplied by the forecasted peak load for the upcoming year is used as the target in the capacity auction and is PJM's UCAP obligation known as the Reliability Requirement. Lastly, portions of the UCAP requirement are allocated to several zones served by a single utility. PJM procures resources on behalf of the LSEs unless LSEs opt out of the RPM capacity market to instead self-supply using the Fixed Resource Requirement Alternative.

PJM also has a non-performance assessment. The non-performance assessment evaluates performance of resources during emergency conditions. Resources that fail to perform are subject to non-performance charge. Resources that over-perform may be eligible for over-performance credit. The resource's expected performance is compared to actual performance for each real-time settlement interval for which an Emergency Action has been declared by PJM. "Emergency Actions" mean any emergency action for locational or system-wide capacity shortages that either utilizes pre-emergency mandatory load management reductions or other emergency capacity, or initiates a more severe action. Performance is assessed for Emergency Actions.

[48] EFORd is a measure of the probability the resource will be on a forced outage and unable to serve load if needed.

MISO

MISO has a voluntary incremental central capacity market known as a Planning Resource Auction (PRA). It is the responsibility of LSEs to determine their forecasted coincident peak which MISO uses to establish the overall system Planning Reserve Margin (PRM). Each LSE is provided with a minimum ICAP responsibility and is given the choice to meet their PRM by participating in the PRA, or using bilateral contracts, similar to CAISO, which constitutes the majority of MISO's forward capacity procurement. However, there are several competitive retail zones within MISO's jurisdiction, accounting for roughly 10% of system load, that operate using the PRA process exclusively.

ISO-NE

ISO-NE uses a Forward Capacity Market which is a centralized market run every year to procure resources three years in advance for system and zonal needs. The Installed Capacity Requirement (ICR) is set based on a loss of load study accounting for the expected load forecasts and the projected installed resources necessary to meet the reliability standards. The ICR is converted to a Net Installed Capacity Requirement (NICR) which subtracts the Quebec Control Interconnection Credit. Unique to the other capacity markets, ISO-NE uses a purely financial obligation model where New England's system operator procures enough capacity and settles payments while it is LSEs that pay for their allocated share of resource needs. ISO-NE also does not consider forced outage rates, unlike the other centralized markets, when calculating a resource's qualifying capacity. Generators instead are incentivized through the use of performance payments to recognize the outages they anticipate and to only offer an ICAP quantity that they are likely to perform. The Pay-for-Performance (PFP) tool is a monthly capacity performance payment (credit or charge) based on system conditions and resource performance during scarcity condition. A scarcity condition is defined as any five-minute interval when the system cannot meet its reserve requirement. The performance payment is an exchange between suppliers (*i.e.*, money collected from those who underperform is used to pay those that over perform), similar to the CAISO's RAAIM.

Table 10: Survey of methodologies and factors determining capacity contribution for thermal, solar, wind, and hydro resources

Resource type	Attributes	NYISO	PJM	MISO	ISO-NE
Existing resources	**Capability verification test**	Capability period: summer (June 1 - Sept 15) and winter (November - April 15)	Seasonally: Summer (June - August) and winter (December - February)	Annual, 1 year prior to deliverability year	Seasonally: summer (June - September) and winter (October - May)
New or returning resources	**Capability**	DMNC is seasonal	ICAP is a summer net dependable capacity	Total Interconnection ICAP is seasonal	Seasonal claimed capacity
	Forced outage	Class average	Blend of class average and outage data	Class average	NA

Resource type	Attributes	NYISO	PJM	MISO	ISO-NE
Thermal	**Equation**	**UCAP = (DMNC) * (1 - AEFORd); UCAP = (DMNC) * (1 - AOF)**	**UCAP = (ICAP) * (1 - EFORd)**	**UCAP = (Total Interconnection ICAP) * (1 - XEFORd)**	Summer and winter Qualified Capacity
	Summary	Based on 5 year average of DMNC test data which is a generators proven ability to generate power. AEFORd factor is used if full GADS data is provided, otherwise an Average Outage Factor (AOF) from GADS average production data is used	Summer net dependable capacity	Total Interconnection ICAP is equal to the lesser of its GVTC or its Total Capacity Tested	Seasonal claimed capacity (SCC) calculated using the median value of five years of summer and winter data
Solar	**Equation**	**UCAP = (Nameplate Capacity) * (Production Factor)**	**UCAP = ICAP**	**UCAP = (Total Interconnection ICAP) * (1 - XEFORd)**	
	Summary	Uses a derating factor that averages one year of historical production during peak hours 14:00 through 18:00 in summer (June, July, August) and 16:00 through 20:00 in winter (December, January, February) of the previous season (winter, summer)	The capacity rating of three years of historical operating data during hours 13:00 through 18:00 for months June, July and August or class average capacity factor	3 year historical average output during hours 15:00 through 17:00 EST in summer (June, July, and August) Note: New or returning PV sources need 30 consecutive days of historical data during summer months for hours 15:00 through 17:00 EST	Five year median net output from 14:00 through 18:00 for summer months June - September and 18:00 through 19:00 during the winter months October - May
Wind	**Equation**	**UCAP = (Production Factor) * (Nameplate Capacity)**	**UCAP = ICAP**	**UCAP = (Total Interconnection ICAP) * (Wind Capacity Credit)**	

Resource type	Attributes	NYISO	PJM	MISO	ISO-NE
	Summary	Uses a derating factor that averages one year of historical production during peak hours 14:00-18:00 in summer (June, July, August) and 16:00-20:00 in winter (December, January, February) of the previous season (winter, summer)	The capacity rating of three years of historical operating data during hours 13:00 through 18:00 for months June, July and August or class average capacity factor	Historical wind availability is used to calculate system-wide ELCC value across all CPNodes with an 80% confidence level. This value determines a Wind Capacity Credit for each wind farm based on a maximum capacity at the highest 8 coincident peaks during summer. Ten years of averaged data is used and all hours are considered.	Five year median net output from 14:00 through 18:00 for summer months June - September and 18:00 through 19:00 during the winter months October - May
Hydro	**Equation**	**UCAP = (Production Factor) * (Nameplate Capacity)**	**UCAP = ICAP**	**UCAP = (Total Interconnection ICAP) * (1 - XEFORd)**	
	Summary	Run-of-River uses a derating factor based on a rolling average of the hourly net energy during the 20 highest load hours for the previous 5 summer and winter capability periods	Hydro summer net capability is determined using tests taken annually during summer period (June-August) based on expected head and streamflow under summer conditions	3 to 15 year historical median hourly integrated net output during hours 15:00 through 17:00 EST in summer (June, July, and August)	Five year median net output from 14:00 through 18:00 for summer months June - September and 18:00 through 19:00 during the winter months October - May

9.2. Hybrid Resources

CAISO provides this section of the appendix for hybrid resources to identify important considerations and issues that resource developers, regulators, and CAISO itself must consider carefully. Hybrid resources refers to a combination of two resource types under one generating facility, co-located behind a single point of interconnection (POI). CAISO has observed that combined hybrid resource configurations submitting interconnection requests or modifying existing facilities to this configuration are growing in number. Due to the number of interconnection requests currently in the queue and strong interest expressed by various developers and stakeholders, CAISO anticipates that hybrid resources will grow in installed capacity in future years. In 2016, CAISO developed a Technical Bulletin for the Implementation of Hybrid Energy Storage Generating Facilities that is available for review: http://www.caiso.com/Documents/TechnicalBulletin-ImplementationofHybridEnergyStorageGeneratingFacilities.pdf

Hybrid resources raise new operational and forecasting challenges that CAISO plans to address prior to the wide scale adoption of these resource configurations are operational on CAISO's system. CAISO believes that Resource Adequacy (RA) counting rules for hybrid resources are an important issue that will likely be a primary driver of future decisions by resource developers.

9.2.1. Operations and Forecasting Considerations

Combining renewable and storage resources as a single hybrid resource present significant issues and challenges that CAISO has outlined in this section. CAISO believes that grid operators, regulators, market designers, and resource developers should work together to ensure they carefully consider the primary issues related to operations and forecasting. The areas of primary concern for CAISO relate to (1) the operation and optimization of hybrid resources under separate resource IDs versus a single resource ID, and (2) forecasting concerns associated with hybrid resources under single resource IDs.

Operation and optimization of hybrid resources under a single Resource ID

There are challenges to determining how to optimize multiple resources combined as under a single resource ID. Configuring a combined hybrid resource with two separate resource IDs allows CAISO to forecast the wind or solar resource component, while also optimally dispatching the separate storage resource to the benefit of overall system reliability. In contrast, a combined hybrid resource under a single resource ID creates an operational and reliability risk and CAISO cannot ensure the same optimization and system benefits.

Current market participation and resource adequacy rules do not consider how market participants or CAISO would actually operate and optimize hybrid resources in CAISO market. For resource owners to participate in CAISO markets under this approach, the Scheduling Coordinator (resource owner) would be the entity tasked with optimizing the utilization of the resource. The variable energy resource output forecasting and storage resource state of charge would be unknown to CAISO and the optimization of the resource would need to be accomplished through the SC's bidding strategy for the resource.

CAISO could also consider developing new resource models to attempt to address this issue of operations and optimization of hybrid resources under single resource IDs. The addition of new market model capabilities to address these issues would present a large-scale project that would require stakeholder input and consideration. This potential solution is not currently included in CAISO's future market design development plans.

Forecasting issues related to hybrid resources under a single Resource ID

CAISO believes there are potential forecasting related reliability concerns related to hybrid resources. Combining storage and renewable resources under a single resource ID will have a significant effect on the CAISO's ability to accurately forecast for the wind and solar outputs for such hybrid resources. CAISO currently provides forecasts for most wind and solar resources on its system. Combining storage with wind or solar resources as a single CAISO resource will degrade the CAISO's ability to accurately forecast for the output of the combined resource. This is because the charging and discharging cycles of the storage component would not be

distinguishable from the output of the underlying renewable resource. Due to this single resource ID related issue, it is currently infeasible for CAISO to generate a reliable forecast for a single resource ID combined hybrid resource. As a result, CAISO believes the potential for increased forecast error would degrade overall system reliability as opposed to improving it.

CAISO may be able to develop alternative concepts to address this concern through the addition of new telemetry requirements that may provide CAISO with accurate and transparent information into the components of hybrid resources. This additional data may be useful in developing new forecasting approaches for these hybrid resources. CAISO notes that the creation of new telemetry provisions and development of enhanced forecasting capabilities is also a large-scale project that would require stakeholder input and consideration.

9.2.2. Resource Adequacy Capacity Valuation for Hybrid Resources

CAISO believes that resolving hybrid resource RA capacity counting rules is a high priority issue for a number of reasons. CAISO is concerned with ensuring that CPUC RA counting rules for hybrid resources provide accurate capacity valuations for resource adequacy purposes. Additionally, the counting rules for these resources are important to determine because it will likely drive decisions by resource owners related to combined hybrid resources under a single resource ID or multiple resource IDs. This is vital because these decisions by resource owners will affect CAISO operations and forecasting, as noted above.

CAISO input in CPUC RA proceeding

For CAISO's latest input into the CPUC RA proceeding regarding hybrid resource counting, see CAISO comments in Rulemaking 17-09-020; Track 3 Proposal Reply Comments (March 22, 2019)[49]

9.3. Additional Details on the Available Import Capability Assignment Process[50]

MIC Allocation Step		Process Description
Step 1	Determination of Maximum Import Capability on Interties into CAISO BAA	CAISO will establish the Maximum Import Capability (MIC) for each Intertie into the BAA, and will post those values on CAISO Website in accordance with the schedule and process set forth in the BPM.
Step 2	Determination of Available Import Capability by Accounting for Existing Contracts and Transmission Ownership Rights	For each Intertie, the Available Import Capability is determined by subtracting the import capability on each Intertie associated with Existing Transmission Contracts (ETCs) and Transmission Ownership Rights (TORs) held by LSEs that do not serve Load within CAISO BAA from the MIC established in Step 1. The remaining sum of all Intertie Available Import Capability is the Total Import Capability. Total Import

[49] http://www.caiso.com/Documents/Mar29-2019-ReplyComments-Track3Proposal-ELCC-ResourceAdequacyProgram-R17-09-020.pdf
[50] Tariff Section 40.4.6.2.1

MIC Allocation Step		Process Description
	Held by Out-of-Balancing Authority Area LSEs	Capability is used to determine the Load Share Quantity for each LSE that serves Load within CAISO BAA.
Step 3	Determination of Existing Contract Import Capability by Accounting for ETCs and TORs Held by CAISO Balancing Authority Area LSEs	The Existing Contracts and Transmission Ownership Rights held by LSEs that serve Load within CAISO BAA will be reserved on the Available Import Capability remaining on each Intertie after Step 2 above, and will not be subject to reduction under any subsequent steps. The import capability reserved pursuant to this Step 3 is the Existing Contract Import Capability.
Step 4	Assignment of Pre-RA Import Commitments	CAISO assigns LSEs serving Load within CAISO BAA Pre-RA Import Commitment Capability on a particular Intertie based on Pre-RA Import Commitments in effect (where a supplier has an obligation to deliver the Energy or make the capacity available) at any time during the Resource Adequacy Compliance Year for which the Available Import Capability assignment is being performed. The Pre-RA Import Commitment will be assigned to the Intertie selected by the LSE during the Resource Adequacy Compliance Year 2007 import capability assignment process, which was required to be based on the Intertie upon which the Energy or capacity from the Pre-RA Import Commitment had been primarily schedule. For a Pre-RA Import Commitment without a scheduling history at the time of the Resource Adequacy Compliance Year 2007 import capability assignment process, the primary Intertie upon which the Energy or capacity was anticipated to be scheduled will be used. (2007 is the date used for Pre-RA Import Commitments for participants in the current CAISO BAA; CAISO will need to establish a new “cut-off” date for new CAISO participants.) To the extent a particular Intertie is over requested with Pre-RA Import Commitments under Step 4, due to either Pre-RA Import Commitments not included in the Resource Adequacy Compliance Year 2007 import capability assignment process or changes in system conditions that decrease the MIC of the Intertie, such that the MW represented in all Pre-RA Import Commitments utilizing the Intertie exceed the Intertie’s Available Import Capability in excess of that reserved for ETCs and TORs under Steps 2 and 3, CAISO will assign Pre-RA Import Commitments Pre-RA Import Commitment Capability based on the Import Capability Load Share Ratio of each LSE submitting Pre-RA Import Commitments on the particular Intertie. To the extent this initial assignment of Pre-RA Import Commitment Capability does not fully assign the Available Import Capability of the particular over requested Intertie, the remaining Available Import Capability on the over requested Intertie will be assigned until fully exhausted based on the Import Capability Load Share Ratio of each LSE whose submitted Pre-RA Import Commitment has not been fully satisfied by the previous Import Capability Load Share Ratio assignment iteration. The Available Import

MIC Allocation Step		Process Description
		Capability assigned pursuant to this Step 4 is the Pre-RA Import Commitment Capability.
Step 5	Assignment of Remaining Import Capability Limited by Load Share Quantity	The Total Import Capability remaining after Step 4 will be assigned only to LSEs serving Load within CAISO BAA that have not received Existing Contract Import Capability and Pre-RA Import Commitment Capability under Steps 3 and 4, that exceed the Load Serving Entity's Load Share Quantity. Only the MW quantity of any Pre-RA Import Commitment Capability assigned to Existing Contract Import Capability under Step 4 that exceeds the Existing Contract Import Capability on the particular Intertie will be counted for purposes of this Step 5. This Total Import Capability will be assigned until fully exhausted to those LSEs eligible to receive an assignment under this Step based on each LSE's Import Capability Load Share Ratio up to, but not in excess of, it's Load Share Quantity. The quantity of Total Import Capability assigned to the LSE under this Step is the LSE's Remaining Import Capability. This Step 5 does not assign Remaining Import Capability on a specific Intertie.
Step 6	CAISO Posting of Assigned and Unassigned Capability	Following the completion of Step 5, CAISO will post the following information to CAISO website: (a) The Total Import Capability; (b) The quantity in MW of Existing Contracts and Transmission Ownership Rights assigned to each Intertie, distinguishing between Existing Contracts and Transmission Ownership Rights held by LSEs within CAISO BAA and those held by load serving entities outside CAISO BAA; (c) The aggregate quantity in MW, and identity of the holders, of Pre-RA Import Commitments assigned to each Intertie; and (d) The aggregate quantity in MW of Available Import Capability after Step 4, the identity of the Interties with Available Import Capability, and the MW quantity of Available Import Capability on each such Intertie.
Step 7	CAISO Notification of LSE Assignment Information	Following the completion of Step 5, the CACAISO will notify the Scheduling Coordinator for each LSE of: (a) The LSE's Import Capability Load Share; (b) The LSE's Load Share Quantity; and (c) The amount of, and Intertie on which, the LSE's Existing Contract Import Capability and Pre-RA Import Commitment Capability, as applicable, has been assigned; and (d) The LSE's Remaining Import Capability.
Step 8	Transfer of Import Capability	LSEs are then allowed to transfer some or all of their Remaining Import Capability to any other LSE or Market Participant. CAISO will accept transfers among LSEs and Market Participants only to the extent such transfers are reported to CAISO through the CAISO's Import Capability Transfer Registration Process, by the entity receiving the Remaining Import Capability who must set forth (1) the name of the counter-parties, (2) the MW quantity, (3) term of transfer, and (4) price on a per MW

MIC Allocation Step		Process Description
		basis. CAISO will post the information on transfers of Remaining Import Capability received under this Step 8 to CAISO website.
Step 9	Initial Scheduling Coordinator Request to Assign Remaining Import Capability by Intertie	The Scheduling Coordinator (SC) for each LSE or Market Participant then notifies CAISO of its request to assign its post-trading Remaining Import Capability on a MW basis per available Intertie. Total requests for assignment of Remaining Import Capability by a SC cannot exceed the sum of the post-traded Remaining Import Capability of its LSEs. CAISO will honor the requests to the extent an Intertie has not been over requested. If an Intertie is over requested, the requests for Remaining Import Capability on that Intertie will be assigned based on each LSE's Import Capability Load Share Ratio in the same manner as set forth in Step 4. A Market Participant without an Import Capability Load Share will be assigned the Import Capability Load Share equal to the average Import Capability Load Share of those LSE from which it received transfers of Remaining Import Capability.
Step 10	CAISO Notification of Initial Remaining Import Capability Assignments and Unassigned Capability	CAISO will notify the SC for each LSE or Market Participant of the accepted request(s) for assigning Remaining Import Capability under Step 9. CAISO publishes the aggregate unassigned Available Import Capability, if any, and identifies the Interties with unassigned Available Import Capability, and the MW quantity of Available Import Capability, on each such Intertie on CAISO Website. CAISO will issue a Market Notice to advise the SC for each LSE or Market Participant that Step 10 is complete and to specify the time at which CAISO will begin accepting requests for the Remaining Import Capability for Step 11.
Step 11	Secondary Scheduling Coordinator Request to Assign Remaining Import Capability by Intertie	To the extent Remaining Import Capability remains unassigned as disclosed by Step 10, SCs for LSEs or Market Participants will notify CAISO of their requests to assign any Remaining Import Capability on a MW per available Intertie basis. Step 10 must be completed before a SC may submit a request under this step for any Remaining Import Capability. Any requests received prior to the time stated in the Market Notice issued at the completion of Step 10 will not be honored by the CAISO. CAISO will honor the timely requests received to the extent an Intertie has not been over requested. If an Intertie is over requested, the requests on that Intertie will be assigned based on each LSE or Market Participant's Import Capability Load Share Ratio, as used in Steps 4 and 9.
Step 12	Notification of Secondary Remaining Import Capability Assignments and Unassigned Capability	CAISO will then notify the SC for each LSE or Market Participant of the accepted request(s) for assigning Remaining Import Capability under Step 11. CAISO will publish any unassigned aggregate Available Import Capability on CAISO website and identify the Interties with Available Remaining Import Capability, and the MW quantity of Availability Import Capability on each such Intertie. CAISO will issue a Market Notice to advise the SC for each LSE or Market Participant that Step 12 is complete and to specify the time at which CAISO will begin accepting requests for the Balance of Year Unassigned Available Import Capability for Step 13.

MIC Allocation Step		Process Description
Step 13	Requests for Balance of Year Unassigned Available Import Capability	To the extent total Available Import Capability remains unassigned as disclosed by Step 12, SCs for LSEs or Market Participants may notify CAISO of a request for unassigned Available Import Capability on a specific Intertie on a per MW basis. Step 12 must be completed before a SC may submit a request under this step for any remaining unassigned Import Capability. Any requests received prior to the time stated in the Market Notice issued at the completion of Step 12 will not be honored by the CAISO. Each request must include the identity of the LSE or Market Participant on whose behalf the request is made. CAISO will honor timely requests in priority of the time that requests from SC were received until the Intertie is fully assigned and without regard to any LSE's Load Share Quantity. Any honored request shall be for the remainder of the Resource Adequacy Compliance Year; however, any notification by CAISO of acceptance of the request in accordance with this Section after the 20th calendar day of any month shall not be permitted to be included in the LSE's Resource Adequacy Plan submitted in the same month as the acceptance. CAISO notifies the SC of the time the request was deemed received by CAISO and whether the request was honored within seven days of receipt of the request. If the request is not honored because the Intertie requested was fully assigned, the request will be deemed rejected and the SC will be required to submit a new request for unassigned Available Import Capability on a different Intertie if it still seeks to obtain unassigned Available Import Capability. CAISO will update the list of unassigned Available Import Capability by Intertie on its website.
Please note: This multi-step process for assigning Total Import Capability determines the import capability that can be credited towards satisfying the Reserve Margin of a LSE under this Section 40. Upon the request of the CAISO, SC's must provide CAISO with information on Pre-RA Import Commitments and any transfers or sales of assigned Total Import Capability.		

9.4. Additional Detail on Slow DR Market-based approach

While slow responding PDR cannot respond to dispatches post-contingency within the required timeframe, these resources can be useful for maintaining reliability by reducing load in local capacity areas. This section discusses how slow responding DR resources can be dispatched pre-contingency to lower loads in anticipation of a contingency.

To receive longer notification times, PDR must elect either the hourly or 15-minute block bidding options proposed in ESDER 3. If the PDR resource elects these bidding options, the resource will not be eligible for corrective capacity awards under CME because the market cannot use these resources to resolve contingencies within the required timeframe if they are dispatched after the contingency occurs. However, while the market cannot reserve corrective capacity for slow response resources, the preventive-corrective constraint may find it economic to pre-dispatch slow response resources for load reduction in the Real-Time Unit Commitment (RTUC) intervals prior to a potential contingency, rather than relying on corrective capacity from other resources. This would occur when it would cost more to reserve corrective capacity from

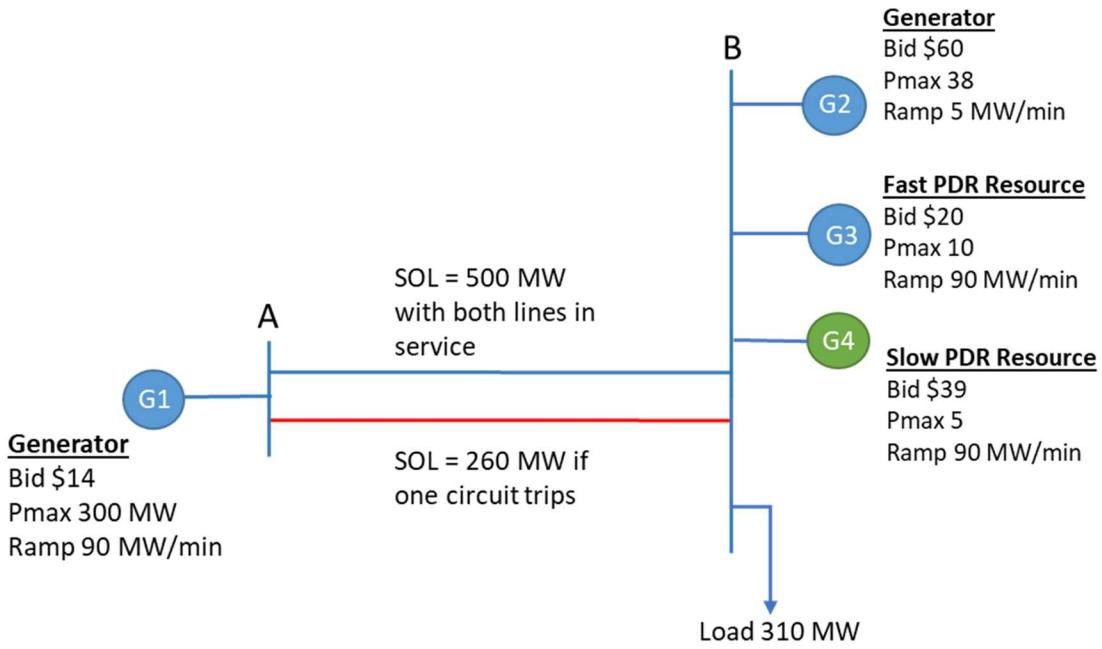
another resource than to economically drop load from the slow responding PDR prior to a contingency occurring. When economic, pre-contingency dispatch of slow responding PDR would decrease the amount of corrective capacity needed to satisfy the preventive-corrective constraint. This proposal is consistent with the proposals put forth in the Commitment Costs Enhancements Phase 3 initiative that allow PDRs to preserve their starts through the use of opportunity costs.

The following example demonstrates how slow responding DR can help lower load in anticipation of a contingency under the preventive-corrective model by receiving a dispatch in RTUC to reduce load in real-time.

Example: A Two-Node System with Two Traditional Generators and Two DR Resources

This example is a two-node system with two traditional generators and two PDRs. At node B, there are 2 PDRs, G3 and G4. G3 is not a slow response resource because can respond to 5 minute dispatches without the need for additional notification time. G4 requires a notification time of at least 50 minutes and therefore, is considered a slow response PDR. Under pre-contingency normal conditions, the limit on lines A-B is 500 MW. If a circuit trips and only one line is in service, the system would need to be repositioned to its post-contingency normal limit of 260 MW. When a contingency occurs, CAISO will have a total of 30 minutes (10 minutes for operator activities and 20 minutes for resource response) to get the system to the post-contingency normal rating of 260 MW.[51]

Figure 23: A Two-Node System with Two Traditional Generators and Two DR Resources



[51] The post-contingency emergency limit for the single line is now 500 MW.

Today, the market would dispatch G1, the cheapest generation, up to its Pmax of 300 MW on lines A-B and 10 MW from G3, the next cheapest generation, to serve the load of 310 MW at node B. This solution is demonstrated in Table 11.

Table 11: Energy Awards without CME

Energy Awards without CME		
Generator	**Energy Award (MW)**	**LMP ($/MW)**
G1	300	14
G2	0	20
G3 (PDR)	10	20
G4 (Slow PDR)	0	20

This solution is blind to the post-contingency limit of 260 MW. If a contingency occurred, the flow on lines A-B would need to reduce from 300 MW to 260 MW within 20 minutes. This solution does not set up the system to be able to respond quickly enough through market dispatches to a contingency after it occurs because G3 is already dispatched to its Pmax of 10 MW, G2 would be dispatched to its Pmax of 38 and the system would still require 2 MWs to serve all the load at node B. The slow responding DR cannot be accessed quickly enough post-contingency due to the notification time required for slow DR to be dispatched.

With CME in place, the market will consider the post-contingency limit in its solution, 260 MW in this example. If a contingency occurs, the system would need to decrease flow from A-B by 40 MW to stay within the post-contingency limit and increase generation by 40 MW at node B to serve all 310 MWs of load. This solution is demonstrated in Table 12.

Table 12: Energy and Corrective Capacity Awards with CME

Energy and Corrective Capacity Awards with CME				
Generator	**Energy Award (MW)**	**LMP ($/MW)**	**Corrective Capacity Award (MW)**	**LMCP ($/MW)**
G1	300	14	-40	0
G2	0	39	35	19
G3 (PDR)	5	39	5	19
G4 (Slow PDR)	5	39	0	19

G1 receives a 300 MW energy award and a 40 MW downward corrective capacity award. The downward corrective capacity award is not priced because it is not constrained by its ramp rate, Pmax, or Pmin. To balance the 40 MW of downward corrective capacity at node A, the system will award 40 MW of upward capacity at node B. Because the G4 is a slow PDR and cannot

respond within the required timeframe, it will not receive a corrective capacity award in the real-time. Instead, the system will award G2 35 MW of corrective capacity. G3 will receive a 5 MW corrective capacity award and a 5 MW energy award. G3 is constrained by its Pmax, and so the next most economic resource, the slow DR resource, will provide the rest of the energy required to serve the load. In this example, the market positions the system so that it serves all the load pre-contingency while reserving corrective capacity so that it can return the system to its post-contingency limit should a contingency occur.

In the event of a contingency, CAISO operations will run its real-time contingency dispatch (RTCD) to dispatch corrective capacity from capacity into energy. In the example above, the market would dispatch G1 from 300 MW of energy down to 260 MW of energy to reduce flow on the line to its post-contingency rating. To replace the 40 MW from reduced from G1, the market would dispatch G2 from 0 MW to 35 MW of energy and G3 from 5 MW to 10 MW of energy.

Slow DR resources cannot respond quickly enough within the post-contingency timeframe to mitigate local area contingencies within 30 minutes. As such, slow DR cannot receive corrective capacity awards and would not be dispatched after a contingency. Instead, they would be dispatched pre-contingency when they are economic over awarding another resource a corrective capacity and should preform based on their energy dispatch in RTUC whether or not a contingency occurs in real-time.