Resource Adequacy Enhancements

Third Revised Straw Proposal

December 20, 2019

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1. Executive Summary

The California Independent System Operator (CAISO) is performing a comprehensive review of the CAISO's Resource Adequacy (RA) tariff 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 the CAISO tariff provisions for System, Local, and Flexible RA.

The CAISO's third revised straw proposal considers enhancements to RA counting rules and assessments. This includes considering methodologies for determining forced outage rates for system, local, 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 or derate at some point when it has been procured for RA capacity. The 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 operational needs in all hours. The proposal also considers the inclusion of a portfolio assessment process to ensure that reliability needs can be met by the shown RA portfolio during all hours. The CAISO believes this proposed portfolio assessment is necessary to address the growing reliance on use- and availability-limited resources as part of the RA fleet.

Regarding provisions for RA must offer obligations and bid insertion, the CAISO is proposing modifications to ensure coordination with the Day Ahead Market Enhancements and Extended EIM initiatives. This coordination is key to ensure all three proposals work without creating conflicting outcomes. RA resources' must offer obligations will be set at the amount of NQC shown for RA, not the amount of UCAP shown. To align with the CAISO's Day-Ahead Market Enhancements initiative, RA resources will have a 24 by 7 must offer obligation into the day-ahead market unless explicitly provided an exemption to this requirement through the proposed policy modifications. The CAISO also proposes that non-use-limited resources and use-limited resources with an opportunity cost are subject to bid insertion, unless exempted.

The CAISO is proposing several changes to the existing planned outage provisions and the planned outage process. In response to stakeholder feedback, several changes are intended to ensure planned outages scheduled by 45 days prior to the month actually can be taken when scheduled. The proposal attempts to remove obligations for outage substitution to the greatest extent possible. The CAISO proposes to redesign the planned outage process to reflect system UCAP targets rather than traditional NQC targets. This proposed change better aligns with the counting rules and RA assessment proposal to incorporate forced outage rates in capacity valuation and assess resource adequacy on a UCAP basis.

The CAISO proposes modifications to the RA import provisions, including adoption of certain existing California Public Utilities Commission (CPUC) rules to ensure RA imports are backed by a forward commitment of physical capacity with firm transmission delivery and sufficient operating reserves to back obligations. LSEs will be required to submit supporting documentation demonstrating that any non-specified RA import resource shown on annual and monthly RA and Supply plans represent physical capacity and firm transmission. The CAISO will include these requirements in the tariff to ensure similar treatment among all LSEs. The

CAISO also proposes to require that non-specified RA imports, at minimum, identify the source BA that will provide the capacity to ensure that RA imports are not double counted for EIM entities' resource sufficiency tests or otherwise relied upon by the host BA to serve native load. The CAISO has also removed consideration of Maximum Import Capability provisions from the scope of this initiative and has initiated a standalone stakeholder initiative to fast track resolution of MIC related modifications.[1]

The CAISO is proposing a new flexible RA framework that more deliberately captures the CAISO's operational needs for unpredictable ramping needs between day-ahead and real-time markets. Proposed changes to the flexible capacity product and flexible capacity needs determination are intended to closely align with CAISO's actual operational needs for various market runs (*i.e.*, day-ahead market and fifteen-minute market). 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.

The CAISO is proposing modifications to its backstop capacity procurement provisions to align backstop authority with the resource adequacy counting rules and adequacy assessments outlined above. These proposed modifications include new 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. The CAISO is proposing modifying its tariff authority to address energy needs in local capacity areas, and will seek 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.

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 the 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,[2] the 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

[1] Maximum Import Capability Stabilization and Multi-Year Allocation Stakeholder Initiative Webpage: http://www.caiso.com/StakeholderProcesses/Maximum-import-capability-stabilization-multi-year-allocation

[2] 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

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.

The CAISO has identified certain aspects within the 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:

- 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 do not sufficiently align with operational needs;
- Provisions for import resources need clarification to ensure physical capacity and firm delivery from RA imports;
- Current system and flexible RA showings assessments do not consider the overall effectiveness of the RA portfolio to meet the CAISO's operational needs; and
- Growing reliance on availability-limited resources when these resources may not have sufficient run hours or dispatches to maintain and serve the system reliably and meet energy needs in local capacity areas and sub-areas.

The 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 second revised straw proposal specifically presents the CAISO's 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.

The CAISO also provides updates to its proposal for flexible RA capacity. The 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.

Regarding local RA modifications, the CAISO is examining incorporating forced outage rates into the local RA process. The CAISO proposed changes to local capacity assessments to address availability-limited resources, and meeting local capacity needs with slow demand response. The CAISO also presents its proposal to modify aspects of its backstop capacity procurement, including certain enhancements to the Capacity Procurement Mechanism.

3. Stakeholder Engagement Plan

Table 1 outlines the schedule for this stakeholder initiative below. The CAISO plans to seek CAISO board approval of the elements in this RA Enhancements initiative in the first quarter of 2021.

Table 1: Stakeholder Engagement Plan

Date	Milestone
Dec 20	Third revised straw proposal
Jan 7-8	Stakeholder meeting on third revised straw proposal
Jan 22	Stakeholder comments on third revised straw proposal
March 19	**Fourth revised straw proposal**
Late March	Stakeholder meeting on fourth revised straw proposal
Early April	Stakeholder comments on fourth revised straw proposal due
Late June	**Draft final proposal**
Mid July	Stakeholder meeting on draft final proposal
Early Aug	Stakeholder comments on draft final proposal
June-Dec	Draft BRS and Tariff
December	**Final proposal**
Q1 2021	**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 (LSEs) 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 does not guarantee there will be adequate resources 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)."[3] 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.

The 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.

[3] 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.

As noted above, the current RA practices rely heavily on the existing NQC counting rules. CAISO believes that resources' NQC values will continue to be an important aspect of the RA program in the future. CAISO envisions Must Offer Obligations being tied to NQC values. However, CAISO is also considering how to incorporate resource forced outage rates into system, flexible, and local RA assessments. Similar to the current provisions of other ISOs, the 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 Third Revised Straw Proposal

The following sections detail the CAISO's proposed modifications and provide the CAISO's rationale and supporting justification. The CAISO has organized the Third Revised Straw Proposal into sections covering System, Flexible, and Local RA and related sub topics, and a section covering proposed modifications to the CAISO's backstop procurement provisions. In its Second Revised Straw Proposal, the CAISO separated two local RA topics from previous versions into a separate draft final proposal.[4]

The RA Enhancements Third Revised Straw Proposal covers the following topics:

- System Resource Adequacy
  - Determining System RA Requirements
  - Unforced Capacity Counting
  - System RA Showings and Sufficiency Testing
  - Must Offer Obligation and Bid Insertion Modifications
  - Planned Outage Process Enhancements
  - RA Import Provisions
  - Operationalizing Storage Resources
- Flexible Resource Adequacy
  - Identifying Flexible Capacity Needs
  - Identifying and setting Flexible RA Requirements
  - Establishing Flexible RA Counting Rules: Effective Flexible Capacity Values and Eligibility
  - Flexible RA Allocations, Showings, and Sufficiency Tests
  - Flexible RA Must Offer Obligation Modifications
- Local Resource Adequacy
  - Forced Outage Rates and RA Capacity Counting
- Backstop Capacity Procurement Provisions
  - Capacity Procurement Mechanism Modifications
  - Making UCAP Designations
  - 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.*, the CAISO will continue to perform NQC calculations exactly as it does today, and will continue to derate Qualifying Capacity values (QC) based on deliverability.

[4] Draft Final Proposal for Local Assessments with Availability Limited Resources and Meeting Local Needs with Slow Demand Response can be found on the RA Enhancements Webpage: http://www.caiso.com/informed/Pages/StakeholderProcesses/ResourceAdequacyEnhancements.aspx

For all resources with NQC values, the CAISO proposes to establish UCAP values to identify the unforced capacity value (discounted for units' forced outage rates) for use in system, local, and flexible RA showings and assessments.[5] The UCAP value speaks to the quality and dependability of the resources procured to meet RA requirements. The CAISO also proposes to establish system RA requirements and associated sufficiency tests that account for unit forced outage rates. In other words, a 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 the CAISO's proposed modifications to incorporate these changes into CAISO RA processes and tariff.

5.1.1. Determining System RA Requirements

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

System UCAP Requirement

From a planning perspective, it is reasonable to require that the amount of UCAP made available should be sufficient to serve forecasted peak load and ancillary services requirements given the forced outage rate of resources is embedded in the UCAP value. After removing forced outages from the planning reserve margin, what remains is forecast error and ancillary services. When the RA program was originally developed, the estimated forced outage rate for RA resources was approximately 4% to 6% of the 15% planning reserve margin. Unfortunately, as noted in greater detail below, the CAISO observes forced outage rates far exceeding these values at critical times. The inference drawn from this is that the current PRM, after accounting for such high forced outages rates, is insufficient to cover load, forecast error, and operating reserves during key times, jeopardizing reliability and not meeting a "good utility practice" standard.

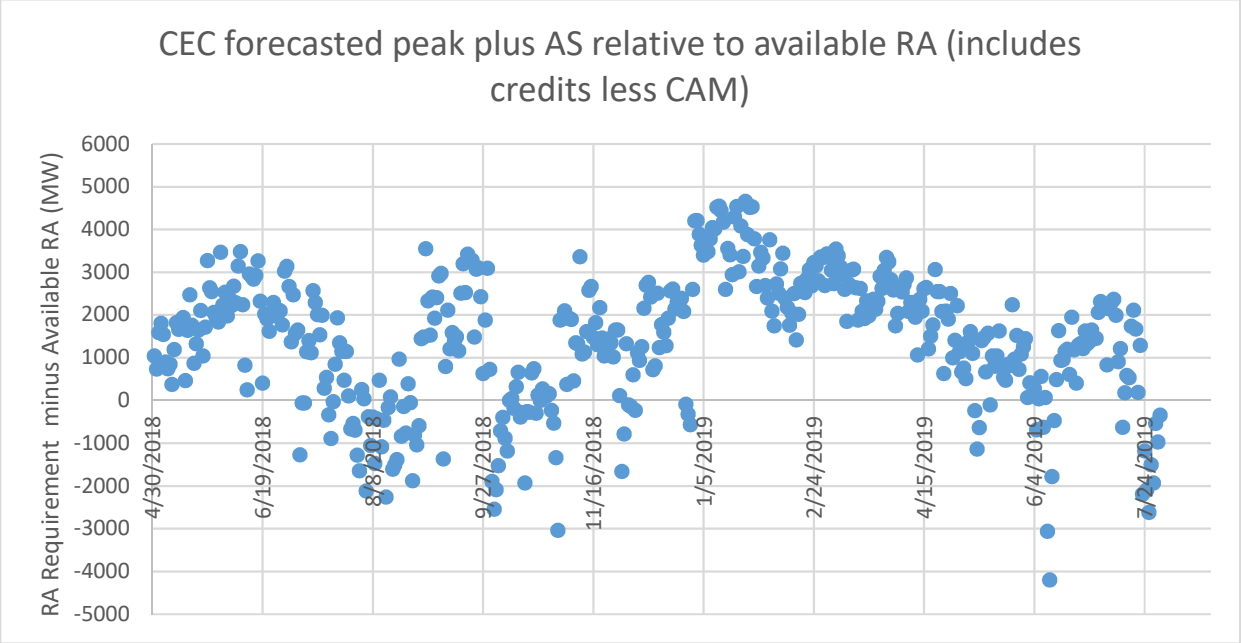
To address these concerns, the CAISO is proposing a system UCAP requirement to more directly account for forced outages. To ensure resource adequacy, the CAISO must carry operating reserves for three percent of load and three percent of generation, or cover the Most Severe Single Contingency according to BAL-002-WECC-2a,[6] and must have sufficient RA capacity to provide regulation and the flexible ramping product. Therefore, CAISO proposes to develop a minimum system UCAP requirement that all LSEs must meet and show as RA under the CAISO tariff.

The current system RA structure is designed to cover peak forecasted load, operating reserves, forced outages, and demand forecast error. It is reasonable to assess how well the current program achieves those objectives. The CAISO analyzed data from its Customer Interface for Resource Adequacy (CIRA) system. The goal of this analysis was to assess how well the RA requirements would meet peak forecasted load, operating reserves, and forced outages.

[5] Resources without an NQC are not eligible to provide system or local RA capacity.
[6] BAL-002-WECC-2a found here: https://www.nerc.com/_layouts/15/PrintStandard.aspx?standardnumber=BAL-002-WECC-2a&title=Contingency%20Reserve&jurisdiction=United%20States

Forecast error was excluded from the assessment. The CAISO used the RA requirements for May 2018 through July 2019 based on the CEC 1-in-2 peak load forecast. The CAISO added six percent to that number to account for required operating reserves. Then, the CAISO compared that value to the available RA capacity. Available RA capacity is defined as shown RA capacity plus credits[7] minus forced outages. This analysis was conducted at a daily granularity.[8] As shown in Figure 1, there are several days that the CAISO would have been unable to cover CEC forecasted peak demand plus operating reserves. This is shown by observations below zero on the vertical axis. More specifically, on just over 17.5 percent of the days, CAISO would not have adequate RA capacity to meet its planning targets. Further, this assumes that 100 percent of all RA credits are available at the fully credited level, including over 1000 MW of credited demand response in all but one month (which was 950 MW). For example, if 500 MW of credited capacity is not available or was not responsive for any reason, the percent of days the CAISO would be deficient increases to 25 percent.

Figure 1: Available capacity relative to forecasted need

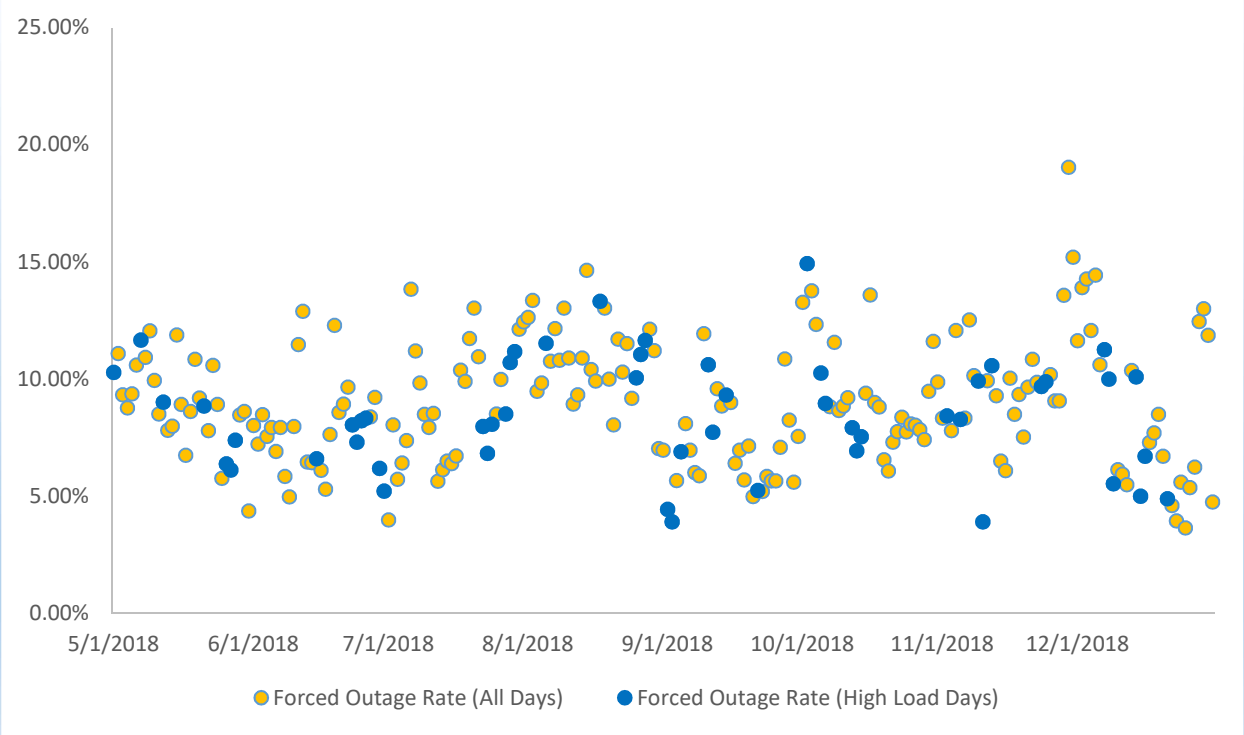


Additionally, the CAISO looked at the coincidence of forced outages rates with high load days. The CAISO wanted to see if forced outages rates differed based on actual load. Figure 2 shows the forced rates from May 1, 2018 through December 31, 2018. Additionally, the highest load days in each month have been isolated as well. This figure shows there is only a very slight reduction in the forced outage rates on high load days meaning there is very little difference between forced outage rates based on load. Put another way, a planning reserve margin should assume forced outage rates are the same regardless of load. Figure 2 shows forced outage rates regularly in excess of ten percent, and even exceeding 15 percent on multiple occasions, including higher load days. This means that any LRA setting a planning reserve

[7] CAM credits were excluded from this analysis to avoid double counting.
[8] CIRA only captures when a forced outage flag has been inserted for a day. Hourly granularity is not available in CIRA.

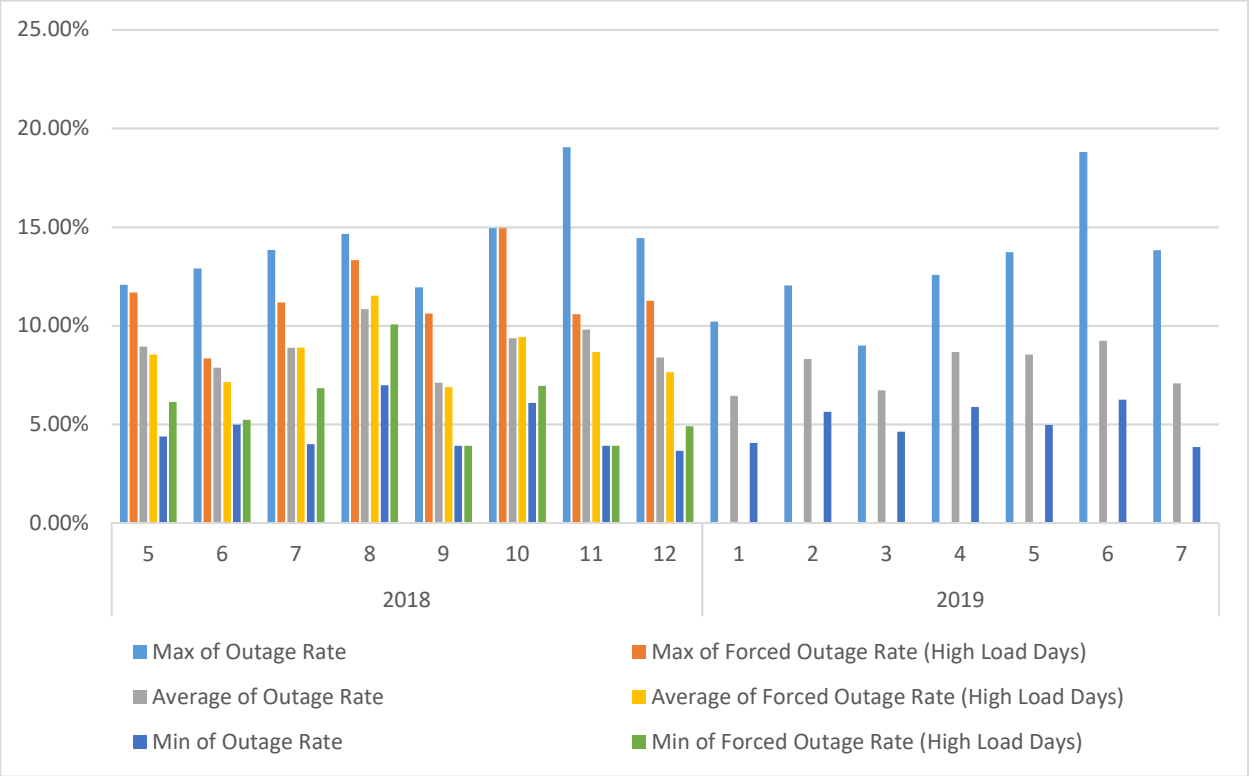
margin that accurately and thoroughly accounts for forced outages should include at least a 10-15 percent range on top of the forecasted peak demand. This is further demonstrated by the distributions shown in Figure 3, which shows the maximum, minimum, and average forced outage rates for each month.[9]

Figure 2: Forced outages relative to monthly high load days (2018 only)



[9] Additional assessments regarding the RAAIM and its effectiveness at incentivizing forced outage replacement capacity is provided in section 5.1.2. If RAAIM is working effectively, it would likely reduce the overall need for UCAP values. However, as shown below, it has not been very effective at incentivizing replacement capacity.

Figure 3: Distributions of Forced Outage Rates



CAISO examined two options to establish the minimum amount of UCAP required to maintain reliable grid operations: Top-down and bottom-up. The top down assumes all units in a given tech type will have the same average forced outage rate while the bottom up examines each unit individually.

The top-down approach relies on developing a probabilistic model to determine how much installed capacity must be procured to reach a predetermined loss of load expectation. This installed capacity value is then translated to an estimated UCAP requirement. This study can be conducted using either individual or system average forced outage rates. Top-down approaches that use system wide average forced outage rate rely heavily on the assumption that forced outage rates are homogenous within a technology type. As shown in section 5.1.2, this assumption may not hold in California under greater scrutiny. Large variances in the forced outage rates within a technology type can lead to inefficient capacity procurement. Further, this type of study has not been applied to a system as reliant on variable and energy-limited resources as is the CAISO's. Studies that rely on individual forced outage rates still have to account for the various permutations of outages that occur to derive the estimated UCAP requirement.

The bottom-up approach is built on the foundation of forecasted peak demand. From there, ancillary services are added. However, unlike the top down approach, the bottom-up approach does not rely on any assumptions about average forced outage rates for various technology types. Only individual resource outage rates are needed and then only for procurement and

showing purposes. Therefore, average forced outage rates are not used since this information is embedded in the UCAP values.

On balance, the CAISO believes the bottom-up approach is best to establish a minimum system RA requirement based on UCAP because it helps ensure minimum resource adequacy requirements are achieved to maintain reliability given the growing number of LRAs and the potential variance in the LRAs' PRM targets. A RA requirement based on UCAP should also help mitigate the potential for capacity leaning among LSEs.

In comments to the revised straw proposal, the CPUC staff suggested using either a higher planning reserve margin or a more conservative load forecast (*i.e.*, 1-in-5 instead of 1-in-2) as an alternative solution to UCAP. As noted in CAISO's testimony in the CPUC's RA proceeding, the CAISO supports using the more conservative 1-in-5 load forecast, particularly for the shoulder months where the CAISO observes greater variability in the monthly peaks.[10] Utilizing higher load forecast would ensure more diverse load profiles can be addressed by RA procurement. However, such a change does not address the fundamental and underlying issue of incorporating forced outages upfront in the procurement process.[11]

Based on the data reviewed by the CAISO, to avoid deficiencies caused by forced outages, all LRAs must provide ancillary services to ensure six percent operating reserves based on forecasted peak demand, plus an additional 10-15 percent to reasonably address forced outages. The results of CAISO's analysis show that a planning reserve margin of at least 20 percent is needed to address all needs, including peak demand, forced outages, and operating reserves. This excludes forecast error, which, at least in part, can be addressed by using a 1-in-5 peak load forecast. However, this may not provide adequate RA capacity in many years. For example, using a 1-in-10 year forecast for planning purposes should cover all reasonably foreseeable procurement needs, avoiding the need to include forecast error in a planning reserve margin. Alternatively, using a 1-in-2 forecast would require that virtually all under-forecasting error be included in the planning reserve margin.

Therefore, the CAISO recognizes that efforts to establish a minimum UCAP requirement needs additional collaboration with LRAs to address under-forecasting risks. At this time, CAISO believes that the UCAP requirement should be set at a minimum of 110 percent of forecasted peak. This number accounts for forecast load, reserves, and forecast error. The value used for the forecast error is derived from comparing the low, mid, and high load forecasts from the CEC's 2018 final Integrated Energy Policy Report (IEPR).[12] The IEPR mid load forecast was approximately between one to three percent higher than the low load forecast. The high load forecast was between four and seven percent higher. To account for forecast error, the planning reserve margin likely would need an additional two to six percentage points. The CAISO has selected four percent as a reasonable starting point.

[10] http://www.caiso.com/Documents/Jul10_2018_RAProceedingTrack2Testimony-Chapter4-SystemRADemandForecasts_ProposalNo3_R17-09-020.pdf

[11] These tools may provide more capacity to the CAISO but they do not ensure the quality and reliability of that capacity.

[12] 2018 Integrated Energy Policy Report found here: https://ww2.energy.ca.gov/2018_energypolicy/

The CAISO received stakeholder feedback indicating a need for the CAISO to consider how to coordinate these important system RA modifications with the CPUC's RA program and with other LRAs. The 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.

5.1.2. Unforced Capacity Evaluations

The CAISO is proposing to adopt provisions for evaluating the reliability and availability of resources that account for the probability of forced outages and derates. This proposed evaluation will eliminate the need for complicated assessments of availability and replacement capacity rules. Many of the U.S. Independent System Operators (ISOs) and Regional Transmission Operators (RTOs) utilize an Installed Capacity (ICAP) and UCAP concept. ICAP values generally account for resource capacity impacts 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 value and measure capacity value 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 or availability factor. There are several key advantages to integrating forced outages and derates into a generator's calculated RA qualifying capacity value. Recognizing a unit's contribution to reliability enables one to compare its reliability to other resources. Section 9.1 of the Appendix contains examples of how accounting for forced outage rates of similar resources reflects the reliability provided by each. Greater resource accountability should produce market signals that promote procurement of better performing resources with improved operational reliability and availability. The accessibility of information on the forced outages and derates of resources that impact their availability can help buyers avoid risks and make better informed decisions when making bilateral trades or procuring replacement RA capacity.

To date, neither the CAISO nor the CPUC account for the impact forced outages and unit derates have on system reliability beyond what is minimally assured in the established planning reserve margin requirement. Instead, the CAISO relies on substitution rules and the Resource Adequacy Availability Incentive Mechanism (RAAIM) to discipline capacity availability on the very back-end, *i.e.*, the operational end of the process. RAAIM calculates incentive payments and resource non-availability charges based on a resource's bidding behavior. RAAIM is intended to incentivize compliance with bidding and must-offer obligations and ensure adequate availability of RA resources. However, the CAISO believes that confirmation that RA capacity will be available, or be replaced if unavailable, occurs inappropriately late. The dependability and reliability attributed to all resources should be better known and understood upfront during the RA procurement process.

Resource specific NQC and UCAP determinations

The CAISO proposes to calculate and publish monthly NQC and UCAP values for all resources annually (*i.e.*, once per year a unit will get a distinct NQC and UCAP value for each month of the upcoming year). The NQC process will remain similar to the current approach with no major proposed changes. The CAISO proposes that the calculation of each resource's UCAP will be limited at a resource's NQC value and will consider the resource's forced outages and derates in determining a resource's UCAP value. The CAISO proposes to calculate seasonal availability factors for UCAP determination purposes. The CAISO proposes to utilize two seasons for this availability factor determination, on-peak (summer) and off-peak (winter). UCAP values will not be affected by CAISO approved planned outages.

The CAISO will calculate UCAP values for all resource types that do not rely on an LRA established Effective Load Carrying Capability (ELCC) methodology for determining QC values. For resources with QC values calculated using an ELCC methodology, the CAISO will use the ELCC value as the UCAP value. The CAISO provides more discussion regarding the basis for this treatment below.

Previously, CAISO proposed to adopt the standard UCAP calculation similar to some other ISO/RTO approaches. After review of other options utilized by other ISO/RTOs and stakeholder feedback, the CAISO has modified its proposed calculation of resource UCAP values. The CAISO will develop and utilize a seasonal availability factor based approach for UCAP determinations. Resource availability factors will incorporate historical derates and forced outages, and will exclude planned outages and force majeure outages. Reductions to available capability due to transmission outages including wires or fuel deliverability –deemed "outside of management control" or OMC will also be excluded from the availability factor calculation.

Proposed UCAP Determination Process

The CAISO proposes to calculate UCAP seasonally. To establish the proposed summer and winter Average availability Factors used to calculate the seasonal UCAP values for each resource, the CAISO will establish a process that includes the following steps and underlying calculations. The CAISO believes that this updated UCAP determination proposal, based on seasonal availability factors, is best applied to the following resource types: Thermal, Hydro, and Storage resources.

The CAISO will calculate an hourly availability factor for each resource during the tightest system supply cushion hours. Supply cushion is a measure of real-time system resource adequacy risk. A large supply cushion indicates less real-time system resource adequacy risk because more energy remains available to respond to unplanned market events. A low supply cushion indicates the system has fewer assets available to react to unexpected outages or load increases, indicating a high real-time system resource adequacy risk. The cushion provided by the RA supply compared to load conditions will define tight supply conditions.

Evaluating the historical performance of a capacity asset during a subset of tight supply cushion hours captures the correlation of the asset's availability and capability with all other system factors that drive the tight supply cushion hours. This technique should provide a better

indication of how the asset will perform in the future under similar conditions when capacity is needed. The CAISO proposes to determine the 100 tightest supply condition hours during each summer and winter season based upon available RA for each hour compared to hourly loads. The CAISO will provide additional clarity on how this determination will be made with examples in future proposal iterations.

The CAISO will calculate an hourly availability factor using forced outages and derates for each hour studied, divided by the resource's maximum capability for each of the 100 tightest supply cushion hours per summer season, May-September (on-peak), and 100 tightest supply cushion hours per winter season, October-April (off-peak), for the past five years. To determine the each resource's Hourly Availability Factor (HAF) for each of the 100 tightest supply cushion hours per season the CAISO proposes the following approach:

$$\textbf{Hourly Availability Factor} = \frac{\textbf{Derates} + \textbf{Forced Outage Impacts}}{\textbf{NQC}}$$

The CAISO will utilize the average of the Hourly Availability Factor (HAF) for each season for each of the past five years to create a Seasonal Average Availability Factor (SAAF) for each resource:

$$\textbf{Seasonal Average Availability Factor} = \mathbf{1} - \frac{\sum \textbf{Hourly Availability Factors}}{\textbf{Number of Observed Hours}}$$

The CAISO also proposes incorporating a weighting method that places more weight on the most recent year's performance and less weight on more historic periods in determining a resource's UCAP values. The CAISO proposes to place the following percentage weights on the availability factor calculation by year from most recent to most historic: 30-25-20-15-10. In other words, the following percentage weights will be applied to the seasonal availability factors; 30% weight for the most recent year's seasonal availability factor, 25% weight on the second year, 20% on the third year, 15% on the fourth year and 10% weight on the fifth and most historical seasonal availability factor.

The Seasonal Average Availability Factor described above will be calculated for each of the five prior historical years (for both on-peak and off-peak seasons). These Seasonal Average Availability Factors will based on each Hourly Availability Factor that is derived by assessing forced outages and derates compared to the annual NQC value for each resource. The CAISO will then apply the proposed weighting approach described above to each of the five previous annual periods (for each on-peak and off-peak season) to create Weighted Seasonal Average Availability Factors (WSAAF) as follows:

$$\textbf{Weighted Seasonal Average Availability Factor} = \textbf{Annual Weighting} * \textbf{Seasonal Average Availability Factor}$$

Once the Weighted Seasonal Average Availability Factors are established for each season of each of prior 5 years the CAISO will sum the factors and apply them to each resource's NQC to determine the resource's seasonal UCAP ratings as follows:

$$\textbf{On Peak UCAP} = \sum \textbf{Weighted Seasonal Average Availability Factors}^{\textbf{Summer}} * \textbf{NQC}$$

$$\textbf{Off Peak UCAP} = \sum \textbf{Weighted Seasonal Average Availability Factors}^{\textbf{Winter}} * \textbf{NQC}$$

The following tables provide an example to describe the proposed UCAP determination process. For brevity and simplicity, the initial steps of determining the Hourly Availability Factors and Seasonal Availability Factors have been omitted, but those steps will be calculated as described above and incorporated prior to the following steps in the process.

Table 2: Resource UCAP determination example

Year	Summer SAAF	Annual Weight	Weighted SAAF (Summer)
5	0.87	10%	0.087
4	0.98	15%	0.147
3	0.79	20%	0.158
2	0.85	25%	0.2125
1	0.9	30%	0.27
		Total = 100%	**0.8745**
Year	**Winter SAAF**	**Annual Weight**	**Weighted SAAF (Winter)**
5	0.85	10%	0.085
4	0.73	15%	0.135
3	0.75	20%	0.15
2	0.88	25%	0.22
1	0.97	30%	0.291
		Total = 100%	**0.8555**

Sum of Weighted SAAFs (Summer)	Sum of Weighted SAAFs (Winter)	NQC	On-Peak UCAP	Off-Peak UCAP
0.8745	0.8555	100MW	**87.45 MW**	**85.55 MW**

The CAISO considered other approaches for weighting UCAP values related to the proposed Seasonal Average Availability Factors. For instance, the CAISO considered a NQC based annual weighting method that considers the resource's annual NQC value in addition to its Seasonal Average Availability Factors. The CAISO determined that this approach could have undesirable UCAP outcomes that could unfairly discount a resource's UCAP for having lower NQCs in prior years. To address this issue, the CAISO is proposing a weighting approach that does not discount a resource's UCAP based on its historic NQC levels, but only on its historic Seasonal Average Availability Factors. This proposal provides equivalent availability determinations for each historic period that are then weighted and applied to provide a fair UCAP determination for each resource.

UCAP transitional phase-in approach

UCAP values for resources without five years of operating history will also be subject to an availability factor calculation, as described above. Until a full 5 years of operating history is available, the CAISO will use a class-average approach. The CAISO proposes to apply class-average data based on operating data for similarly designed resources of the same technology type. The class-average will be based on availability factors observed during the 100 tightest supply cushion hours each season (summer and winter) per year for the previous five years. The CAISO will calculate class-average capacity factors for each of the previous five years. As new resources begin to build an operational history, the CAISO will blend their actual performance data with class average data for any observed tightest supply condition hours that a resource was not yet operational during the previous 5 years.

UCAP related stakeholder suggestions

Several stakeholders suggested that the CAISO consider allowing a UCAP adjustment after an outage has occurred and repairs have been made to the resource. The CAISO cannot allow this for two reasons. First, part of the goal of UCAP is to incentivize upfront maintenance to avoid the forced outage in the first instance. Allowing for an after-the-fact maintenance adjustment would eliminate this important incentive. Second, although the CAISO's proposed weighting method would reflect the forced outage in the subsequent year, it also provides two supplemental benefits.

By weighting recent years more heavily, it ensures that the repairs are durable and not simply quick fixes that may not be durable and similar problems soon reappear. If the repairs are not durable, and the resource continues to go on forced outages, then those would be reflected promptly in the next RA year. The second benefit of the proposed weighting methodology is that it allows resources that have made durable repairs to recover from the UCAP reduction fairly quickly because the outage will impact the UCAP value less with each passing year. Therefore, the CAISO does not propose to adjust UCAP values based simply on maintenance performed after-the-fact; the CAISO's intent is to incentivize preventative maintenance, before-the-fact, so that forced outages are prevented in the first instance.

UCAP determination for other resource types that Availability Factor approach may not be applicable

This updated proposal may not work well for certain other resource types, specifically, Solar, Wind, and Demand Response, which likely require an alternative approaches. The CAISO recognizes that the proposed availability factor approach to determine UCAP values may not be the best approach for every resource type.

The CAISO proposes to use an ELCC value for wind and solar to set UCAP values. Other resource types that may not work well under Availability Factors are those that have inherent use limitations such as some DR and QF resources. The CAISO considered these different resource technologies and explains the current proposal for setting UCAP values for these resource types below.

ELCC will establish UCAP values for wind and solar resources

The CAISO will rely on an ELCC methodology when applicable. Currently, the CPUC only applies this methodology to wind and solar resources, but could expand it to cover other variable energy resources such as weather sensitive or variable output DR. The reason for the CAISO's reliance on the ELCC calculation is two-fold. First, 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.[13] Therefore, the CAISO understands these technologies already have their QCs reduced for expected forced outages and derates.

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 as RA.

The CAISO notes that some DR resources may also need an alternative approach for determining their UCAP values. This is because majority of DR resources exhibit variability and are availability-limited. This approach may not work well with the availability factor approach that assesses availability based upon tightest supply condition hours that can occur during any hour of the day, and may include hours when DR programs are not available. This approach would likely impact DR resources' UCAP values since these resources are generally only available during a subset of hours. Because of their limited and variable availability on a daily and annual basis, the CAISO believes that DR resources are best evaluated under an ELCC approach similar to wind and solar resources that have limited or variable output.

Through the Energy Storage and Distributed Energy Resources initiative, the CAISO is studying application of an ELCC methodology to DR resources.[14] The CAISO will use this methodology to inform local regulatory authorities of a QC counting methodology that incorporates the variable and availability-limited nature of certain DR resources into its QC value. Similar to the ELCC methodology for wind and solar, an ELCC methodology for DR would consider resource availability and DR's ability to serve system reliability when determining the capacity value of DR. If LRAs adopt an ELCC methodology for DR resources, the CAISO could rely on the ELCC methodology to establish UCAP values for DR resources as it proposes to do for wind and solar

[13] Forced outages are accounted for by using actual production data to inform the wind and solar production profiles in the ELCC modeling.
[14] ESDER 4 Stakeholder Initiative Webpage: http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_DistributedEnergyResources.aspx

resources. If LRAs do not adopt an ELCC methodology for DR resources, the CAISO proposes to use a historic performance based approach described below.

Resources that do not have ELCC based QC methodologies applied but need alternative approaches for UCAP determination

For DR and QF resources their availability is often variable or limited to certain periods dictated by program hours or end-use customer needs. The CAISO believes these resources should be assessed in a different manner to establish their UCAP values. If the LRAs do not adopt an ELCC based QC methodology for these variable and availability-limited resources, the CAISO will apply the following UCAP determination approach. For DR and QF resources, the CAISO will evaluate these resources' performance relative to their dispatch instructions for periods when they received market awards.

For DR providers, the CAISO is also contemplating the need to apply this approach at an SC-level, rather than an individual resource level to mitigate the potential for gaming or manipulation by simply creating new DR resource IDs. This SC-level approach is intended to block the ability for poorly performing DR providers to receive class-average UCAP values simply by changing or creating a new resource IDs that have no historical data.

The CAISO will track these resources historical performance over the prior 3 years and compare their market dispatches to their actual performance during those periods to establish the availability that will be applied to their UCAP value.

Resource Forced Outage and Derate Data

The first and primary input needed to calculate a resource's UCAP value is accurate and appropriate forced outage and derate data. The availability factor proposed above will be based upon a resource's forced outages and derates during the tightest system supply condition hours. This forced outage and derate data is the key information necessary to calculate the expected value (in terms of MWs) of a capacity resource's unforced capacity. To determine resource availability factors, CAISO considered two potential data sources, the CAISO's Outage Management System, and the NERC Generation Availability Data System (GADS).[15]

NERC's GADS compiles resource outage data for resources across the country. Although 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 the number of small distributed resources increases over time, GADS may miss a large number of resources and/or resource types that can provide RA capacity. The CAISO could establish tariff requirements for reporting of NERC GADS data to aid data development for the CAISO's proposed UCAP concept. However, this could be problematic due to the limitations on size and resource types requiring potential exclusions or caveats. Furthermore, the CAISO is concerned that more universal outage reporting for GADS purposes may not always align with the potential CAISO forced outage nature of work cards. The CAISO believes a good area to focus on for this stakeholder process is defining the

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

type/nature of outages that will be assessed against a resource's forced outage rate. It is a vital issue to establish an accurate and fair forced outage rate definition.

The CAISO has numerous outage cards in the CAISO Outage Management System (OMS) that are designed to describe the nature of work for resource outages. The CAISO also uses these outage cards to determine whether a resource must provide substitute capacity to avoid RAAIM charges, or if the outage is beyond the resource's control and therefore RAAIM exempt. However, the CAISO has encountered challenges utilizing the OMS as currently configured. More specifically, the OMS system is not currently designed or easily converted to generate forced outage rates.

Given these challenges, the CAISO is exploring additional options for collecting data to calculate forced outage rates. The CAISO efforts can be broken down into two objectives: (1) transitioning to UCAP, and (2) longer term outage collection and reporting. These efforts continue to look at both GADS and OMS data while also considering potential for new outage reporting. Ultimately, the CAISO seeks a solution that a) aligns the outage reporting in CAISO systems and GADS and b) provides incentive for individual resources to minimize forced outage rates, instead of leaning on technology type class averages. The remainder of this subsection provides additional details regarding the CAISO's efforts to both transition to UCAP and then ensure accurate long term outage reporting.

To transition to UCAP, and address the challenges with using the existing OMS data, the CAISO is considering other options. Given the outage reporting differences between GADS and OMS, the CAISO believes a perfect estimate of UCAP in year one is unlikely. Therefore, the CAISO is considering a transitional approach that creates a reasonable estimate of resources' forced outage rates, while longer-term, a new or revised system is developed. As such, the CAISO will look to balance precision with complexity and cost. The CAISO proposes to rely on GADS data as a transitional approach to establish initial UCAP values.

The CAISO proposes requiring all resources to submit five years of GADS data to the CAISO, or as many years of data as the resource has available in GADS. The CAISO would then use these values to generate resource specific UCAP values. Finally, the CAISO proposes to reconfigure its OMS system or to develop an alternative system to accurately track resource's forced outages and derates to generate resource specific UCAP values once the process has been established using the available GADS data to begin the initial UCAP implementation process. This would require the CAISO to make changes to the OMS system and nature of work outage cards.

The CAISO is also considering an alternative option that requires all resources to submit GADS data on an annual basis to calculate UCAP values instead of updating the CAISO's OMS or other systems. The CAISO must balance the cost and benefits of creating a new or revised system to calculate forced outage rates.[16] However, the CAISO is concerned about the growing

[16] Transitioning to a new OMS system or creating a new outage reporting system requires the CAISO to determine if there are any necessary modifications to the forced outage cards nature of work definitions. The CAISO also needs to modify the requirements for what information is provided through the CAISO

number of resources that may fall below the 20 MW GADS reporting requirement and the misalignment this could cause between NERC and OMS outage reporting. Therefore, the CAISO is hesitant to rely strictly on GADS data as a long-term solution. Alternatively, the CAISO is also considering assessing UCAP using resource specific outage rates. As noted, accessing this data from NERC is not feasible. Therefore, the CAISO is seeking stakeholder input to assess which of these is a preferred approach.

Finally, the CAISO continues to assess the existing Nature-of-Work cards to determine how best to leverage them for UCAP outage calculations. The CAISO seeks stakeholder feedback on the nature of work card classifications that will be used for calculating resource specific forced outage rates as described below. Further, given the continued (and even increased) importance on outage reporting, the distinctions between forced and planned outages, and how to differentiate among the different outage natures of work, the CAISO seeks stakeholder feedback on what additional outage reporting tariff and BPM clarifications may be appropriate.

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

CAISO must calculate each units 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's availability.

CAISO provides the following table of nature of work outage cards to help develop the appropriate classification for each outage nature of work card and how that outage type will be used in calculating resources' availability. CAISO proposes to assess outages against resources UCAP value for the nature of work outage cards as described in Table 3 below.

Table 3: Forced Outage Cards – Nature of Work

Outage Type	Nature of Work/Opportunity Status	Impacts resource UCAP?
Forced	Ambient Due to Temperature	Yes
Forced	Ambient Not Due to Temperature	Yes
Forced	Ambient due to Fuel insufficiency	Yes
Forced	AVR/Exciter	Yes
Forced	Environmental Restrictions	Yes
Forced	Short term use limit reached	Yes
Forced	Annual use limit reached	Yes

OMS to provide the correct information to make accurate assessments of resource specific availability. Additionally, OMS will likely require some level of system modifications to accurately and automatically track resource outage data on a comparable basis.

Outage Type	Nature of Work/Opportunity Status	Impacts resource UCAP?
Forced	Monthly use limit reached	Yes
Forced	Other use limit reached	Yes
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
Forced	Short Notice Opportunity	No
Forced	RIMS testing	Yes
Forced	RIMS Outage	Yes

Coordination of Proposed UCAP Concept with CPUC RA Program

The CAISO received stakeholder feedback that it must closely consider how its proposed UCAP concept will be coordinated with the current CPUC RA program. Certain parties 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 appreciates these concerns and will work with LRAs to align RA programs with the current

proposal, including the CAISO submitting its proposed counting rules in the upcoming CPUC RA proceeding.

The CAISO's proposal provides improved transparency over resource forced outage rates, which will help improve procurement of the most dependable and reliable resources and better inform retirement decisions. Existing installed capacity measures reflect an expected fleet average outage rate, which can result in efficient resource procurement on the low end of the forced outage distribution and more overall procurement than might be seen using UCAP values. The 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.

Removing Forced Outage Replacement and RAAIM application to forced outage periods

The CAISO's existing 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 AAHs for generic capacity are 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 RA program is designed to ensure the CAISO has sufficient capacity available to serve load reliably through its market dispatch. Any resource providing RA capacity to the CAISO has an obligation to offer that capacity into the CAISO's markets. The Must Offer Obligations (MOO) for various RA and technology types are listed in the CAISO's Reliability Requirements BPM.[17] CAISO also relies on outage reporting to track whether resources are available at any given time. If there is sufficient notice given and capacity available, the CAISO can grant outages without requiring replacement capacity. However, not all outages occur under those conditions, and the CAISO developed RAAIM to address these particular instances.

RAAIM was 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. Although 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.

[17] See the Reliability Requirements BPM, pp. 77-82 for System and Local RA obligations and pp. 93-96 for flexible RA obligations.

The CAISO reviewed the effectiveness of RAAIM to incentivize resources to provide replacement during forced outages. As a starting point, CAISO reviewed data from the CIRA, system. Data was pulled from May 1, 2018 through July 31, 2019. CAISO compared the quantity of shown RA MW for a given day, the reported MWs of capacity on forced outage, and the MWs of forced outage substitute capacity provided. The CAISO did not differentiate the cause of the forced outage, including whether or not the outage was exempt from RAAIM. At the core, the effectiveness of RAAIM should not be measured simply by how much of capacity is replaced for certain outage types, but by how well it ensures there is adequate capacity available to CAISO. Even if the vast majority of outages are RAAIM exempt, CAISO may be left with insufficient capacity. Figure 4 shows that, overall, very little substitute capacity is being provided to the CAISO in response to forced outages. Additionally, the CAISO understands that there may be limited capacity available in some local areas to provide substitute capacity. The CAISO conducted a similar assessment of system level capacity and found, with very limited exceptions, similar results. These results are shown in Figure 5.

Figure 4: Forced Outages vs Replacement Capacity (All)

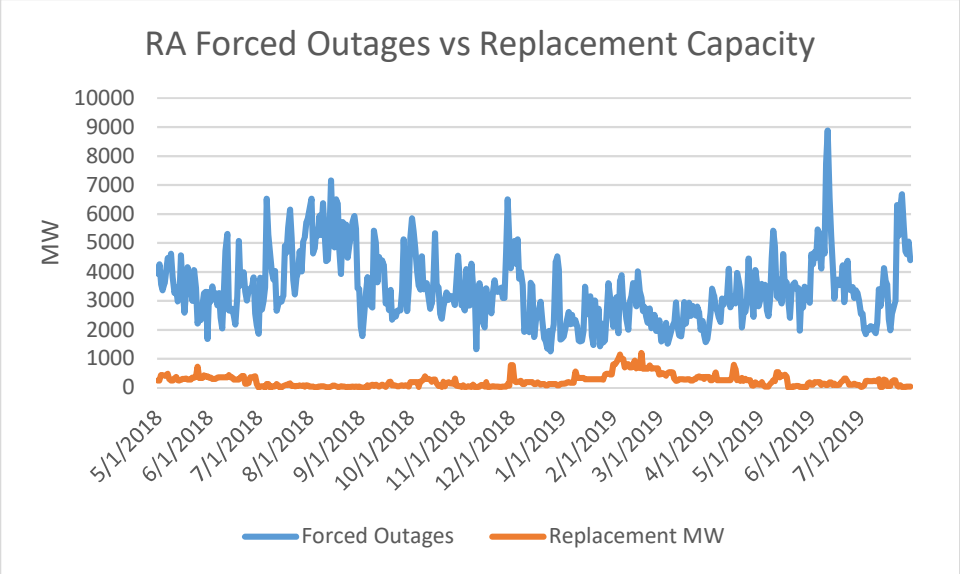
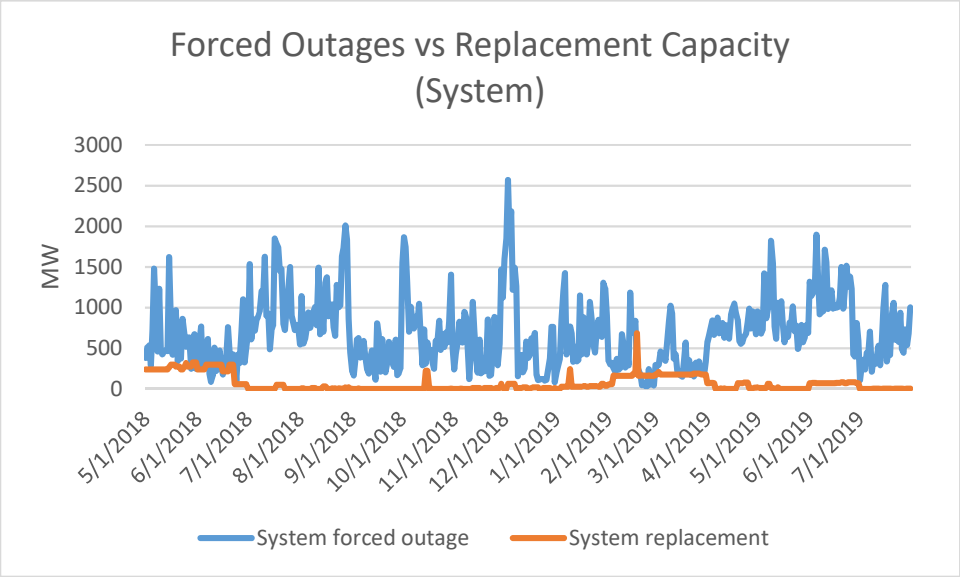


Figure 5: Forced Outage vs Replacement Capacity (System Only)



The CAISO concludes that RAAIM is not providing adequate incentive to provide substitute capacity for forced outages and proposes to eliminate it once UCAP is implemented. The CAISO cannot ascertain if the risk of RAAIM charges is already incorporated into capacity pricing, if RAAIM costs are not high enough, or if benefits are spread too thin to motivate substitution. Other factors could include portfolio effects (*i.e.*, an SC receives similar RAAIM charges and incentives, balancing each other out), too many RAAIM exclusions/exemptions, the dead band applying for the first outages, or some other reasons. Ultimately, CAISO's analysis shows that the RAAIM does not effectively ensure adequate capacity will be provided to the CAISO and, therefore, it is reasonable to eliminate RAAIM once an alternative solution is in place.

The CAISO believes a superior approach is to establish incentives to conduct resource maintenance to avoid outages and to procure capacity that is more reliable in the first instance. UCAP provides the proper incentives, while still allowing LSEs to procure the most cost effective capacity needed to meet their procurement obligations. The relationship between MOOs, RA substitution rules, and RAAIM creates a complex system of processes that differ vastly from other ISOs/RTOs. In light of above data and CAISO's UCAP proposal, it is possible and desirable to eliminate these complex relationships for a process that appropriately relies on the upfront and transparent accounting of resource availability and reliability.

5.1.3. System RA Showings and Sufficiency Testing

The 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. The CAISO will also conduct tests for flexible and local capacity needs; those assessments are discussed in Sections 5.2 and 5.3 respectively.

Individual Deficiency Assessments

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

Additionally, LSEs will not be permitted to procure only the "good part" of a resource (*i.e.*, LSEs cannot simply procure only the unforced capacity portion 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

The CAISO also proposes to develop an individual LSE RA showing incentive. The CAISO proposes to develop a new tool called the UCAP deficiency tool, which is intended to discourage LSEs from failing to show RA at least equal to their UCAP requirement and incentivize LSEs to show above their UCAP obligations and . 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 described in Section 5.4, below. Examples and further discussion of this proposed concept are also provided in Section 5.4.4.

Portfolio Assessment

The CAISO will conduct a portfolio deficiency test of 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 able 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, the CAISO will only conduct this assessment for monthly RA showings, which are the only showings that have 100 percent of the system, local, and flexible RA capacity requirements. The increased number of energy and availability-limited resources on the system and the reliance on these resources to meet RA needs means that some resource mixes provided to meet RA requirements may not ensure reliable operation of the grid during all hours of the day across the entire month. Similar to the local assessments, the CAISO is looking to maintain a consistent definition for capacity to facilitate transacting a homogeneous product. However, the CAISO must assess how the shown RA fleet works collectively to meet system needs.

The objective of a portfolio analysis is to assess if the 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, the CAISO will only conduct this assessment for monthly RA showings.

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

Table 4: Portfolio Assessment Modeling Options

Modeling Approach Option	Iteration[18]	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 pros and cons regarding 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

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

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.

Having assessed the time constraints, complexity, and data output, the CAISO favors the net load deterministic model at this time. However, the CAISO is still assessing the feasibility of each of the above options as well as a couple options that merge elements from each. Part of the CAISO's ultimate decision will come down to a logistics assessment. The CAISO must conduct this assessment and provide feedback to market participants within 10 days of receiving RA showings; therefore, processing time is critical. The CAISO will be the first ISO or RTO to conduct such an assessment, regardless of turnaround time, making it reasonable to start with the least complicated option and "learn to walk before we run."

Finally, the 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 the CAISO's operational needs. The CAISO explored two primary metrics for the portfolio deficiency test: serving load and loss-of-load expectation. Given the CAISO will initially conduct a production simulation that is largely deterministic, there is insufficient information to generate a meaningful LOLE. Therefore, the CAISO proposes to use the portfolio's ability to serve forecasted load for the upcoming month. The portfolio must ensure the CAISO can maintain load, Ancillary Services, and load following [19] requirements for all days and all hours in the portfolio deficiency test. If any of these requirements is not met, the CAISO will identify a portfolio deficiency.

The CAISO will model only RA resources in this portfolio analysis. Any additional energy provided in the CAISO's day-ahead or real-time markets represents energy substitutes in those markets, but are not needed in the portfolio assessment to determine if the RA fleet is adequate. Additionally, the CAISO must establish baseline inputs into the portfolio assessment. The CAISO will rely on the CEC 1-in-2 hourly load forecast. Because the analysis is run on hourly blocks, the CAISO will also include load following requirements. The wind and solar production profiles will be generated prior to 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, no additional actions will be taken. If the portfolio is unable to serve load under given load or net load conditions, then the CAISO will declare a collective deficiency, provide a cure period, and 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.

The CAISO considered additional assessments of individual RA showings, however, it is not feasible to adequately develop individual LSE load profiles and determine how a specific LSE's

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

RA portfolio contributed to the collective deficiency and, therefore, is subject to LSE specific cost allocation. However, the CAISO is supportive of and committed to working with the LRAs to establish up-front procurement requirements, similar to the CPUC's maximum cumulative capacity (MCC) buckets, to help ensure collective procurement of a resource portfolio with the best possibility of passing the portfolio assessment.

5.1.4. Must Offer Obligation and Bid Insertion Modifications

The RA program is designed to ensure the CAISO has sufficient capacity available to serve load reliably all hours of the year. Any resource providing RA capacity to the CAISO is obligated to offer that capacity into the CAISO market. This ensures the market has sufficient bids available to dispatch resources to serve system load reliably. RA resources will continue to have a must offer obligation under RA Enhancements. Currently, the CAISO tariff contains provisions regarding must offer obligations, bidding, and bid insertion rules. The CAISO proposes the following must offer obligation and bid insertion modifications in this initiative:

- Must offer obligations must be set at the amount of NQC shown for RA, not the amount of UCAP shown;
- Resources have a 24 by 7 must offer obligation into the day-ahead market unless exempt, and;
- Non-use-limited resources and use-limited resources with an opportunity cost will receive bid insertion, unless exempt.

Stakeholder Comments

In the last iteration of the proposal, the CAISO introduced a modification to the existing RA must offer obligation to align with developments made in the day-ahead market enhancements initiative. This modification would require RA resources to offer into the day-ahead, and offer into the real-time market if awarded day-ahead, given the introduction of the imbalance reserve product. Several stakeholders, including CalCCA, MRP, Shell, and Wellhead generally support the CAISO's proposal to define day-ahead must offer obligations for resource adequacy resources and base real-time must offer obligations on day-ahead awards. PG&E, SCE, and SDG&E shared concerns with removal of the real-time must offer obligation for RA resources in favor of a real-time MOO based on day-ahead market awards.

PG&E states that freeing capacity from offering in the real-time that can be used to address changes between the DA market and RT markets could result in increased redispatch and uplift costs. While this would be true without an imbalance reserve product, the CAISO has proposed in the Day-Ahead Market Enhancements initiative to procure imbalance reserves to meet imbalance and uncertainty needs between day-ahead and real-time. Because resources with imbalance reserve awards will be required to economically bid capacity into the real-time market, the CAISO anticipates this proposal will likely minimize uplift costs as opposed to increasing them. PG&E requested and the CAISO considered data analysis on the impact of this proposal on uplift costs. The CAISO has conducted significant data analysis through the DAME initiative to analyze the impacts of the proposed imbalance reserve requirement to ensure it is sufficient to cover the 95th percentile of real-time imbalance needs. Therefore, the

proposal should have negligible impacts on uplift costs—and could potentially reduce them since the imbalance reserve product will be locational as well.

SCE and SDG&E expressed concerns with providing capacity payments through the imbalance reserve award because those costs may already be embedded in long-term contracts. The CAISO believes that capacity bidding and payments for imbalance reserve are necessary to efficiently dispatch capacity resources within the CAISO and the greater EDAM footprint. The revenue from imbalanced reserves sales should be considered in long-term contracts (*i.e.*, lower capacity prices). Additionally, SDG&E also suggests this proposal would potentially provide resources additional revenues already captured as part of RMR and CPM payments. The CAISO will claw back imbalance reserve revenue in a manner similar to energy and AS revenues for RMR. The CAISO does not believe this is a concern for CPM as CAISO only pays going forward fixed costs for CPM payments. Imbalance reserves should represent the costs of being available through the CAISO real-time markets. As the CAISO continues to develop the imbalance reserve product and associated must offer obligation modifications, the CAISO will ensure alignment with the RMR and CPM offer obligations.

PG&E and the Six Cities also expressed concern that the proposal to modify the 24 by 7 must offer obligation into the real-time market, as well as the proposed bid insertion rules, does not address the fact that some resources may not be able to participate in all hours of the day due to operational constraints. The CAISO believes a 24 by 7 must offer obligation into the day-ahead market is still appropriate with a fleet made up of increasingly use- and availability-limited resources because it gives the CAISO market the ability to determine which subset of hours a resource is needed. While certain use-limited resources may not be capable of operating 24 hours a day, they are typically still available 24 hours a day (meaning they are available any time of day, with certain limitations such as starts, duration, etc.). If the resource is available, it should be bidding into the CAISO market and the market should determine the most appropriate time to use the resource, while considering the use-limitations of the resource. If a resource is not available, an outage card should be submitted to reflect this availability. To accommodate resources that cannot adhere to the 24 by 7 must offer obligation into the day-ahead because they are not available all hours, the CAISO proposes to have limited exemptions for such resources.

Some stakeholders asked the CAISO how removal of the real-time MOO for RA resources impacts the effectiveness of system market power mitigation. The CAISO is conducting a System Market Power Mitigation initiative, phase one that is considering implementing system market power mitigation in the real-time market only.[20] The CAISO believes the removal of the real-time must offer obligation for RA resources would not impact the effectiveness of system market power mitigation in the real time market. All of the CAISO's current and planned market power mitigation processes treat resources the same regardless of whether or not a resource has a must-offer obligation. Suppliers could attempt to exercise market power through economic withholding with or without a must-offer obligation. Therefore, CAISO's processes will evaluate all resource supply offered to the market to determine when mitigation is necessary

[20] http://www.caiso.com/Documents/ScopingDocument-SystemMarketPowerMitigation.pdf

and which resources should be mitigated. This would continue under the proposal to remove the real-time RA must offer obligation without a day-ahead award.

Several stakeholders, including Calpine, PAO, SDG&E, Shell, and the Six Cities, expressed concern or questioned the benefit of the CAISO's proposal to require non-resource specific imports to submit bids in blocks no longer than one hour. Specifically, stakeholders expressed concerns that operational characteristics (*i.e.*, minimum run times, transition times, etc.) of non-resource specific imports are not modeled and instead, resource owners bid in multi-hour blocks to reflect those operational characteristics. The CAISO understands this concern and believes resources should be modeled as resource specific to reflect these operational characteristics. This is discussed in more detail in the section, Exemptions to Standard Must Offer Obligation, below.

Must Offer Obligations Proposal

Must offer obligations must align with NQC values

The CAISO proposes that a resource's must offer obligation be consistent with the resource's shown capacity scaled up for the forced outage rate adjustment. This means that the must offer obligation will be for the equivalent installed capacity, up to the resource's NQC value. For simplicity, the CAISO will refer to this quantity as shown NQC. This is consistent with the practice in other ISO/RTOs.[21] More specifically, if a 100 MW resource with a 20 percent forced outage rate is shown for 80 MW of UCAP, then it has shown its full 100 MW of NQC. It must then bid 100 MW of capacity into CAISO's markets when the resource is not on outage.[22] This bidding rule is required to ensure sufficient capacity is available to the system at all times by accounting for the fact that some resources will be on forced outage. Absent this requirement, units must be available 100 percent of the time to their UCAP values or provide substitute capacity, otherwise the CAISO would be short of available RA capacity. Assuming resources are available 100% of the time is an unreasonable expectation and requiring replacement capacity defeats the goal of simplifying RA rules.

Alternatively, and as proposed here, setting the must offer obligation at the shown NQC value allows CAISO to eliminate forced outage substitution and its complexities. 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 proposes to eliminate 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 in Section 5.1.2, above.

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[21] 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."

[22] If a resource only shows a portion of its NQC as RA, the must offer obligation is set at the portion of the NQC that is shown for RA, not the full amount.

Resource Adequacy resources will have a day-ahead must offer obligation

As the RA Enhancements and Day-Ahead Market Enhancements stakeholder processes evolve, the CAISO assessed whether there is a need for a real-time RA must offer obligation. Sufficient commitments and capacity reservations made in the day-ahead market could obviate the need for a real-time RA must offer obligation. The CAISO is proposing a new capacity product in the Day-Ahead Market Enhancements initiative called imbalance reserves. Imbalance reserves will help the CAISO commit and position resources during the day-ahead timeframe to provide upward and downward ramp capability in the real-time market. After reviewing developments in both initiatives, the CAISO has determined, with limited exceptions, a day-ahead must offer obligation for resource adequacy resources is sufficient to commit resources and reserve capacity for use in real-time. This is because all resources awarded in the day-ahead, including resources awarded imbalance reserves, will have a real-time must offer obligation up to their day-ahead award. As such, the CAISO proposes must offer obligations for RA resources into the day-ahead market only. As discussed in greater detail below, a limited set of RA resources, due to program design or forecasting challenges, will continue to have real-time must offer obligations, regardless of day-ahead awards.

This solution is more efficient than the current 24 by 7 resource adequacy must offer obligation into both day-ahead and real-time markets. Under this proposal, the resource adequacy program will ensure suppliers offer sufficient capacity into the day-ahead market. The day-ahead market will then commit resources to meet the energy, imbalance reserve, and ancillary service needs for the following trade day. Resources awarded in the day-ahead, including resources with imbalance reserve awards will have a must-offer obligation into the real-time market. The CAISO will require any resource with an imbalance reserve award to reserve capacity in the day-ahead timeframe and make that capacity available in real-time. This will ensure the CAISO can efficiently meet ramping and uncertainty needs between the day-ahead and real-time markets. The real-time must offer obligation based on awards made in the day-ahead will provide the CAISO with adequate capacity for use in real-time, while relieving capacity not committed in day-ahead of their real-time must offer obligation.

Under the Day-Ahead Market Enhancements and RA Enhancements proposals, resource adequacy resources will have a 24 by 7 must offer obligation in the day-ahead market only. Their must offer obligation will be extended into real-time if the resource is scheduled in day-ahead for energy, ancillary services, or imbalance reserves. Although RA resources would not have a real-time must-offer obligation if they are not awarded in the day-ahead, **RA resources must still be available for exceptional dispatch after the day-ahead market whether or not they receive a day-ahead award.** If resources receive an exceptional dispatch, they will be required to provide that energy real-time and would not qualify for an ED CPM designation when they respond to that exceptional dispatch.

While flexible RA resources will be required to bid for imbalance reserves, it is optional for system or local resources to bid for imbalance reserves. Must offer obligations for flexible resources are described in section 5.2.6. This approach will better align the must offer obligations to the operational needs because the day-ahead market will position resources prior to the real-time market to meet energy and imbalance needs and appropriately compensate

resources for being available for re-dispatch in real-time. By committing these resources in the day-ahead, it should be unnecessary for all RA resources to have a 24 by 7 must offer obligation in the real-time market without a day-ahead award.

Standard must offer obligation

The CAISO 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. To simplify the must offer obligations, the CAISO proposes a standard must offer obligation into the day-ahead market that would apply to all resources unless specified by CAISO under an exemption by resource type.

> **Standard day-ahead must offer obligation:** Economic bids or self-schedules for all RA capacity for all hours of the month a resource is not on outage. [23]

Some stakeholders suggested the 24 by 7 must offer obligation does not align with the future makeup of the RA fleet, in which many resources will have use- or availability-limitations. The CAISO recognizes certain resources require exemptions, or variations, to the standard must offer obligation and identifies these below. However, the standard must offer obligation into the day-ahead market remains 24 by 7 for most resource types. While the makeup of the resource fleet is becoming increasingly use- and availability-limited, the CAISO believes most resources should still bid into the day-ahead market for all hours the resource is not on outage. A resource should have bids in all hours it is available, such that the day-ahead market can determine when the resource is needed over the course of the day and schedule it appropriately.

Rather than modifying the day-ahead 24 by 7 must offer obligation, the CAISO believes modifying the MCC buckets would more appropriately address the increased amounts of availability-limited resources on the system. In its Order Instituting Rulemaking in the RA proceeding, the CPUC lists potential modifications to the MCC buckets as an option to consider when structurally changing the RA program in response to the rapidly changing resource fleet. [24] Redefining the MCC buckets, coupled with a 24 by 7 must offer obligation into the day-ahead market could be beneficial because resources with limited availability could contribute to RA needs consistent with their energy limitations, while still providing the CAISO market the ability to determine the hours the resource is needed over the course of the day. Additionally, this approach would benefit LSEs by providing more guidance into resource attributes needed to increase the possibility of passing the portfolio assessment, as discussed in Section 5.1.3.

Bid Insertion Proposal

The CAISO is proposing revisions to the bid insertion rules. Although the CAISO currently requires RA resources to economically bid or self-schedule into the market, it also supplements

[23] Outage refers to both planned and forced. If a resource is on outage, whether it is planned or forced, it should not be bidding that capacity into the market because it would not be able to deliver it.
[24] CPUC Order Instituting Rulemaking, November 13, 2019. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M319/K527/319527428.PDF

those bidding obligations with bid insertion provisions for non-use limited resources. The CAISO considered two potential options for revising bid insertion rules:

1. Apply bid insertion to all non-use-limited resources 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.

The CAISO proposes adopting option 1. The CAISO 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 will ensure that resources have bids in the market and that outages would be reported to avoid market dispatch, enhancing the CAISO's ability to identify forced outages. Additionally, option 2 creates a greater disincentive to show RA capacity.

Conditionally available resources, which have regulatory or operational limitations that do not qualify as use-limited, would not be exempt from bid insertion.[25] Conditionally available resources are able to use special outage cards to manage their conditionally available outages and derates. The ISO requires that conditionally available resources submit outage cards when unavailable, similar to all other resources on the system. Given this, the CAISO proposes not to exempt these resources from the standard must offer obligation or bid insertion.

Exemptions to Standard Must Offer Obligation

The CAISO recognizes that not all resource types are physically capable of meeting the proposed standard must offer obligation, or require variations to the standard must offer obligation to provide the needed attributes of system and local RA. Therefore, the CAISO proposes a limited list of exemptions to the standard must offer obligation outlined in Table 5. Exempt resource types will still be subject to must offer obligations, but they will be defined by the CAISO based on the characteristics of the resource type.

The CAISO also recognizes the need to specifically define 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. Therefore, the CAISO also includes bid insertion exemptions listed in Table 5. If a resource is exempt from bid insertion, the CAISO would not insert bids into the day-ahead market for these resources in the event that required amounts of RA capacity are not offered into the day-ahead market. This table summarizes day-ahead market must offer obligations and bid insertion rules only.

The CAISO initially proposes to generally define the following exemptions for must offer obligations and bid insertion into the day-ahead market based on resources type and seeks stakeholder feedback on this list, including modifications or additions. Resources exempted

[25] Tariff Definition of Use-Limited Resource and Conditionally Available Resource: http://www.caiso.com/Documents/AppendixA-MasterDefinitionSupplement-asof-Sep28-2019.pdf

from the standard must offer obligation will still be required to offer into the CAISO market, but must do so as described in Table 5 and the paragraphs below.

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

Resource Type	DA MOO	DA Bid Insertion
Eligible Intermittent Resource	May, but not required to, submit Bids in the Day-Ahead Market (day-ahead market enhancements proposes to schedule resources at their day-ahead forecast)	No
NGR (Non-REM)[26]	Standard DA MOO plus MOO should reflect charge and discharge capabilities	No
Non-Dynamic, Non-Resource Specific Imports	Standard DA MOO plus block bids or self-schedules should be no longer than one hour for non-resource specific imports providing resource adequacy Economic bids or self-schedules must be submitted under the same resource ID registered as an RA resource on RA supply plan	Yes
PDR[27]	Refer to Energy Storage Distributed Energy Resources Phase 4 initiative for developments on bidding obligations for PDR [28]	No
Participating Load	Participating load that is pumping load shall submit Economic Bids for Energy and/or a Submission to Self-Provide Ancillary Services in the Day-Ahead Market for its Resource Adequacy Capacity that is certified to provide Non-Spinning Reserve Ancillary Service.	No
RDRR	May, but not required to submit Bids in the Day-Ahead Market	No
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
Run-of-River Hydro	May, but not required to submit bids in day-ahead market	No

[26] Additional detail on potential solutions for market participation of storage resources is included in section 5.1.7.
[27] CAISO is considering potential modifications to must offer obligations for variable-output DR in the ESDER 4 stakeholder process, including bidding requirements and submission of forecasted capability. ESDER Stakeholder Initiative Webpage: http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_DistributedEnergyResources.aspx
[28] PDR bidding requirements are specified in CAISO tariff Section 30.6.1 – Bidding and Scheduling of PDRs.

The following paragraphs include additional detail and rationale on the exemptions outlined in Table 5 above.

The CAISO proposes that for resources participating under the NGR model, the must offer obligation reflect both the charge and discharge capabilities of the resource so the CAISO can fully optimize the resource. To do so, the CAISO must have bids available for the unit's full capability. Bidding full charge and discharge capability will allow the CAISO to ensure fuel sufficiency for the resource. At this time, the proposal would also apply for battery storage resources participating under the NGR model regardless of the point of interconnection (*i.e.* transmission or distribution), and the CAISO is considering how it would apply to other technology types that may participate under NGR in the future.

The 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. The 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.

Currently, RA imports may submit multi-hour block bids or self-schedules. As outlined in Section 5.2, the CAISO is proposing to adopt requirements for the flexible RA program that focus on meeting uncertainty needs between day-ahead and real-time, rather than predictable ramps over the course of the day. However, the CAISO still needs to be able to shape day-ahead market awards to meet predictable ramping needs over the course the day. The system RA fleet must, therefore, be capable of being shaped hour by hour. Multi-hour block schedules negatively impact the CAISO's ability to avoid renewable curtailment and ramping constraints. Therefore, under this proposal the CAISO proposes that system RA resources may not submit block bids or self-schedules greater than one hour.

Several stakeholders expressed concern or questioned the benefit of this proposal. Specifically, stakeholders expressed concerns that operational characteristics (*i.e.*, minimum run times, transition times, etc.) of non-resource specific imports are not modeled. Instead, resource owners bid in multi-hour blocks to reflect those operational characteristics. If the CAISO requires resources to submit no greater than one hour block bids, then these characteristics may not be respected. The CAISO understands this concern, but believes resources that require operational characteristics to be modeled should register their resource as resource specific, such that their operational characteristics can be reflected by modeling them in Master File rather than by bidding them in multi-hour blocks. This allows the CAISO to shape resources hour by hour while still respecting the operational characteristics of the resource. As described in Section 5.1.6, the CAISO is reconsidering a resource-specific import RA requirement, which could obviate the need for this aspect of the proposal.

A few resources will continue to have a real-time must offer obligation for RA capacity, including RDRRs and resources with intra-hour variability. The CAISO must maintain the real-time must offer obligation for RDRR resources. Unlike other RA resources, RDRR is not required to participate in day-ahead and is only available in real-time if the CAISO declares a warning or

emergency. Therefore, the CAISO must ensure RDRR resources continue to have a real-time must offer obligation to ensure they are available in real-time if needed. Additionally, the CAISO proposes to apply bid insertion for RDRR resources in the real-time. The CAISO proposes to insert bids at 100% of the bid cap so RDRR resources, which are reserved for emergencies, are not used before resources that offer below the cap.

The CAISO must also maintain the real-time must offer obligation for resources with intra-hour variability, such as eligible intermittent resources and run-of-river hydro. Run-of-river hydro resources have similar operating characteristics to wind and solar because they have limited ability to control output from one interval to the next. It is optional for eligible intermittent resources to bid into the day-ahead market. In real-time, they are scheduled based on a forecast provided by the CAISO. This ensures feasible real-time dispatches that reflect intra-hour variability. The CAISO does not currently receive forecast data for run of river hydro or have the ability to provide forecasts for them. Therefore, run-of-river hydro cannot be treated as a VER due to lack of data availability. However, they can be treated similarly for the purposes of the must offer obligation. The CAISO proposes run-of-river hydro submit their own forecast of resource output to set the upper economic limit on bids. Eligible intermittent resources and run-of-river hydro would, therefore, not have a day-ahead must offer obligation, and would have a real-time must offer obligation up to their forecasted amount.

The CAISO is also proposing changes to bidding rules and must offer obligations for variable-output demand response resources in the Energy Storage and Distributed Energy Resources (ESDER) initiative.[29] These changes would allow resources to submit forecasted capability and satisfy their must offer obligation by bidding this capability. Additional details on the bidding requirements for variable output demand response will be developed within the ESDER initiative.

For resources providing their own forecast, such as run-of-river and variable-output DR, the CAISO is considering potential provisions that limit opportunities to submit inaccurate forecasts for strategic purposes. Additionally, as resource types requiring treatment based on a forecast increases, the CAISO may also consider the need to allocate commitment costs made due to forecasting uncertainty.

The 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 the CAISO market. The CAISO welcomes stakeholder feedback on the proposals for the standard must offer obligations and list of exemptions.

Additionally, the CAISO has limited NGR eligibility for system RA to resources under the non-regulation energy management (non-REM) option. The CAISO cannot maintain system reliability over-relying on resources limited to providing regulation only. REM management

[29] As per the ESDER 4 initiative The CAISO defines variable-output demand response resources as those demand response resources whose maximum output can vary over the course of a day, month, or season due to production schedules, duty cycles, availability, seasonality, temperature, occupancy, etc. For more detail, see ESDER 4 Revised Straw Proposal at: http://www.caiso.com/StakeholderProcesses/Energy-storage-and-distributed-energy-resources

resources are neither required, nor capable, of providing energy needed to meet the energy needs of system. Therefore, the CAISO has limited the system RA eligibility of NGRs to NGRs with the non-REM option.

5.1.5. Planned Outage Process Enhancements

The CAISO considered modifying its planned outage provisions to correspond with the proposed modifications to its RA counting rules and assessments. The CAISO describes its proposed changes to its planned outage provisions in the following section and some relevant background on the current provisions.

Stakeholder feedback

In the second revised straw proposal, the CAISO put forward a new planned outage process aimed at simplifying the planned outage process and timeline. All stakeholders agreed with the CAISO's proposal to eliminate the "comparable" capacity requirement for planned outages. However, there was not a similar consensus among stakeholders with respect to other elements of the CAISO's new proposed timeline and process. In comments, MRP supported the CAISO proposal. CalCCA supports the CAISO proposal, but expresses concerns that it will incentivize capacity withholding. PG&E is generally supportive, but requests the CAISO use the Competitive Solicitation Process (CSP) to procure adequate substitute capacity. SDG&E believes that the CAISO's proposal will actually result in decreased flexibility and complicate planned outages management. NCPA states that the CAISO proposal needs to better reflect the operational realities of planned outages. Calpine argues that the CAISO proposal is unlikely to achieve its goal of improving certainty. Specifically, Calpine suggests that the existing compensation for CAISO cancelled planned outage is not adequate and can be extended for some approved outages, for example, outages submitted and approved before T+45.

Given the differing views on the proposal, the CAISO believes it is appropriate to further examine the proposal put forward in the second revised straw proposal. The CAISO has also developed an alternative proposal for facilitating planned outages. These two options are discussed in more detail below.

There were several requests for clarity that extend more generally to planned outages. Specifically, SCE asks for additional detail regarding the administration of the outage proposal and requests the CAISO clarify that any planned outage turns into a forced outage will not be considered a tariff violation. The CAISO clarifies that it is not proposing changes to its current policy that denied planned outages taken as forced outages is considered providing false information to the CAISO and subject reporting to FERC.

Wellhead and Calpine recommend that the CAISO allow for short-term opportunity outages. Wellhead specifically notes that if the resource has not received a day-ahead market award it should be permitted to take a short-notice opportunity outages. The CAISO believes this is consistent with the must-offer obligations described in section 5.1.4, and clarifies below that this type of outage is allowable but remains subject to CAISO discretion.

Background

The 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 and the Outage Management BPM. RA resources currently enter planned outages into CAISO Outage Management System (OMS). The 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,[30] therefore resources submitting planned outages earliest will have the greatest likelihood of being approved to take their planned outages without substitution requirements. The POSO process compares the total amount of operational RA capacity to the total system RA requirement.

As noted previously, LRAs establish system RA requirements 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, the CAISO assigns substitution obligations for resources seeking to take planned outages during those short timeframes.

Objectives and Principles

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

- Encourage resource owners to enter outages as early as possible
- Avoid cancellation of any approved planned outages to the extent possible
- Minimize the need to require substitute capacity to greatest extent possible
- Identify specific replacement requirements for resources requiring replacement
- Allow owners to self-select, or self-provide, replacement capacity
- Include development of a CAISO system for procuring replacement capacity

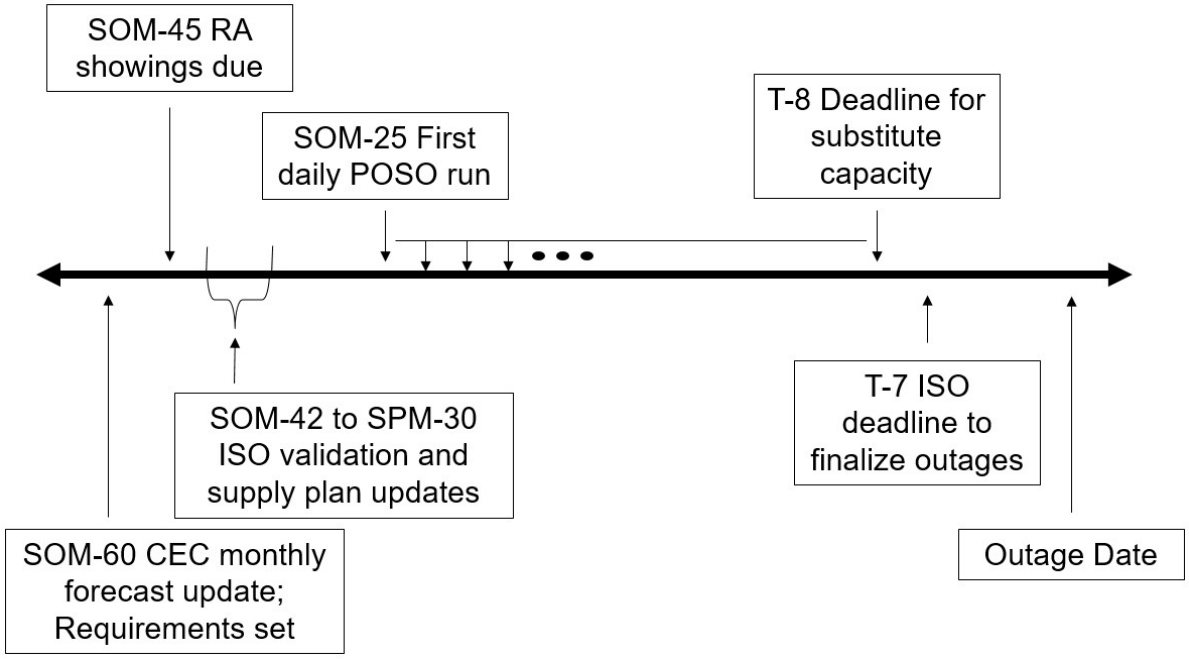
Current Planned Outage Substitution Obligation Timeline

The current POSO timeline is provided in Figure 6 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

[30] 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.

replacement capacity through the T-8 timeframe, and the CAISO finalizes replacements and outages at T-7.

Figure 6: Current POSO timeline



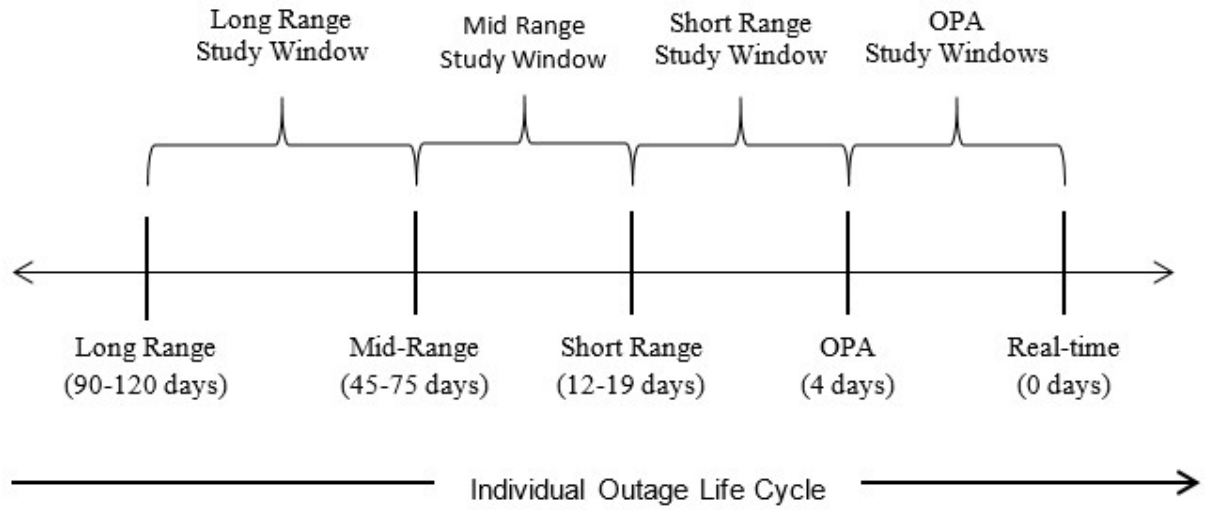
Proposed Modifications to the Planned Outage Process

The CAISO is considering several changes to the existing planned outage provisions and planned outage process. Further, based on numerous stakeholder comments to the revised straw proposal, the CAISO is proposing several changes to ensure planned outages can be taken with lower risks of cancelation after initial approval. Additionally, numerous stakeholders noted the challenges with providing comparable capacity for planned outages. Therefore, the CAISO has removed this requirement. The CAISO also is attempting to remove obligations for outage replacement to the greatest extent possible. The CAISO proposes to redesign the planned outage process to reflect system UCAP targets rather than traditional NQC targets. This proposed change will better 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.

Revised RA Planned Outage Process

The CAISO proposes to revise the RA planned outage process to align with the timeline provided in the Outage Management BPM. This timeline is provided in Figure 7, below.

Figure 7: Outage management timeline[31]



To facilitate this alignment, provide the greatest certainty regarding the timing of planned outages to both the CAISO and resource SCs, to the CAISO is considering two options. The first option attempts provide greater flexibility in RA procurement and showings, while mitigating the need for replacement capacity. The second option provides greater certainty that approved outages will not be cancelled, offers less complexity for RA showings, but more rigorous replacement obligations. Both options will allow for short-term opportunity outages. Specifically, the CAISO would allow for resources to take limited outages after the day-ahead market when the resource does not receive any awards in the day-ahead market. This is discussed in greater detail after the two primary options.

Option 1

Under this option, the CAISO would modify the opportunities and definitions for planned outage opportunities. Specifically, the CAISO proposes three unique types of planned outages:

1. Planned outages – Outages submitted at least 45 days prior to the RA month.
2. Post-RA planned outages – Outages submitted between 44 days and eight days prior to the outage.
3. Forced outages – Outages taken seven or fewer days prior to the outage.

Each outage type will have different approval criteria and treatment on RA showings and supply plans. The following provides additional details regarding how the CAISO will consider each outage type.

Planned outages must be submitted at least 45 days prior to the month. This aligns with the timeline by which mid-range planned outages must be submitted as per the CAISO's Outage Management BPM. Because these showings are known so far in advance, the SC for the

[31] For additional details, see the CAISO Outage Management BPM at https://bpmcm.caiso.com/BPM%20Document%20Library/Outage%20Management/Outage%20Management%20BPM%20Version%2021_clean.docx

resource may not put them on a supply plan for the days the resource is on planned outage. To facilitate this, the CAISO would allow internal resources to be shown for RA for a subset of the whole month. However, this does not mean that CAISO would allow daily RA deficiencies. Resources providing RA capacity during a month and taking planned outages are responsible for working with the LSE to provide any substitute capacity needed to ensure RA requirements are met. Because these resources essentially are not providing RA capacity on those days, the outage will be approved or denied based only on the existing CAISO reliability check. Additionally, because these are not on an RA showing, they will also be excluded from the CAISO's portfolio analysis.

One of the goals of this option is to provide both the CAISO and resource SC as much lead time as possible to perform their maintenance reliably. This includes getting all needed parts, resources, and expertise ready prior to the outage. Additionally, resources taking planned outages cannot extend a planned outage after 45 days prior to the month. If an outage is expected to last beyond the initially submitted outage dates, then the CAISO will assess the extension request as a post-RA planned or as forced outage and apply the appropriate standard. If the CAISO does not approve an outage extension, any additional outage time will be considered forced and included in the resource's forced outage rate. If approved, these outages will not be included in forced outage calculations.

If a resource has submitted a request for a planned outage and the resource is still on an RA showing, then the CAISO will notify the resource of a discrepancy and give the resource the opportunity correct the discrepancy. If the discrepancy is not corrected, the CAISO has two options. First, the CAISO could cancel the planned outage. Given CAISO's objective not to cancel planned outages, this is not a preferred outcome. The other option is to account for the planned outages in the RA adequacy assessment, but treat the outage as forced for purposes of UCAP calculation. This option creates an incentive to not inform the CAISO of the planned outage, instead deferring the outage to the post-RA showing time period.

The CAISO recognizes planned outages may occur after RA showings have been made. As such, the CAISO will allow for planned outages taken after RA showings have been made. Any outage submitted between 44 days prior to the month and 8 days prior to the outage will be considered post-RA planned outages. CAISO will approve these outages if two conditions are met;

1) There is sufficient RA capacity available so the CAISO is not deficient relative to the RA requirements, and
2) The outage is approved through the CAISO reliability check.

These conditions will be assessed sequentially. If the requested outage will result in deficient RA capacity, the CAISO will reject the outage without running the reliability check. The resource requesting the outage may provide substitute capacity to resolve any RA deficiencies.

As discussed in greater detail below, the CAISO proposes to maintain a planned outage calendar that allows resource SC to assess when a planned outage request would most likely be approved without the need for substitute capacity. Therefore, the CAISO will assess outages as they are submitted. For example, an outage request without substitute capacity will be

approved or denied based on an assessment without additional capacity. If the outage is denied, the resource SC would need to submit a new request with either different dates or with substitute capacity. In comments, CalCCA expressed concerns that the CAISO's proposal would result in incentives to withhold capacity instead of making the capacity readily available to the market. The CAISO notes that the shift to UCAP counting rules, above, will significantly mitigate the incentive to withhold capacity from the bilateral capacity market. This aspect of the CAISO proposal may result in an LSE holding capacity for replacement purposes. Any opportunity or requirement for replacement capacity will create some level of withholding incentive. Here the CAISO attempts to balance this incentive with allowing some flexibility to resource SC to plan outages as needed. However, given the other incentives and information provided in the CAISO's proposal, this risk is likely reduced to the lowest point possible.

If there are no RA deficiencies or all deficiencies are resolved, the CAISO will run the reliability check. The CAISO will run the reliability check, with the replacement capacity. If the CAISO approves the outage, then the new resource will take on the must-offer obligations for RA capacity. If the CAISO rejects the outage, then the replacement capacity's RA obligation is absolved. If the outage is approved, the must offer obligation for the replacement capacity will be for the duration outage approved by the CAISO. Any requested extensions must be made more than eight days prior to the last day of the approved outage window. If approved, these outages will not be included in forced outage calculations. Any extensions made after that date will be treated as forced.

All outages requested seven days or less prior to the outage will be treated as forced. These outages will be included in the resource's forced outage rate consistent with the CAISO forced outage calculation described on section 5.1.2. This treatment incentivizes a resource to either notify CAISO as soon as possible it is going on outage or to complete the planned outage within the CAISO-approved window. However, the CAISO runs the final reliability check eight days prior to the operating day. Outages after that time have already be considered with the RA UCAP requirements.

In comments, NCPA notes that outage schedules can change for any number of reasons and that the CAISO's proposal may result in insufficient flexibility. The CAISO agrees that schedules can and do change. The CAISO must balance the need to schedule existing outages and future planned outages needed to maintain grid reliability. For example, the CAISO may have approved an outage for one resource for five days and then another resource for the next five days. Failure to maintain the outage schedule will not only impact that CAISO, but may also impact the other resource's ability to take its approved planned outage. The CAISO feels that by offering numerous opportunities for resource SC extend outages as planned balances the incentives to keep outages on schedule with allowing the resource extend a planned outage when feasible.

Option 2

Stakeholders comments on the second revised straw proposal raised two significant concerns that warranted further the CAISO consideration. First, the CAISO's proposal – option 1, above – would result in additional complexity in conducting monthly RA contract and showings. Second, this additional complexity would create an incentive for resource SC to wait to submit

planned outage requests until after RA showings are made. Further, it was not clear to some stakeholders that the CAISO's proposal in the second revised straw would provide sufficient certainty that the CAISO would not cancel an approved planned outage. The CAISO has considered these concerns and developed an alternative proposal to attempt to address them.

Under option 2, substitute capacity would always be required for planned outages. Further, this replacement obligation would be the responsibility of the resource SC taking the planned outage. Under this option, LSEs submitting planned outages prior to t-45 days to the month (*i.e.*, prior to RA showings) may show resources for days the resource has an approved planned outage.[32] However, the SC for the resource would be required to provide the CAISO with a notice of substitute capacity as part of its supply plan. The CAISO will utilize the substitute capacity in its portfolio assessment. As with option 1, the CAISO must determine the most appropriate manner to address instances where substitute capacity is not provided: cancel the outage or treat it as forced.

RA resources submitting requests for planned outage any time after t-45 must also include sufficient substitute capacity to cover the loss of the RA capacity. However, even if the substitute capacity is sufficient to cover the outage of the RA capacity, the CAISO must still determine that the substitute capacity is adequate in the CAISO reliability assessment. If, using the substitute capacity, the CAISO fails the reliability assessment, then the planned outage will be denied. If the outage is approved, the source may take the planned outage and the outage will not be counted against is outage rate.

This option provides a much cleaner process in terms of RA contracting and showings. However, it imposes a more stringent replacement obligation then option 1. The result is the potential for increased capacity withholding from the bilateral RA market. The CAISO must weigh these pros and cons in order to determine which option is superior. As such, the CAISO seeks stakeholder feedback regarding these two options or if an alternative option is needed.[33]

Short-term opportunity outages

As noted in section 5.1.4, above, the CAISO is proposing to modify the RA must offer obligation to focus on day-ahead bidding. With limited exceptions, if resources do not receive any day-ahead awards, the resource will be eligible to take a short-term opportunity outage. These outages may only be requested after the day-ahead market closes and are subject to the CAISO review and approval. If approved, no replacement capacity is required for these outages. However, because no replacement is required, these outages are only permitted for a single day and they must participate in the subsequent day-ahead market.

Planned Outage Outlook Transparency

The CAISO proposes to offer greater visibility into how much resource adequacy capacity is shown relative to the resource adequacy 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 in advance and on a daily basis,

[32] Unlike option 1, this option would still require internal resource be shown for the entire month
[33] This includes if the CAISO should leave the planned outage rules unchanged.

the potential availability of additional system RA headroom. This RA headroom should allow resources to identify potential calendar dates with RA headroom in advance of requesting planned outages, thus mitigating replacement obligations and 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 be approved and denied through the planned outage tool discussed above. Outages and substitute capacity will continue to be evaluated, accepted, the outage calendar adjusted on a first-in-last-out basis. Thus, resources submitting outage requests will be assessed first, making it less likely the CAISO will deny their outage or require them to provide substitute capacity compared to later requesting resources. The CAISO will continue to allow resources taking outages requiring replacement to self-provide substitute capacity for any outages requiring replacement.

Figure 8 demonstrates the conceptual planned outage outlook calendar. The CAISO proposes to publish this type of calendar including daily MW values for UCAP headroom in excess of system RA requirements.

Figure 8: Example substitution availability calendar

Additional issues related to planned outage provisions

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

The CAISO will retain its authority to deny any outage for reliability reasons, even those that have provided substitute capacity. The 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

The CAISO proposes to develop a bulletin board for resources to match planned outages requiring substitution with substitute capacity resource sellers. This planned outage substitution bulletin board should 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.

The 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. Accepting capacity through this tool will automatically match resources on outage with substitute capacity.

5.1.6. RA Import Provisions

The CAISO has included the review of import RA rules and provisions in this initiative. The CAISO provides analysis and updates the proposed modifications to the RA imports provisions in the following section. The CAISO previously discussed Maximum Import Capability (MIC) provisions under this RA Enhancements initiative. Prior proposals provided the CAISO's review of the MIC provisions and proposed modifications to the MIC allocation process. To fast track this issue and remain in alignment with the CPUC's multi-year RA provisions, and the impending resource needs in 2021, the CAISO has established a stand-alone initiative to timely address changes to the MIC provisions.

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.[34] Thus, the quantities are significant and may affect the RA program and its ability to ensure reliability.

Today, RA import resources are not required to be resource specific or to specify that they represent supply from a specific balancing area. RA import resources are only required to be shown on RA and supply plans with associated maximum import capability (MIC), 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.

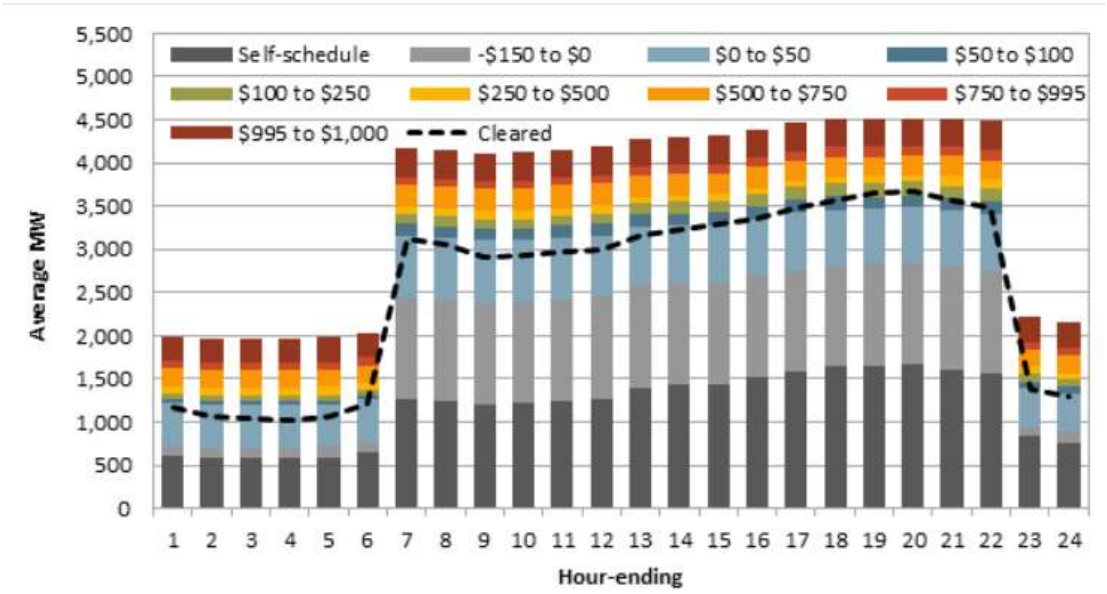
Some stakeholders previously expressed concerns that current RA import provisions potentially undermine the integrity of the RA program and threaten system reliability. The CAISO's Department of Marking Monitoring (DMM) expressed similar concerns in their September 2018 DMM special report on import RA.[35] In that report, DMM explained the existing rules could allow for some portion of resource adequacy requirements to be met by import RA that have limited availability and value during critical system and market conditions. For example, Non-Resource Specific (NRS-RA) RA imports could satisfy their RA must offer obligation by routinely bidding

[34] 2017 CAISO DMM Annual Report, p. 259: http://www.caiso.com/Documents/2017AnnualReportonMarketIssuesandPerformance.pdf
[35] DMM Special Report: Import Resource Adequacy, September 10, 2018: http://www.caiso.com/Documents/ImportResourceAdequacySpecialReport-Sept102018.pdf

significantly above projected prices in the day-ahead market so they do not clear the market, relieving them of any further offer obligations in real-time. This is possible because NRS-RA imports do not have bid cost recovery or bid cost verification and can determine the price at which they choose to bid import energy.

The CAISO DMM provided specific examples of these bidding behaviors in its comments on the recent CPUC Proposed Decision clarifying RA Import rules (R17-09-020). Figure 9 shows the average hourly RA imports offered into CAISO's market at various price levels. [36] This information provides additional evidence that around 1000-1200 MW RA imports were participating at bid levels in excess of $500/MW in August of 2018.

Figure 9: Average hourly RA imports offered by price bin (weekday hours) August 2018



RA Import related concerns and issues under review

The CAISO's review of the current RA import provisions is focused on determining if they cause reliability concerns and identifying how any potential issues can be mitigated. The CAISO has identified two areas of concern with the current RA import provisions:

1. **Double counting of RA import resources**:

The 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. The CAISO cannot be sure whether RA imports are being double counted under current provisions.

[36] CAISO DMM comments on CPUC Proposed Decision clarifying RA Import rules (R17-09-020). September 26, 2019: http://www.caiso.com/Documents/CommentsofDepartmentofMarketMonitoringonProposedDecisionClarifyingRAImportRules-R17-09-020-Sept262019.pdf

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

The CAISO believes that RA import provisions should foreclose (or at a minimum, discourage) 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.

The CAISO previously described speculative RA import supply and noted DMM's similar concerns above. Previously, the CAISO indicated this could present a significant reliability problem due to initial evidence of relatively high priced DA bidding by NRS-RA imports. This type of behavior can represent a potential bidding strategy used by speculative supply to avoid a subsequent RT MOO or actual RT energy award and resulting delivery obligation. The CAISO completed additional analysis efforts in attempt to better understand the issues related to NRS-RA import resource's reliability contributions, included in this section and in the proposal appendix.

Objectives

The CAISO identifies the following objectives to guide any potential RA import rule modifications.

- Modify RA import provisions to ensure that RA imports are backed by physical capacity and reserves with firm transmission delivery.
- Create more comparable treatment for RA imports to internal RA resources. The current provisions provide less rigorous requirements for RA imports.
- Coordinate import provisions with any related modifications being proposed through CAISO's extended EIM and DAME initiatives. Coordination between the RA Enhancements initiative, Day-Ahead Market Enhancements (DAME) initiative, and Extension of the Day-Ahead Market for EIM (EDAM) is vital to ensure all of the interrelated aspects work together without unintended consequences.

RA Import Proposal

The CAISO proposes to require specification of the Source BA for any NRS-RA imports used on RA and Supply Plans for monthly showings. The CAISO also proposes to adopt provisions similar to current CPUC RA program rules and regulations for RA imports. Specifically, all LSEs must submit supporting documentation that any non-specified RA import resource shown on annual and monthly RA and Supply plans represent physical capacity and firm transmission. This will ensure RA imports are backed by a forward commitment of physical capacity with firm transmission delivery and sufficient operating reserves to back obligations. The CAISO will include these requirements in the tariff to ensure similar treatment among all LSEs. The CAISO also proposes to align any RA import bidding obligations with other interrelated aspects of this proposal and the Day Ahead Market Enhancements initiatives. These modifications are described in further detail below.

Specification of RA Import resource Balancing Area source

The CAISO's current RA provisions allow NRS-RA imports 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 physical supply from a specific Balancing Area. They are only required to be shown as sourced on a specific intertie into CAISO's system.

The CAISO proposes to require RA imports to specify the source Balancing Area to ensure all RA import resources are fully available and dedicated to the CAISO for reliability. This is increasingly important as the CAISO considers extending the day-ahead market to EIM entities, ensuring that resources outside of the CAISO's BA are not double counted for meeting resource sufficiency requirements. Because of tighter capacity supply in the West, the CAISO has expressed increasing concerns about the potential for Non-Resource Specific RA import resources to be double counted for reliability. Double counting of capacity 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.

With the potential extension of the day-ahead market to EIM entities, the CAISO believes that, at minimum, RA import resources must specify the source BA. The proposed modification would allow the CAISO to ensure that RA imports are not double counted for EIM entities' resource sufficiency tests. Without this rule, it would be possible for an EIM entity to count on capacity from a resource within its own BA to pass the EIM resource sufficiency evaluation, while also showing the resource as import RA to the CAISO. This is not a reasonable outcome because the resource is incapable of physically meeting both the BA's flexibility needs *and* the CAISO's RA needs. Requiring a designation of the source Balancing Area ("Source BA") will be sufficient to ensure RA imports are not being double counted for EIM resource sufficiency tests.

Reconsideration of resource specific requirements for RA imports

The CAISO's current provisions allow for non-resource specific resources to qualify to provide System RA. As noted above, RA imports are not required to be resource specific or to represent supply from a specific balancing area. Instead, they are only required to be shown as sourced on a specific intertie into the CAISO system. The CAISO previously explored the need for a resource specific designation to qualify for providing System RA as RA import resources. Previous review of RA import rules have not resulted in related tariff modifications to date. The CAISO believed that changes were not warranted due to the specific circumstances at the time of the prior reviews.

Because of tighter supply in the West, the CAISO is increasingly concerned about Non-Resource Specific RA import resources being double counted for reliability. This occurs when a resource is relied upon by other regions or Balancing Areas and also shown as CAISO System RA. To ensure all RA imports are dedicated and available, the CAISO is reconsidering modifications to the provisions for specifying the source of RA imports. The CAISO has previously discussed this specification of the source of RA imports in the initial straw proposal for RA enhancements but withdrew it primarily due to stakeholder opposition.

The CAISO did not receive overwhelming support for its scaled back proposals for bolstering RA import provisions throughout this stakeholder process. The fact remains that double counting and speculative supply concerns continue in the face of ever tightening system conditions in the broader Western region.

The CAISO is reconsidering its previous proposal to require resource specific imports and CAISO has responded stakeholder feedback by developing a proposal that recognizes that many non-specific RA importers are behaving generally as expected and are providing reliable RA import supply, likely backed by physical supply. However, the CAISO has also observed market performance and bidding behaviors that could indicate a limited number of RA imports are not backed by physical supply or may be speculative supply. The CAISO welcomes feedback and other suggested options regarding the need for the specification of RA import resource sources.

The CAISO also notes that it is considering the need for day-ahead tagging requirements for all import transactions under the CAISO's Extended Day-Ahead Market (EDAM) Initiative. This aspect of import participation requirements is important to consider for all import transactions, not only RA imports.

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

Under CPUC decisions, the CPUC's qualifying capacity rules require sufficient physical resources – both energy and operating reserves – supporting NRS-RA 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)." [37]

The CPUC's RA program allows for non-unit specific imports to qualify as RA capacity if 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).[38] To support compliance with these requirements, the CPUC requires LSEs provide documentation in their RA compliance filings reflecting that unspecified imports shown as RA 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 importer confirming the import is supported by firm energy and operating reserves.

The CAISO has revisited its previous consideration of resource specific requirements for RA imports in this iteration of the proposal, as described above. The CAISO is strongly considering the need for these resources specific requirements, however, this complex issue may require a balanced approach that allows for some flexibility for RA import supply as discussed previously.

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

If the CAISO does not end up pursuing a resource specific requirement as a final policy, the CAISO believes it would still be appropriate to incorporate similar CPUC-type provisions for RA imports in the CAISO tariff.

Therefore, the CAISO proposes that all LSEs must submit supporting documentation that any non-specified RA import resource shown on annual and monthly RA and Supply plans have firm energy delivery. Similar to the CPUC requirements, the supporting documentation that the CAISO will 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.

Bidding requirements for RA imports

Consistent with other resources covered in 5.1.4 and the Day-Ahead Market Enhancements initiative, the CAISO is proposing to maintain the current bidding rules for RA imports. Thus, only import bids that receive day-ahead awards will be required to bid in real-time.

The efficient utilization of the transmission system is an important factor to consider. The proposed provisions also promote the most efficient utilization of transmission capability because when RA 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 for economic energy imports. Requiring a real-time bidding obligation for all RA imports could have a negative impact on the efficient utilization of the transmission system, potentially increasing overall costs to serve load. This is because for RA imports to participate in the real-time market the import SC would need to reserve transmission capability to support their bids. If an RA import resource's bid in the real-time was priced at a level that would not clear the market, it could result in precluding the utilization of that reserved transmission capability by other more economic energy. In this scenario, a lower cost energy import would have cleared the real-time market but was precluded from receiving the energy award due to inefficient use of transmission resources. The result is overall costs to serve load increasing. For these reasons, CAISO believes it is appropriate to maintain the current bidding rules for RA imports.

NRS-RA Import Analysis

The CAISO analyzed the impact of NRS-RA imports on the RA program and CAISO markets. This section includes updated analysis that incorporates day ahead market participation. The CAISO also provides updated granularity of this analysis that breaks down some aspects by scheduling coordinator (SC) to provide transparency into the potential of speculative supply occurring. Stakeholders also requested additional analysis on these issues.

The CAISO conducted related imports analysis in the summer of 2018 as a part of the Intertie Deviation Settlement initiative.[39] 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

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

that analysis to determine if there is a problem with non-delivery of import RA when awarded in the CAISO real-time market.

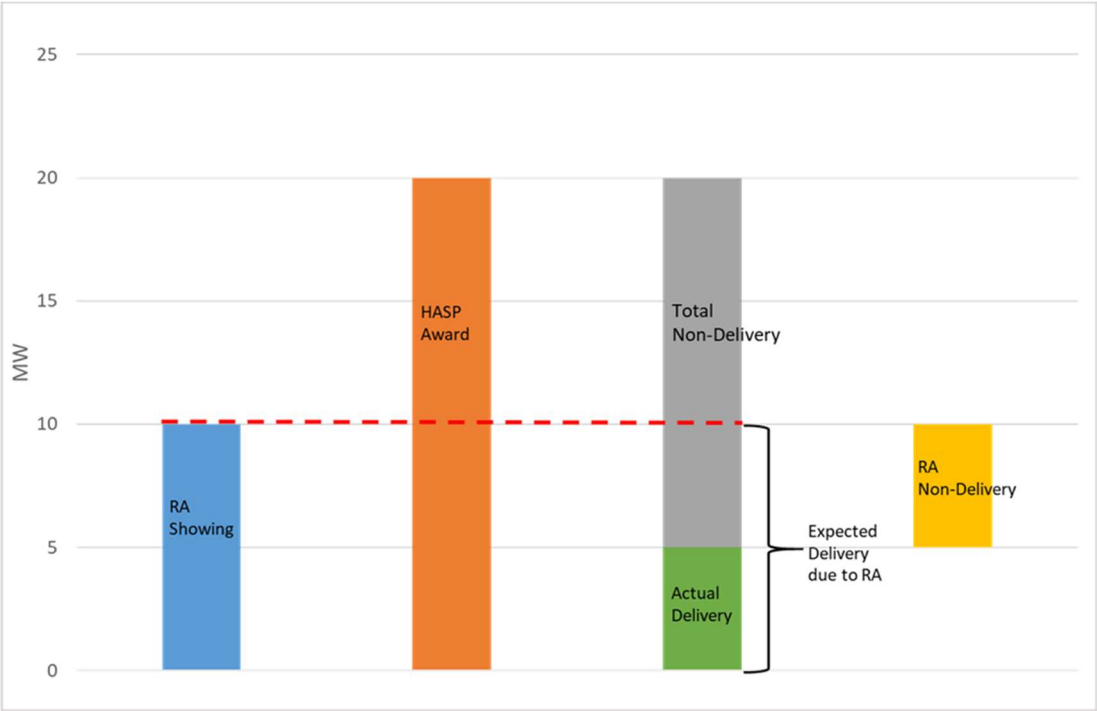
To assess market awards and delivery patterns of RA imports, the CAISO analyzed three data sets: import RA showings; HASP schedule for import RA resources; and RA delivered quantities. This enabled the CAISO to identify if imports that were awarded in the real-time market but failed to deliver, did not deliver because the scheduling coordinator failed to bid, or actually delivered a MWh quantity greater than the RA showing.

The 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's Resource ID is not limited to bidding only the amount of MWs that have been shown for RA, and the CAISO has observed many instances when bidding and awards for RA import Resource IDs exceed the amount of MWs shown for RA. The 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.

As illustrated in Figure 10 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 five MW was delivered. Therefore, 15 MW can be classified as undelivered. This quantity is depicted in the grey colored bar.

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

Figure 10: Clarifying "non-delivery" related to RA import delivery



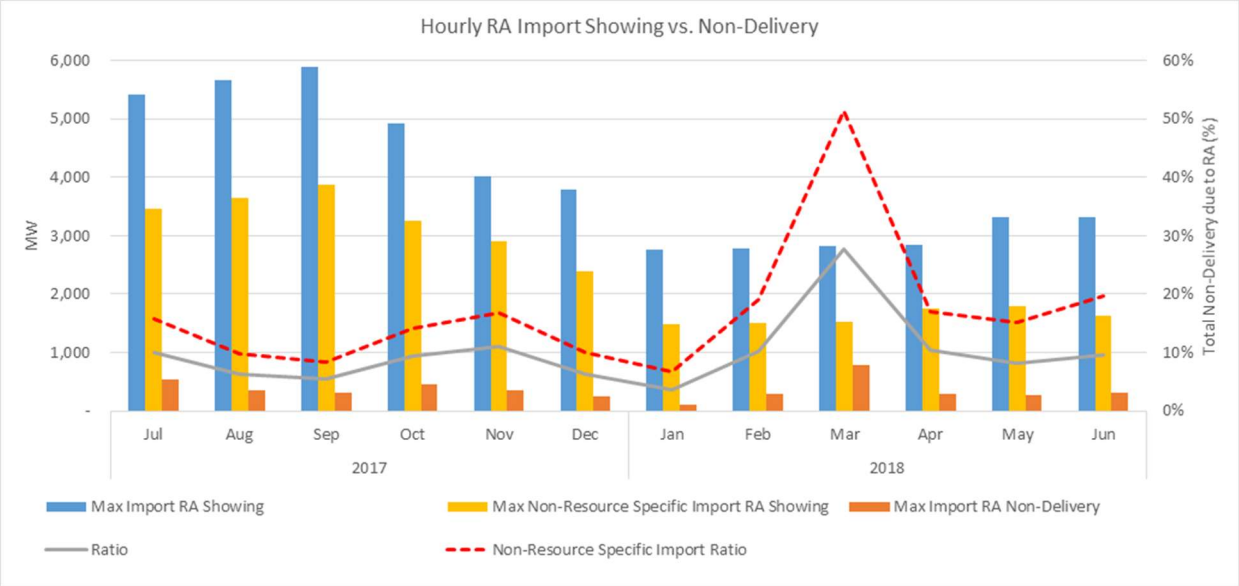
The CAISO applied the approach described in the hypothetical example to the initial RA enhancements analysis, previously presented in the CAISO straw proposal to ensure that the actual stated magnitude of non-delivery of RA imports provided through this analysis is accurate and appropriate.

The analysis shown in Figure 11 provides data from July 2017 to June 2018 for RA import non-deliveries. The CAISO noted in the revised straw proposal that actual non-delivery results, after considering the modification to its analysis described above, shows a maximum monthly non-delivery of RA imports of approximately 10% on average over the study period.[40] The CAISO has identified that some tie gen resources (pseudo-tied or dynamic scheduled) resources were also included in the sample previously analyzed.

The CAISO updated the analysis that indicates the maximum monthly non-delivery from NRS-RA imports resources was on average 17% during the study period. This change is due to the removal of the other tie-gen capacity so the analysis now compares non-deliveries to only the NRS-RA imports.

[40]See CAISO Revised Straw Proposal.

Figure 11: Observed non-delivered RA import resources (hourly average)



In addition to correcting the real-time non-delivery figure from the revised straw proposal, the CAISO provides analysis of day ahead and HASP bidding and awards for NRS-RA import resources. This analysis also includes SC level data, but values have been averaged over the year timeframe studied and the names of specific SCs have also been masked to prevent confidentiality issues or any anti-competitive information related concerns.

Figure 12 provides the Day Ahead bidding and awards for the AAH hours (on average). Figure 13 provides the HASP bidding and awards for the AAH hours (on average). These charts indicate non-delivery is relatively low, and generally consistent with expected forced outage rates of internal RA resources. Additionally, the analysis shows that RA import behavior is generally consistent with requirements and expected participation by NRS-RA import providers. Additional SC level analysis provided further below helps to differentiate the general statistics provided in these figures. However, CAISO notes that this analysis does not bring to light the true potential or impact of speculative supply because the CAISO does not have information regarding the source of these RA import transactions. Because the CAISO does not have information regarding the source of these transactions, it is also unable to opine on the impacts of price level of RA import transactions on the potential for speculative supply.

Figure 12: Day Ahead bids, awards, self-schedules, and actual non-delivery – average during AAH hours

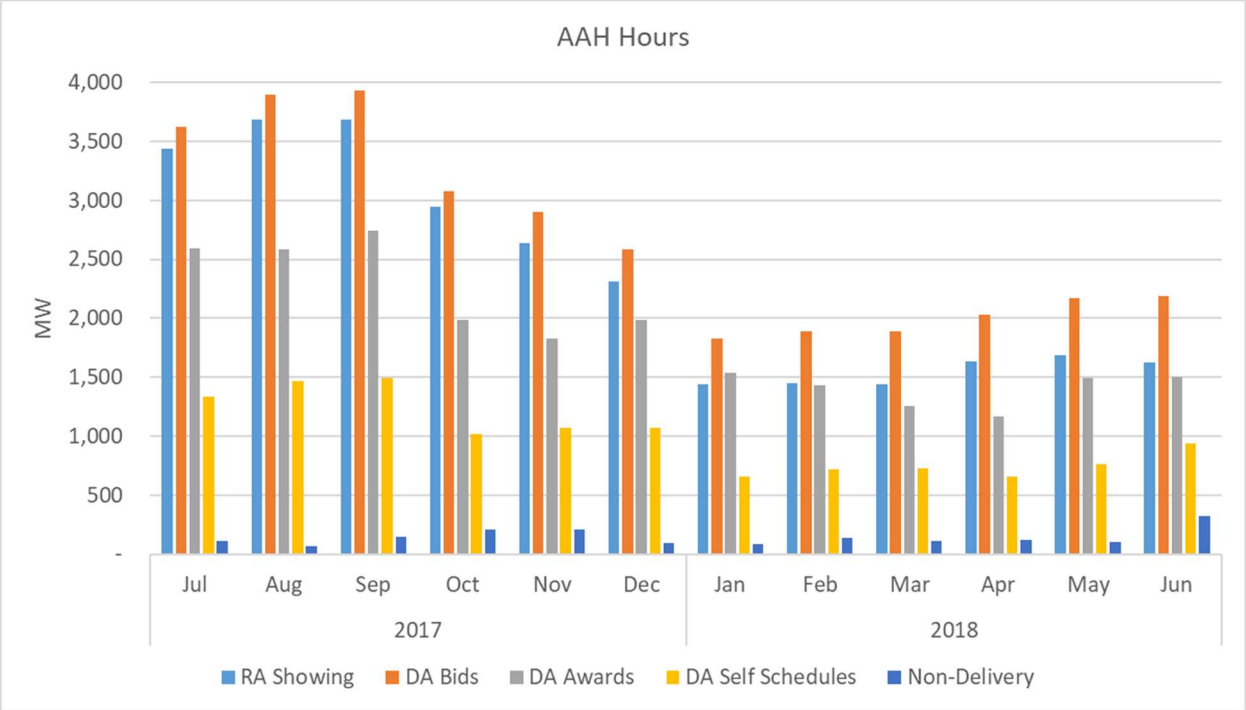
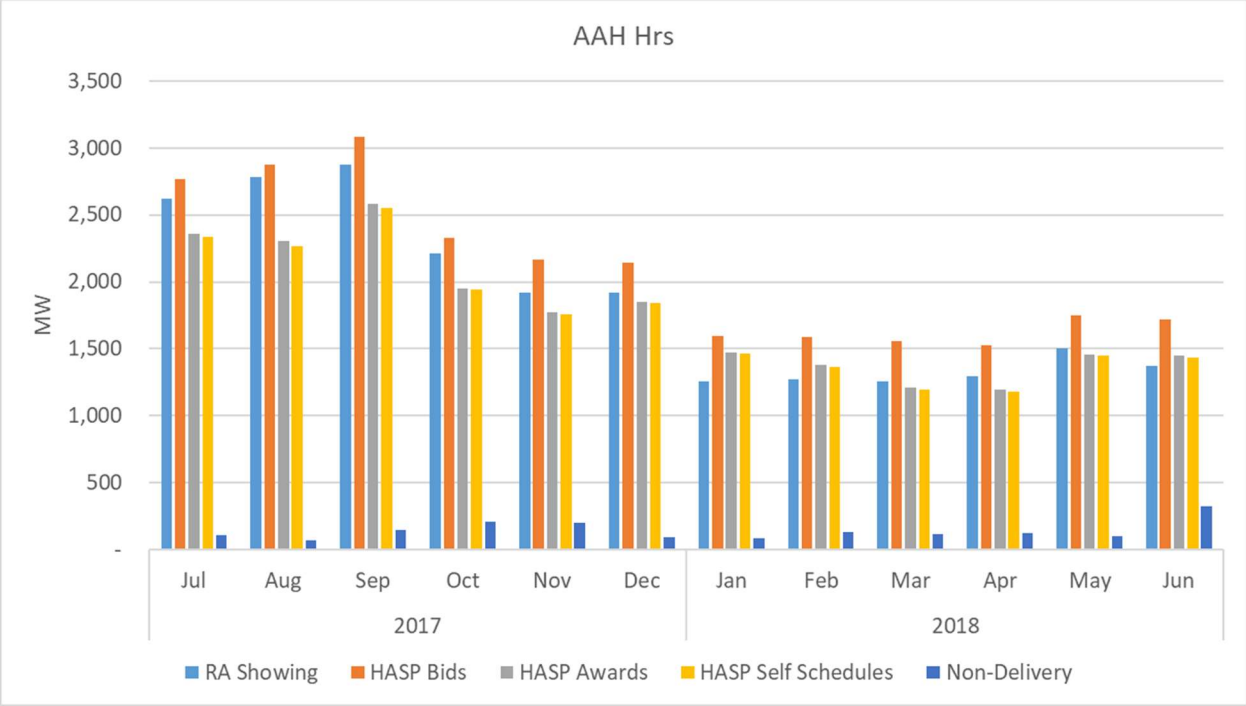
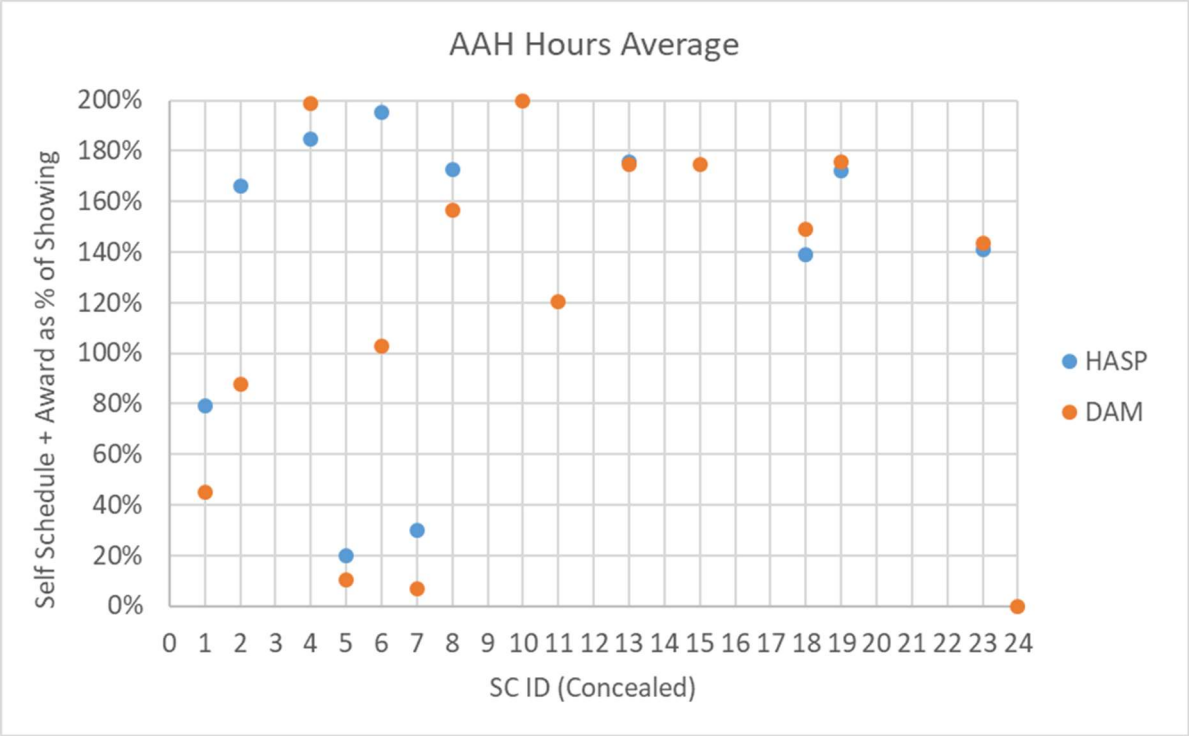


Figure 13: HASP bids, awards, self-schedules, and non-delivery – average in AAH hours



The CAISO also provides additional analysis of the 24 resource SCs that provided import RA over the studied period. Figure 14 provides SC awards and self-schedules as a percent of RA showings for AAH hours (on average).

Figure 14: SC Awards and Self Scheduled as percentage of RA showings – Average in AAH hours



This additional analysis indicates that most SCs providing NRS-RA imports on RA showings are likely providing physical capacity that has been secured in advance with firm delivery capability and operating reserves. This is evidenced by the high ratio of awards and self-scheduled import RA to RA showings by most SCs providing NRS-RA imports. The data also provides evidence that a select number of SCs may be providing NRS-RA imports that could represent speculative supply or not be backed by sufficient reserves or firm transmission necessary to support actual delivery of energy, should the CAISO markets actually call on these supplies to deliver the capacity that is shown. This is evidenced by the low ratio of awards and self-scheduled import RA to RA showings by select SCs providing NRS-RA imports.

For example, twenty of the NRS-RA import SC's awards and self-schedules were all at or near 100% of their NRS-RA showing amounts, on average, over the year analyzed. In contrast, four of these SC's awards and self-schedules were far below their NRS-RA showing amounts, on average, over the year analyzed. Additionally, in the day-ahead timeframe, three SCs averaged under 10% awards and self-schedules compared their NRS-RA import showing MWs over the year. These results are anticipated given the current RA import provisions, but CAISO believes that the proposed modifications should help ensure NRS-RA imports are backed by physical capacity with firm transmission.

5.1.7. Operationalizing Storage Resources

The CAISO has a small number of storage resources operating on the grid today, but that number is likely to grow rapidly during the next few years, representing a growing share of the system's resource adequacy capacity. Therefore, it is imperative that we fully understand the operational characteristics of storage, how it contributes to system reliability, and how it most effectively serves and operates as a resource adequacy resource.

Storage resources are different from other resources in that they must first charge to discharge energy back to the grid. The CAISO's current real-time market may not allow sufficient lead-time to optimize the use of storage resources and to dispatch the storage resources most effectively over an extended operational horizon. Thus, being unable to charge a storage resource for anticipated future needs can create reliability issues for the CAISO.

Since storage resources qualify as resource adequacy resources, it is important that the CAISO can access and confidently rely on storage RA capacity. Given these important considerations, the CAISO is exploring potential market, systems and rules modifications to most effectively operate storage resources and establish proper must offer obligations to ensure the safe and reliable operation of the grid. The following section presents possible modifications necessary for storage resources to provide RA in an effective and efficient manner.

Operationalizing Storage Resources

Storage is often cited as a key component of California's long-term solution to decarbonize the electricity grid. It is viewed as a potential and enabling resource to help retire existing resources in the gas fleet, resolve local transmission issues, and address near-term capacity shortfalls in upcoming years.

Today there is relatively little storage, about 150 MW (excluding pumped hydro), of grid connected storage resources on the system. This does not include behind-the-meter storage resources. However, there are several thousand megawatts of storage resources in the CAISO interconnection queue, which could potentially be developed and deployed on the system within the next few years. When new storage generation is installed on the system, the CAISO will need tools to effectively manage these resources. Specifically, the CAISO must be able to use these resources' flexible capability and their ability to charge during non-peak hours when there is more generation (generally during peak solar hours) and then discharge during peak net load periods when system needs are greatest.

The CAISO uses market price signals to determine when resources should be dispatched. The premise is that the least expensive resources are dispatched first and more expensive resources are only dispatched in least cost order when needed. The CAISO's day-ahead market matches demand with least cost supply for each of the 24 hours in the day in one cost minimization problem. This problem includes the costs and operating characteristics for the entire fleet of resources available to the CAISO, including storage resources. Generally, this could include charging storage resources during the lowest priced hours of the day and discharging them during the highest priced hours of the day. The market also has the latitude to start additional resources at different points in the day, again preserving the concept of cost

minimization to ensure the system has sufficient generation online to meet local, peak, and ramping needs across the entire balancing area footprint.

The real-time market optimization is different. If conditions are forecast to be particularly tight, resources may be committed in the short-term unit commitment process (STUC) up to 4.5 hours in advance. Further, the CAISO only looks at expected market conditions up to 65 minutes in advance to send binding dispatch instructions to specific resources in the 5-minute market. This implies that if a storage resource is essential to meeting system energy needs, that resource may only start receiving dispatch instructions to charge 65 minutes prior to when the resource is needed. Each storage resource in the market can charge and discharge at the same rate, so if the state of charge for the resource is 0% it would be able to charge for a maximum of 60 minutes before having to discharge in the subsequent interval, if needed. This 60 minutes of charge would allow for 60 minutes of discharge. If the actual need for the resource is for four hours, or more, the resource would have insufficient time to charge to meet those four hours of need.

This could be exacerbated if system conditions are already tight, leaving little additional energy or capacity available to charge the storage resources for later energy delivery. An extreme scenario is illustrated in the example below.

Example

Assume a system has only two resources: a 300 MW gas resource and a 50 MW storage resource with 200 MWh of storage capability. Dispatch instructions for generation and storage charging are awarded in the day-ahead market to meet system needs over the course of the entire day. The real-time market dispatches resources based on prices, bids, and system needs up to only 65 minutes into the future.

In this simple example, assume that system needs are very tight in the evening and that the system actually requires the full power available for dispatch of the storage resource (50 MW Pmax) and also requires all of the energy available that the gas resource could provide at full charge (200 MWh). In the day-ahead, market the storage resource is scheduled to charge during the morning hours, hours 9-12, and discharge as needed in the five hour window from hours 18 to 22.

The hypothetical storage resource bids into the day-ahead market to charge at any price lower than $30/MWh and to discharge at any price higher than $60/MWh. Because the day-ahead market performs a cost minimization, and the resources available are sufficient to avoid a power balance constraint violation, the market chooses to optimally charge the storage resource fully when prices and loads are lowest, at $50/MWh, then to discharge the resource fully between when the system loads and prices are the highest, at $100/MWh. The day-ahead optimization realizes that although the storage resource bids only to charge when prices are lower than $30/MWh, it is actually optimal to charge when prices are $50/MWh because they will be higher later in the day, and the price spread captured by the resource will be greater than the $30/MWh bid into the market.

In the real-time market, like the day-ahead market, the resource initially starts the day at 0% state of charge. The resource also updates bids in the real-time market to match the prices that energy was awarded at in the real-time market.[41] The real-time market does not look forward across all 24 hours as does the day-ahead market, and generally compares prices bid into the market with current real-time prices. During the hours 9 through 11, the resource bids to charge at $50/MWh and actual real-time market prices are $60/MWh. Because prices are higher than the charging bids, the resource does not charge and receives real-time dispatch instructions for zero MW of output. Market bids, prices and dispatch persists through hour 16. In hour 17, the real-time market begins to include expected needs for hour 18 when dispatching resources. At this time, the market determines that the storage resource will be needed to discharge in hour 18. Unfortunately, at this time, there is no additional generation that can be scheduled to allow the market to charge the storage resource for use in later hours because the system requires the maximum amount of output from the gas resources just to meet load.

Table 6: Example Storage Bids and Schedule

Hour	9	10	11	12	…	17	18	19	20	21	22	23	24
Load	190 MW	190	190	200	…	300	330	335	345	350	340	280	210
DA Bid ↓	$30/MWh	$30	$30	$30		$30	$30	$30	$30	$30	$30	$30	$30
DA Bid ↑	$60/MWh	$60	$60	$60		$60	$60	$60	$60	$60	$60	$60	$60
DA Price	$50/MWh	$50	$50	$50		$60	$100	$100	$100	$100	$100	$80	$70
DA Sched	-50 MW	-50	-50	-50		0	30	35	45	50	40	0	0
DA SOC	50 MWh	100	150	200		200	170	135	90	40	0	0	0
RT Bid ↓	$50/MWh	$50	$50	$50		$50	$50	$50	$50	$50	$50	$50	$50
RT Bid ↑	$100/MWh	$100	$100	$100		$100	$100	$100	$100	$100	$100	$100	$100
RT Price	$60/MWh	$60	$60	$60			$1,000						
RT Sched	0 MW	0	0	0	0								
RT SOC	0 MWh	0	0	0	0								

This scenario also has financial implications for both the storage resource owner and for grid reliability. The storage resource makes money in the real-time market in the morning because actual prices are higher than day-ahead prices and the resource is able to buy back the real-time schedule to charge at higher prices than originally paid in the day-ahead market. However, these revenues may be very small compared to potential losses that could accrue in the evening because of scarcity prices. The resource owner will be required to buy all of the energy scheduled in the day-ahead market at these scarcity prices because the resource was never charged and, therefore, incapable of returning energy back to the system.

CAISO Market Implications

Although the example discussed above is stylized, similar outcomes can occur on the CAISO system today. Further, these outcomes could occur without prices or bids changing from day-ahead to real-time markets.

[41] These results hold even for resources that bid the same values in both the day-ahead and real-time markets.

Similar to the actual CAISO markets, in the example above, there is nothing that guarantees schedules in the real-time market match those in the day-ahead market. In fact, the real-time market is set up specifically to be agnostic about day-ahead schedules. This allows real-time schedules to generally be based on market bids, where resources bidding in at lower values are dispatched first and resources bidding in higher values are only dispatched when needed. This allows for revenues to only increase, for traditional generators, if bids are unchanged between the day-ahead and real-time markets.[42]

The current CAISO day-ahead and real-time markets do not function in this manner for storage resources. Storage resources bid in a dollar amount to charge and a different, generally greater, bid to discharge. If the day-ahead market finds such a time that the resource will achieve the 'spread' indicated by the bids, it will schedule the batteries to charge and discharge. For example, if a resource bids to charge at $0/MWh and discharge at $30/MWh, the CAISO would schedule the resource to charge if day-ahead prices were $50/MWh during the lowest net-load periods and $90/MWh at the peak periods. Overall costs in the day-ahead market would be minimized, and the resource would receive revenue in excess of implied costs, which are represented by the spread between the charge and discharge portions of the bid curve.

The real-time market may also make similar tradeoffs if there are differences in prices between current binding intervals and prices in expected future advisory intervals. However, the real-time five-minute market only considers market conditions up to 12 intervals in the future, or about one hour in advance of the current time. On most days, the lowest point on the net load curve is more than eight hours prior to the peak net load. A storage resource bidding at $0/MWh to charge would not be dispatched to charge in the real-time market unless real-time prices were actually below that level. The real-time market would only select a storage resource to charge 'uneconomically,' or at prices above $0/MWh, after it detected prices in an advisory future period greater than the current binding price plus the price spread. This could occur from forecasting very high prices and system tightness in future periods, with prices potentially set by the penalty price for the power balance constraint if supply is not available to meet demand.

Discussion

The CAISO considered a number of potential options to address the above scenarios, including:

1. Requiring that storage resource's day-ahead schedules are fully self-scheduled into the real-time market;
2. A minimum charge requirement that ensures a resource can meet day-ahead schedules in the real-time market; and
3. The extension of the real-time market to look out several hours in advance of the current time.

[42] When bids are unchanged for traditional generation from the day-ahead market to the real-time market, they generally earn more revenue in the real-time market compared to the day-ahead market. For example, if real-time prices are higher than day-ahead prices this increases the real-time schedule and revenue. When prices are less in the real-time market this will decreases real-time schedules relative to day-ahead schedules and again increases total revenues, and allows resources to buy back energy at lower day-ahead prices.

The CAISO recognizes that requiring storage resources to self-schedule into the real-time market at their day-ahead schedules, listed as option (1) above, is not without potential challenges. Storage resources generally can quickly shift from charging to discharging and are capable of ramping very quickly. Requiring a storage resource to self-schedule in the real-time market to meet their capacity commitments forces these resources to miss potential opportunities to earn additional revenues from discharging energy during very high priced period when system conditions are tightest, or from charging when system prices are lowest and there is excess supply available in the real-time market. These conditions often occur during hours that the system has the highest ramping needs.

Expanding the true real-time market where binding commitment decisions, as described by option (3) above, considering advisory market conditions many hours into the future is not feasible given the existing market system. There are potential market solutions, like the short-term unit commitment (STUC) tool, where the CAISO could perform a look-ahead for several hours to make a determination on the needed aggregate state of charge from storage resources at the present time. These tools can be very complex, and there are many challenges implementing and integrating such changes into the real-time market systems and software.

Therefore, the CAISO is considering a minimum state of charge requirement, as described in option (2), above. This would allow storage resources to continue to bid flexibly in the real-time market, above the expected energy that the storage resources would need to provide to the system for reliability.

Operationalizing Storage Concepts

Some of the concepts envisioned for better operationalizing storage to ensure it can participate and be utilized in a reliable manner include the possible implementation of a minimum charge requirement (MCR) for all storage resources. A minimum charge requirement would need to be imposed in the real-time market and would reflect a needed state of charge level such that each storage resources would be assured a state of charge to meet day-ahead schedules.

This requirement will consider charging and discharging schedules set in the day-ahead market. For example, a resource with a 180 MWh discharge schedule in the evening and a 50 MWh charge schedule in the afternoon, would have a minimum charge requirement set at 130 MWh in the morning prior to the charging schedule, and a 180 MWh minimum charge requirement between the charging and discharging schedules.

Generally, there will be no minimum state of charge during times of the day after the hour when the resource receives its final awards in the day-ahead market. Resources may bid in a way to ensure additional flexibility and availability in the real-time markets. Resources with greater aggregate discharge schedules may have greater minimum charge requirements, which may bind more frequently than those with lower requirements. Two detailed examples of how these requirements would work are outlined below. Both examples include resource similar to the hypothetical resource discussed in the example above.

Example 1:

Suppose a 50 MW storage resource with 200 MWh of storage capability is dispatched to charge zero MWh during the lowest priced hours in the morning in the day-ahead market, and is scheduled to discharge a total of 180 MWh in the evening. The ISO minimum charge requirement will require that the resource be charged sufficiently to meet the evening schedule so that it can discharge the full 180 MWh. Because the day-ahead schedule to discharge does not start until hour ending 19, the resource is required to maintain a 180 MWh state of charge until this time. After that time, the minimum charge requirement begins to decrease.

In this example, suppose there is a real-time sustained price spike at $1,000/MWh for energy in hour ending 17, perhaps during the peak ramping period. Ideally, the resource would like to dispatch up to the full 50 MW of capability to capture these high prices, but it is prevented from doing so and limited to only 20 MW because of the minimum charge requirement.[43] This is illustrated by the numbers in the red boxes in Table 7, below.

In the later hours of the day, the minimum charge requirement decreases with the day-ahead schedule. If the resource is not scheduled to discharge as much energy in real-time as was scheduled in the day-ahead market, the resource will have an actual state of charge that exceeds the requirement. This is illustrated by the numbers in the green boxes in Table 7 below.

Table 7: Minimum charge requirement example 1

Hour	9	10	11	12	...	17	18	19	20	21	22	23	24
Load	190 MW	190	190	200	...	300	330	335	345	350	340	280	210
DA Bid ↓	$30/MWh	$30	$30	$30		$30	$30	$30	$30	$30	$30	$30	$30
DA Bid ↑	$60/MWh	$60	$60	$60		$60	$60	$60	$60	$60	$60	$60	$60
DA Price	$50/MWh	$50	$50	$50		$60	$60	$80	$80	$100	$100	$80	$70
DA Sched	0	0	0	0		0	0	20	30	50	50	30	0
DA SOC	200 MWh	200	200	200		200	200	180	150	100	50	20	0
RT Bid ↓	$50/MWh	$50	$50	$50		$50	$50	$50	$50	$50	$50	$50	$50
RT Bid ↑	$100/MWh	$100	$100	$100		$100	$100	$100	$100	$100	$100	$100	$100
RT Price	$60/MWh	$60	$60	$60		$1,000	$60	$100	$100	$100	$100	$100	$70
RT Sched	0 MW	0	0	0		20	0	20	30	40	50	30	0
RT SOC	200 MW	200	200	200		180	180	160	130	90	40	10	0
Min Chrg	180 MW	180	180	180		180	180	160	130	80	30	0	0

- Note that in this example, the minimum charge requirement does not necessarily match the scheduled state of charge in the day-ahead market.

[43] In reality, the 5-minute market would dispatch the resource at the full 50 MW Pmax until the state of charge was equal to the 180 MWh minimum charge requirement. After this point the dispatch resulting from bids would be overridden with a dispatch instruction (zero MW) respecting the minimum charge requirement. All of these examples use hourly time blocks for simplicity.

Example 2:

Suppose the same 50 MW storage resource with 200 MWh of storage capability, is dispatched to charge 50 MWh during the lowest priced hours in the morning in the day-ahead market, and is scheduled to discharge 80 MWh in the evening. In this case, the ISO minimum charge requirement will require that the resource be charged sufficiently to meet the evening schedule inclusive of the day-ahead morning schedule. Because the day-ahead schedule to discharge does not start until hour ending 19, the resource is required to maintain an 80 MWh state of charge between hour ending 11 and hour ending 19. However, prior to hour ending 11, the resource has a lower minimum charge requirement because of day-ahead schedule to charge 50 MW at that time. The start of the day requires a minimum charge value equal to the state of charge at the beginning of day in the day-ahead market. In the evening, after the scheduled discharge in the day-ahead market, the minimum charge requirement decreases to zero MWh.

This example illustrates that it is possible for a resource to charge in the morning prior to the interval that scheduled for charge in the day-ahead market. This may occur when prices are lower than expected and lower than real-time market bids. This occurs in the example in hour ending 10 where prices are $25/MWh and the resource has a bid to charge at prices at or below $25/MWh. In this hour, the resource is scheduled to charge at 30 MW, which increases the state of charge to 60 MWh, above the 30 MWh requirement. The numbers in the green boxes in Table 8 illustrate this below.

This example also illustrates that in hour ending 11 the resource does not have the required 80 MWh of storage and is therefore compelled to charge, with an energy schedule of 20 MW, to bring the total state of charge up to the requirement. The numbers in the red boxes in Table 8 illustrate this below.

Prior to the period when the resource was scheduled to discharge in the day-ahead market periods with particularly high prices may develop. However, if the resource is not charged above the minimum charge requirement the resource may not be able to respond to these high prices. In this example, prices spike to $200/MWh in hour ending 18, however the hypothetical storage resource is unable to respond these signals because of the minimum charge requirements, ensuring that later day-ahead schedules can be delivered. In hour ending 18, the resource has a requirement for 80 MWh state of charge and has a state of charge of exactly 80 MWh. The numbers in the orange boxes in Table 8 illustrate this below.

Table 8: Minimum charge requirement example 2

Hour	9	10	11	12	...	17	18	19	20	21	22	23	24
Load	190 MW	190	190	200	...	300	330	335	345	350	340	280	210
DA Bid ↓	$30/MWh	$30	$30	$30		$30	$30	$30	$30	$30	$30	$30	$30
DA Bid ↑	$60/MWh	$60	$60	$60		$60	$60	$60	$60	$60	$60	$60	$60
DA Price	$50/MWh	$50	$25	$50		$60	$60	$60	$70	$70	$60	$60	$60
DA Sched	0	0	-50	0		0	0	0	30	50	0	0	0
DA SOC	30 MWh	30	80	80		80	80	80	50	0	0	0	0
RT Bid ↓	$25/MWh	$25	$25	$25		$25	$25	$25	$25	$25	$25	$25	$25
RT Bid ↑	$70/MWh	$70	$70	$70		$70	$70	$70	$70	$70	$70	$70	$70
RT Price	$60/MWh	$25	$60	$60		$60	$200	$60	$60	$60	$60	$60	$60
RT Sched	0 MW	-30	-20	0		0	0	0	0	0	0	0	0
RT SOC	30 MW	60	80	80		80	80	80	80	80	80	80	80
Min Chrg	30 MW	30	80	80		80	80	80	50	0	0	0	0

- Note that in this example, real-time prices remain low in the evening and the resource does not receive a market instruction to discharge.

It is important for resource owners to understand how the minimum charge requirement will work for bidding into the real-time market and state of charge management. This tool will only stipulate a minimum state of charge that a resource needs to maintain based on day-ahead market schedules. These minimums will be determined at the conclusion of the day-ahead market run and will be known to scheduling coordinators in advance of the real-time market. Knowing these minimums and how actual state of charge values develop in the real-time market may encourage resource operators to adapt bids in the real-time market to increase state of charge for resources so that they have more availability to respond to unexpected high real-time market prices.

5-minute charge requirements

The examples outlined above all include hourly charge requirements and hourly dispatch instructions. The actual real-time market is broken into 5-minute intervals. The charge requirements will be smoothed over the hour, so they are achievable within 5-minute dispatch instructions. For example, if the minimum charge requirement is zero MWh in the prior hour and 12 MWh for the current hour, then the minimum charge requirement for the first five minute interval would be one MWh, then two MWh for the second interval, increasing by one MWh with each successive interval and ending with a requirement of 12 MWh for the final 5-minute interval.

Bidding Obligations

As discussed above, storage resources providing RA capacity will be subject to the 24 by 7 must offer obligation in the day-ahead market. Storage RA resources will be required to bid their full range of operation into the day-ahead market, and those bids will have associated minimum charge requirements in the real-time market. Storage resources will be required to respect the minimum charge requirement and will be required to bid capability into the real-time

market during day-hours when they were scheduled. These bidding requirements must be sufficient for the resources to meet the day ahead schedules.

RA Value for Storage Resources

Storage resources will continue to count for RA credit up to their full 4-hour discharge capability. For example, a five MW resource with a 20 MWh energy capacity will be eligible to receive five MW of credit according to the QC methodology for storage resources. If however that resource was only capable of providing 18 MWh of energy due to operational/charging limitations, the total possible credit would be reduced to 18/4 = 4.5 MW. Storage resources have the ability to reduce the amount of deliverable energy at any given time through the minimum and maximum state of charge parameters available in master file. If these parameters are employed to reduce the capability of the resource to the CAISO during the course of the year, the resource will receive a reduced amount of capacity that it is capable of qualifying for. Further, and similar to most other resources, forced outages and derates will be used to determine the UCAP availability for storage resources as described above.

5.2. Flexible Resource Adequacy

The CAISO seeks to close certain gaps in the existing flexible RA construct through a new flexible RA framework that more deliberately captures the CAISO's operational needs and the predictability (or unpredictability) of ramping needs. Changes to the flexible capacity product and flexible capacity needs determination must closely align with CAISO's actual operational needs for various market runs (*i.e.*, day-ahead market and fifteen-minute market).

Background

In 2014, FERC approved tariff revisions to implement CAISO's FRACMOO proposal. The 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 the CAISO that would ensure the 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 the 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 the CAISO filed the tariff revisions to implement the FRACMOO proposal with FERC, it 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."[44]

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). The CAISO anticipated enhancing 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 the CAISO's operational needs and the transforming grid.

Subsequently, the CAISO initiated the FRACMOO2 stakeholder process. The objective of that initiative was to make changes to the existing flexible capacity framework to address fundamental gaps between the CAISO's markets and operational needs. Although the FRACMOO2 initiative was placed on hold, the objectives and work from that initiative have been integrated into the present initiative.[45]

5.2.1. Identifying Flexible Capacity Needs and Requirements

Flexible Capacity Needs

To define a flexible RA capacity requirement, the CAISO reviewed the drivers of flexibility on the system. This assessment sought to identify reasons the 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 the 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. The CAISO identified multiple drivers of its 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)

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

- Net-load ramps are non-linear

The 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

The CAISO requires all three types of flexibility, but not all are required to be procured through a RA 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 ensures the market has sufficient flexibility reserved to address day-to-day operational needs provides 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
- Facilitation of state environmental policy cost effectively
- Mitigate random price spikes
- Provide for lower cost, more reliable market solutions
- Ensure CAISO can maintain reliability during highly variable weather conditions

As a result, the 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,
- The 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)

The CAISO reviewed the day-to-day operational system needs pertaining to flexible capacity. The 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 requirements. Predictable and reasonably forecastable ramping needs require a set of resources available to the CAISO's day-ahead market to properly shape the day-ahead market to meet forecastable ramps. This allows the CAISO to create a feasible market dispatch in the day-ahead market. The current flexible RA needs determination is based on the largest forecasted three-hour net load plus 3.5 percent expected peak load.[46] 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. The CAISO agrees these ramps are largely forecastable on a day-to-day basis and can be addressed through day-ahead market awards. The day-ahead market will set up the resources needed to meet day-ahead net load ramps.

A greater depth of economic bids allows the CAISO to shape day-ahead commitments and maximize the benefits to load. Specifically, a deeper pool of flexible resources that submit economic bids in in the day-ahead market and have sufficient ramping capabilities will improve the efficiency of CAISO dispatch and management of renewable resources. However, the CAISO relies on LSE resource procurement to address these ramps. This procurement should consider the trade-off between capacity costs, ramp speeds, and RPS obligations. Large quantities of slow or fixed output resources will likely result in renewable curtailment in the day-ahead time frame to ensure adequate capacity and ramping capabilities are available to CAISO to balance load and generation. Long-term, procurement of inflexible resources may put renewable energy goals at risk.

The CAISO's proposed flexible capacity framework is based on connecting forward procurement and market and operational needs into a single flexible RA product. The CAISO proposes to develop a flexible capacity product that will ensure it has sufficient flexible capacity to address uncertainty between the day-ahead and real-time markets. This product, including the requirements, flexible RA counting rules, and must-offer obligations will align directly with the Imbalance Reserve product. The CAISO's day-ahead market will provide commitments to address forecastable ramps. Additionally, the CAISO defers to LSE procurement to ensure RPS/GHG goals are achieved. Therefore, the CAISO proposes to eliminate the existing three-hour net load ramping requirement and will not pursue flexible RA capacity to address predictable ramping needs at this time.[47] Furthermore, as long as the system RA is sufficient to meet the net load peak, the CAISO's day-ahead market can commit and schedule resources to meet the predictable ramping needs (neck of the duck).

The remainder of this section describes CAISO's proposed flexible capacity product. With the continued increase in 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 CAISO market rules, no additional long-start resources are committed after the day-ahead market closes and RUC awards are made. All remaining

[46] 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.

[47] CAISO will continue to assess the market and operational needs to determine if large and/or steep net load ramps begin to create reliability concerns that require forward procurement.

uncertainty, including both load following and forecast error, must be addressed by resources previously committed in the day-ahead market or by faster starting resources available for commitment in the real-time market.

The CAISO's first full market run is its day-ahead market. This market currently runs with hourly granularity using a forecast between 14 to 36 hours ahead of actual operations. To date, the CAISO has managed most resource commitments through the day-ahead market process. CAISO does not expect this to change. However, once the CAISO produces a day-ahead dispatch solution it must rely on real-time market dispatches to account for unpredictable ramps caused by uncertainty. 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 resulting from forecast error and time granularity. This is particularly true during sunrise and sunset.

As already noted in this proposal, to ensure the CAISO has adequate capacity available to the real-time markets to address uncertainty between the day-ahead and real-time markets, the CAISO is developing an Imbalance Reserve product in the Day-Ahead Market Enhancements initiative. The Imbalance Reserve product will ensure both upward and downward capacity is available to the real-time markets to address differences between the day-ahead and real-time markets caused by time granularity differences and forecast error. Additional details about the Day-Ahead Market Enhancements and the Imbalance Reserve product can be found on the CAISO's market initiatives webpage.[48]

The 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.

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, the CAISO will develop new flexible capacity requirements that incorporate shorter interval ramping capabilities. The CAISO will sunset the existing flexible capacity products once these new requirements are developed and implemented.

To address the above flexible capacity needs, the CAISO proposes a single flexible capacity requirement equal to the historic forecasted net load error between IFM and FMM plus a growth factor to account for additional growth in uncertainty.

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

[48] Available at http://www.caiso.com/informed/Pages/StakeholderProcesses/Day-AheadMarketEnhancements.aspx

- 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, the 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 Flexible RA Requirements

The flexible RA product is designed to address differences between the IFM and FMM caused by both time granularity differences (*i.e.*, hourly day-ahead schedules to fifteen-minute FMM schedules) and forecast error. The CAISO proposes 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 (*i.e.*, how much it increase year over year). The CAISO will combine the identified needs from the calculated flexible RA needs with expected changes in load, wind, and solar (including behind the meter solar) as submitted by LSEs in the CAISO's annual flexible capacity needs assessment survey and CEC load forecast. The 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, the CAISO can reexamine this practice and consider establishing this need based on imbalance reserves procurements. The CAISO seeks stakeholder input on this approach to determining the requirements for uncertainty.

5.2.4. 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, the CAISO, as it does today, will publish a list annually showing all resources' EFC values. Each eligible resource will receive an EFC value for each month. The remainder of this section details the eligibility and counting rules meeting CAISO's proposed flexible RA for meeting the requirement. The 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.

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. The CAISO hopes to simplify the eligibility criteria. At this time, CAISO is proposing a basic set of eligibility criteria.

Eligibility Criteria

Currently, flexible RA capacity can only come from resources internal to the CAISO BAA. Import resources are not eligible to provide flexible capacity. However, the CAISO has found

that import capacity is capable of providing significant ramping capabilities. Therefore, the CAISO will allow imports to provide flexible RA capacity.

For any resource to be eligible to provide flexible RA, 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
- Cannot be a Conditionally Available Resource
- Must be dispatchable in at least 15 minute increments (including imports)
- Cannot be a regulation energy management resource [49]

The CAISO seeks stakeholder input regarding any additional eligibility criteria that should be included.

Unlike internal resources that provide flexible RA capacity, import resources providing flexible RA capacity under this proposal will not necessarily be tied to specific resources like internal flexible RA capacity.[50] As noted above, the CAISO may continue to allow non-resource specific imports to provide RA, but has provided additional clarity about the requirements for doing so.[51] Further, 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. Although the MIC ensures the flexible capacity is deliverable, the CAISO must still ensure the flexible capacity is credited to the CAISO balancing area authority for purposes of the EIM sufficiency tests. Therefore, the resource must identify its BAA of origin and the interconnection point with CAISO system. The CAISO will also 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.

Although these eligibility criteria provide cleaner eligibility criteria than the existing flexible capacity eligibility criteria, they also leave two primary issues unresolved. The first is how the eligibility criteria account 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 resource's ability to have available energy when needed.[52] Similarly, there are no requirements for starts or ramping frequency. For example, the current Base Ramping flexible RA capacity product requires two starts or two

[49] 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
[50] However, dynamic and pseudo-tied resources are connected to specific resources. Their counting rules will be the same as internal resources.
[51] CPUC decision in proceeding R17-09-020 requires all non-resource specific resources shown by its jurisdictional LSEs to self-schedule into the CAISO market. Under the requirements of that decision, NRS-RA import resources would be ineligible to provide flexible RA capacity for CPUC jurisdictional LSEs.
[52] The specific treatment of energy limitations is also being considered as part of the Day-Ahead Market Enhancements initiative.

ramps per day. The CAISO is not proposing minimum start or ramp requirements herein, but this issue requires further discussion.

The CAISO recognizes that with these two unresolved issues, there is a risk resources can receive commitments that change from day-ahead to real-time, potentially rendering the resource unable 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 unable to recharge during the day. The CAISO is seeking stakeholder input about how, or if, flexible RA capacity eligibility criteria should address these concerns. Additionally, the CAISO seeks stakeholder feedback regarding the proposed eligibility rules and any additional criteria that should be considered.

EFC Counting Rules

The EFC for all resources 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 and a weighted average ramp rate for the resource. The CAISO will no longer consider those elements. Instead, to align with the imbalance reserve product, the CAISO will calculate the EFC using the largest range a resource can move over 15-minute interval capped at the resource's UCAP.[53] There is no planning reserve margin flexible RA. Capping EFC at UCAP provides the same forced outage benefits for flexible RA that UCAP offers for system RA. 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 resource's EFC. The CAISO will calculate resources from warm start, and will consider the full range of the resource from its lowest operating limit to max output.

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, the CAISO is unable to calculate an EFC for imports 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. The CAISO will allow imports to provide EFC up to the UCAP of the resource.

At this time, the CAISO proposes to use the above counting rules for all technologies, with two exceptions: Solar and non-generator resources (NGR). Solar resources' NQCs are based on their ELCC values and may not reflect the resources' availability during all hours of the day. Additionally, they are limited in their ability to provide imbalance reserves outside of sun-up hours. As such, the CAISO in considering a couple options for solar resources including:

[53] 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).

1. Limits on the amount of flexible RA that can be shown from solar resource
2. Creating a separate flexible RA product that would have a more limited availability

As such, the CAISO is not proposing an EFC counting rule for solar at this time. Instead, the CAISO seeks stakeholder feedback on which of these options is preferred and how the CAISO should calculate EFC for solar given the preferred solution.

Consistent with current practices, the 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, the CAISO proposes to count NGR resources' EFC based on the resource's ability to provide generation (positive and negative) over a fifteen minute period. This allows NGR resources to potentially receive EFC values that include their full charge and discharge ranges.

5.2.5. Flexible RA Allocations, Showings, and Sufficiency Tests

Each LSE must demonstrate it can meet its proportionate share of the requirement. The CAISO will provide each LRA its jurisdictional LSEs' contribution to the flexible capacity requirement. Each LRA can then determine its own allocation of the requirement to its LSEs. If the LRA does not provide the CAISO with an allocation, then the CAISO will allocate to each LSE based on the CAISO's allocation methodology.[54]

The CAISO proposes to allocate the flexible RA capacity requirements to LRAs based on each LRAs' proportional share of peak load, and MWs of wind and solar. This allocation reflects that these factors, although not the only drivers, are the major drivers of uncertainty. However, the CAISO seeks 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 requirement in both the year ahead and month ahead RA showings. Showings should be submitted in terms of EFC values. As is done today, the CAISO will assess the flexible RA showings independently of system and local RA showings.

Once the CAISO receives flexible RA capacity showings, it will do two things. First, it will notify all LSEs whether they have provided adequate flexible capacity and will notify any LSE that is at risk of potential backstop procurement cost allocation. Second, the CAISO will assess the requirement at a system level. If the CAISO has received enough flexible RA at system level, it will not undertake any additional action regarding flexible RA capacity.[55] If the CAISO finds a deficiency, 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 requirements. Once the cure period closes, the CAISO will proceed with the

[54] The CAISO is not looking for LRAs to provide an allocation methodology, instead, the LRA should provide the CAISO with each of its jurisdictional LSE's allocation.
[55] The CAISO may also develop locational flexible capacity requirements as part of this or a future stakeholder initiative.

remaining validation processes. These processes 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, the CAISO is looking to simplify the must offer obligations for flexible capacity. As noted in Section 5.1, the CAISO is clarifying must offer obligations for system and local RA capacity. More specifically, system and local RA capacity must offer obligations will typically run through the day-ahead market only. Real-time must offer obligations will be derived from day-ahead market awards, including imbalance reserves. CAISO data shows the uncertainty tends to be higher between 5:00 AM and 9:00 PM.

As a starting point, the CAISO proposes that any resource providing any flexible capacity must submit economic bids for energy, ancillary services, and imbalance reserves to the CAISO's day-ahead market from 5:00 AM to 9:00 PM for all shown flexible RA capacity. The CAISO considered requiring a 24 hour bidding obligation. However, creating such an obligation would add significant complexity to the proposed flexible RA product. For example, it would require either the creation of two products: A 24-hour product and day-time product to facilitate solar resources. Alternatively, the CAISO would have to put a cap on how much solar capacity could provide flexible RA. At this time, the CAISO believes the single product is adequate. The CAISO will continue to assess the need for an over-night flexible capacity must-offer obligation. If there is insufficient flexible capacity available during those hours, then the CAISO can explore additional flexible capacity products.

The CAISO proposes to require resources providing flexible RA to submit economic bids covering the entire range of the resource above Pmin. This is necessary to ensure the CAISO has access to the operational range used to determine the EFC. For example, if a 500 MW resource has two ramp segments, the first at 20 MW/min up to 300 MW and the second at 10 MW/min from 300 MW to 500 MW, then the EFC would be calculated as 300 MW. However, if the resource self-scheduled the first 200 MW, then the CAISO would only have access to 100 MW of 20 MW/min ramp speed and 200 MW of 10 MW/min ramp speed or 200 MW of 15 minute ramp capability.

In other words, the CAISO would not be able to position the resources in the day-ahead market to access the flexible capacity the resource has sold. As an alternative, the CAISO considered allowing a resource to only bid its shown EFC. However, as the above example shows, this does not ensure adequate ramping speed is available. If the CAISO established the EFC for resources using their slowest 15 minute ramp capabilities, then only requiring the EFC to economically bid and provide imbalance reserves would be sufficient. However, aligning the proposed EFC counting rules and must offer obligations require the entire resource to bid the entire range of the resource.

The CAISO is proposing a day-ahead flexible capacity must offer obligation for wind and solar resources. Wind and solar resources providing flexible RA capacity would be required to

economically bid for energy, any ancillary services it is eligible to provide, and imbalance reserves into the day-ahead market for the minimum of its forecast or shown EFC. The CAISO notes that system and local capacity must offer obligations are not eliminated under this option.

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 their shown EFC.

5.3. Local Resource Adequacy

In previous proposals, the CAISO developed proposals for Local Assessments with Availability Limited Resources and Meeting Local Needs with Slow Demand Response. These proposals have been separated out from this document and finalized in a separate Draft Final Proposal.[56] A discussion of how to potentially apply UCAP counting to local RA is also now included in this section.

Stakeholder Feedback

In the Second Revised Straw Proposal, the CAISO outlined a proposal to apply UCAP calculations for local capacity counting. Although the CAISO continues to prefer local RA procurement be done with NQC values, it has identified two options for applying UCAP counting rules for local capacity products.[57] Most stakeholders have expressed a desire to further explore these options. SDG&E objects to the use of UCAP for local noting the difference between the 1-in-10 load used for local versus the 1-in-2 load used for system as primary reason. Though SDG&E is correct that the load levels used to determine local capacity requirements are greater than those used for system RA, the CAISO does not agree with SDG&E that applying UCAP to local requirements will result in over procurement. This is discussed in greater detail below.

CESA recommends the CAISO consider using class average UCAP values in different local areas. The CAISO disagrees with this approach. The overall goal of the CAISO's proposal is to align the system and local RA counting rules. As noted above, using technology or fleet averages to calculate UCAP values does not provide the correct incentives for resources. Further, using different UCAP values for system and local would defeat the purpose of using UCAP for local. PG&E and SCE asks for additional examples to clarify how the CAISO would apply the various options for UCAP in local areas. The CAISO offers additional detail below. Finally, several parties, including PAO and CalCCA, supported the CAISO's proposed option to apply a conversion factor after the local capacity studies have been completed. The CAISO has continued to explore both options put forward in the Second Revised Straw Proposal and determined that the option of running the local studies using UCAP values in the study instead

[56] The Draft Final Proposal on these items is available at: http://www.caiso.com/informed/Pages/StakeholderProcesses/ResourceAdequacyEnhancements.aspx.

[57] In the revised straw proposal, the CAISO proposed to leave the existing local RA studies and counting rules largely intact. However, numerous stakeholders commented that the CAISO should develop a proposal for local RA that would align with the proposed system UCAP rules. Given this feedback, the CAISO herein examines the potential for utilizing UCAP for local RA.

of NQC is not aligned with any of the CAISO's other mandatory processes. As a result, that option has been removed from this proposal.

UCAP in Local RA Studies

The CAISO will continue running the local capacity studies exactly as is done today using NQC values and will publish the local capacity requirements in terms of NQC. At the beginning of the CAISO's local capacity study report, the CAISO will include a translation table from NQC to UCAP at the level of LSE compliance requirement. The translations will be done by TAC, as required by the CAISO Tariff. For each TAC, the total local UCAP requirement will be defined as follows:

$$\boldsymbol{Total\ TAC\ UCAP\ responsibility} =$$

$$\left(\sum \boldsymbol{of\ TAC\ wide\ NQC\ requirements}\right) \times \left[\frac{\sum \boldsymbol{of\ TAC\ wide\ UCAP\ values}}{\sum \boldsymbol{of\ TAC\ wide\ NQC\ values}}\right]$$

The CAISO's local capacity study report is done by May 1 and local requirements are sent out in July before the NQC/UCAP list for the next compliance year is available (September). Therefore, the NQC and UCAP *values* used in second term (*i.e.* the conversion factor) are given by all available values in the previous year's NQC/UCAP list for resources already in-service. This is necessary to avoid complications derived from including estimated NQC and estimated UCAP values for new resources that may or may not become in-service between the time when the report is written and the compliance year.

The CAISO believes using the NQC and UCAP values from the current year is both an infeasible and undesirable result. The LCR base cases are built in December-January and studies are run in February. The stakeholder process runs through May 1.[58] The annual NQC deliverability study is done in June-July timeframe and, per CAISO Tariff and BPM, LCR allocations are released mid-July. The NQC list is currently completed in August (sometime early September). Therefore, it is not possible to utilize actual NQC and UCAP values for the LCR studies.

Because the annual LCR studies begin in December before the year of need, they are run with the previous year's NQC. Given the timing of the studies, this is necessary even though those values will not be the actual NQC values used in RA showing made in the subsequent October or later. Similarly, given that NQC values already come from previous years and given the limited year-by-year changes in new resources and potential for TAC-wide available total UCAP, waiting for the new UCAP is not needed.

The CAISO will calculate LSEs' local load-share ratio responsibility in terms of UCAP at the TAC level. As is done today, LRAs will be given their share UCAP to allocate to their LSEs. The LRA may allocate these responsibilities using its preferred methodology, however, as specified

[58] Per Tariff section 40.3.1 (and RR BPM) LCT study (including the new UCAP translation) needs to be final by May 30 – 120 days before the showings get here. CPUC requires us to file draft LCR study by around April 1 and final by May 1.

in 40.3.2 (c) of the CAISO Tariff, if the LRA does not allocate their entire responsibility to their jurisdictional LSEs the CAISO will allocate the difference.

LSEs' individual compliance in meeting their given local allocation is calculated in UCAP[59] (for compliance with ISO Tariff sections 43A.8.1 and 43A.8.2). In other words, an LSE will be determined to be individually adequate if its shown UCAP is greater than its allocated share. As all RA showings will be made in terms of UCAP, the CAISO will convert UCAP values back into NQC values and run its compliance studies of all RA showings with local technical criteria and requirements using NQC values, as done today. In addition to deficiencies caused by effectiveness factors that exist today, the CAISO must also ensure there are adequate MWs in a given area. For example, the CAISO may receive adequate UCAP to meet individual obligations, but not enough MW to serve peak load in a local capacity area. Therefore, collective deficiencies will be defined as both insufficient MW of NQC to meet the LCR as well as the existing insufficiently effective capacity.

The CAISO will notify LSEs of any deficiencies and provide them an opportunity to cure. If still short, the CAISO may purchase capacity from remaining non-RA resources through its CPM authority cure the deficiency. The cost will first go pro rata to each SC for an LSE based on the ratio of its Local Capacity Area Resource Deficiency to the sum of the deficiency of Local Capacity Area Resources in the deficient Local Capacity Area(s) within a TAC Area (all calculated in UCAP – per 43A.8.1) and second if anything else is required the cost allocation will be based on the SCs proportionate share of Load in such TAC Area(s) as determined in accordance with Section 40.3.2 – per 43A.8.3.

In assessing which resources to offer CPM designations to cure deficiencies, the CAISO may continue to assess a number of variables from the available resources, including but not limited to cost, effectiveness, and reliability as dictated by ISO Tariff section 43A.4.2. The CPM cost will be divided to the LSEs per the different varieties of CPM as required by the CAISO Tariff. The LSEs that receive cost allocation for the CPM will get a capacity credit commensurate with their CPM cost ratio allocation. The amount of the credit is based on the quantity of UCAP purchased, not the NQC value.[60]

[59] This is consistent with existing ISO Tariff sections 43A.8.1 and 43A.8.2.

[60] In other words depending of the situation they may get one-for-one cost/credit allocation, sometimes it may not be one-for-one cost/credit allocation, at worst it could be as low as no credit if the resource has no qualifying UCAP value.

5.4. Backstop Capacity Procurement Provisions

In this initiative the 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.

The 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 or sub-area fails to meet the energy sufficiency test. These three needs are extensions of 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 CPM is the tool that the CAISO uses to backstop the RA program. Specifically, when there is insufficient capacity shown in the RA process to reliably operate the grid, the 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 the CAISO makes a CPM designation. Generally, in any timeframe the CAISO makes a designation, all options for procurement are reviewed and the least cost option that meets the reliability need is selected. Additionally, when the CAISO makes any CPM designation, it posts information about the designation and supporting documentation outlining why the CAISO needs the resource.

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

7. Capacity is at risk of retirement that is needed for reliability in a future year

The CAISO proposes modifications to its existing CPM authority to procure additional capacity in the following 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 or sub-area fails to meet the energy sufficiency test.

The CAISO will seek additional CPM authority to procure capacity based on system UCAP deficiencies. The CAISO will not make these designations merely because some LSEs are deficient, but instead will only make such designations when there are overall system deficiencies based on all RA showings. To make these designations, the CAISO will compare all UCAP reflected in RA showings to the total requirements for UCAP, and may make additional designations based on that difference. This authority will be 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 timeframes. Similar to existing authority, CAISO will alert entities with shortfalls and provide those entities with a chance to cure any shortfall. CAISO backstop procurement will only occur after this cure period closes.

The CAISO is not seeking authority to procure additional backstop capacity merely because an individual entity shows less capacity than its requirement. CAISO procurement based on individual LSE shortfalls could result in CAISO procuring more capacity than was necessary if other LSEs procure more capacity than required. By procuring only for system UCAP shortfalls, the 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 authority, where the 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, the CAISO also proposes to implement a UCAP incentive mechanism, discussed further below.

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

Finally, the CAISO proposes additional backstop authority to assure that procured local resources can meet energy needs in each local area and sub-area during the upcoming year. If CAISO identifies any capacity and/or energy shortfall, it will provide a cure period for entities to clear any deficiencies before exercising backstop procurement authority.

Example: UCAP Deficiency

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

Assume in this example 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. The CAISO provides additional discussion, below, about how LSE 1's showing can result in incentive payments for its 25 MW of excess capacity.

Figure 15: UCAP Deficiency CPM Backstop

LSE	Req. (MW)	Shown (MW)	Shortage (MW)
1	100	125	
2	100	80	20
3	100	75	25
TOTAL	300	280	45

Cost Allocation
20/45
25/45

↓

BACKSTOP: 20 MW

CPM Designation Order

Today if the 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. The CAISO will maintain the similar paradigm with the new authority. Going forward, the CAISO will first allocate the costs to system UCAP deficiencies, then to NQC system deficiencies, then to local individual deficiencies, then to local collective deficiencies, and finally to portfolio deficiencies. This order is illustrated in Figure 16 below. As with current practice, if the CAISO were to consider multiple designations in one timeframe, it 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 the CAISO makes multiple CPM designations using different CPM authority.

Figure 16: CPM Designation Order

- **System UCAP deficiencies**
- **System NQC deficiencies**
- **Local individual deficiencies**
- **Local collective deficiencies**
- **Portfolio analysis deficiencies**

5.4.2. Making UCAP Designations

Today the CAISO uses net qualifying capacity as the basis for determining all designations for all CPM procurements. These quantities are used to determine the total capacity cost for the designations (Quantity x CSP price) and the total amount of credit that is allocated to load serving entities who incur these costs. With the proposed additions to the CPM authority discussion in the section above, the CAISO may procure for a specific MW quantity of UCAP, rather than NQC. The CAISO is not planning to change pricing rules, the soft offer cap or bidding rules for the existing CPM tool.

Each resource will have a value for UCAP and for NQC which is stored in CAISO databases used for resource adequacy calculations. These values can be used to inform a ratio, or conversion factor, between UCAP and NQC. With this ratio, a specific price can be determined for any quantity of UCAP designation, similar to any NQC designation. This may imply that a designation for UCAP may be awarded to a resource with a higher bid price, but better conversion factor.

An example of the UCAP counting is outlined in Table 9. This table shows two hypothetical resources, resource 1 and resource 2. In this example resource 1 has an NQC value of 200 MW with an accompanying UCAP value of 100 MW, and resource 2 has an NQC value of 150 MW and a UCAP value of 125 MW. Resource 1, the less reliable resource bids into the competitive solicitation process for CPM at $5/MW, while resource 2 bids at $6/MW. If the CAISO makes a designation for NQC needs for a local deficiency it will first select capacity from resource 1, as the bid prices are less expensive for resource 2. However, if the CAISO is making a designation for UCAP, capacity from resource 2 will be selected first, as the effective bid prices for resource 2 are less expensive. In this example, the effective price for UCAP capacity for the resource 1 is $10/MW, while the price is $7.20/MW for resource 2.

Table 9: UCAP CPM price example

	NQC	UCAP	UCAP:NQC	Bid ($/MW NQC)	Effective UCAP Bid ($/MW UCAP)
Resource 1	200	100	0.5	$5	$10
Resource 2	150	125	0.8	$6	$7.20

5.4.3. Reliability Must-Run Modifications

This proposal includes removing the RAAIM tool from CAISO processes and tariff provisions. Today RAAIM currently serves as a mechanism intended to incentivize resources to bid shown RA capacity into the market during the availability assessment hours, and penalize resources that do not. RAAIM also serves as the primary incentive mechanism to ensure that RMR resources are bidding into the market. The CAISO proposes that the ability to compose a custom metric to track and incentivize performance continues to be available for any resources that receives as RMR designation. Additionally, the CAISO proposes a new penalty structure for RMR resources, which would assess performance if the resource was not available above some pre-determined threshold.

An appropriate penalty structure for RMR resources may be one similar to the existing RAAIM tool, with several notable differences. The RAAIM penalty has a predetermined threshold for performance, where performance below 94.5% is penalized at the soft offer cap during any specific month. The RAAIM tool also incentivizes resources with availability above 98.5%. A penalty parameter for RMR resources might be different from RAAIM because it would not offer a potential incentive payment for performance above the pre-determined threshold. Further, the threshold will not be set at 94.5%, but may be set at an appropriate target level for the specific resource receiving the RMR designations. This may allow resources with historically lower performance to not be held to an unreasonable standard, and for resources with very high historic available to also be held to a reasonably expected threshold. Further, these targets could be designed to vary with different seasons. This may be appropriate as the critical need for a resource may be focused on one time of year. Similar to the RAAIM penalty, the CAISO would calculate the availability on a monthly basis and assess penalties on those amounts. Unlike RAAIM, this tool would not be self-funding and any collected penalties would be returned to the parties initially assessed costs for the RMR designation.

The CAISO may continue to use the CPM soft offer cap as the penalty price for poor performance for the RMR incentive tool, but may also elect to use a penalty price set at the RMR price. Using the CPM soft offer cap would be consistent with historic penalty rates assessed for resources, and using a rate equal to the rate that the RMR deal was struck at might set a price more appropriate for the specific resource receiving the RMR designation. The CAISO will continue to seek feedback on an appropriate design for a tool to incentivize availability from RMR resources after the removal of the RAAIM tool.

5.4.4. UCAP Deficiency Tool

As noted above, the CAISO is not proposing new CPM authority to make a designation when a specific entity shows less UCAP than individual requirements as long as the system as a whole is adequate. However, the CAISO is proposing a new tool, called the UCAP deficiency tool, which will impose deficiency charges 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 charge to resources that show less than their UCAP requirement, and distribute those collected charges 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 for the amount of capacity the entity is short. This proposal includes specifications that the deficiency 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.

Example: 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, the 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 17: 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 five 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 chooses note to 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 charge of $63,100 and LSE 2 is assessed a charge 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 18: 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.

Figure 19: 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 five 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 eight 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 five MW or exactly the capacity that that LSE 1 showed above its requirement.
- Therefore, the remaining shortfall, inclusive of the CPM allocation, is two MW for LSEs 1 and three 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 20: 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

The CAISO originally targeted 2021 implementation for this initiative, meaning application to the 2022 RA compliance year. The CAISO understands this is a challenging and comprehensive initiative. Given these implementation considerations, the CAISO is planning a phased implementation in three parts. The first phase includes elements that can be implemented relatively quickly. The second phase includes elements that are needed to align with the day-ahead market enhancements and the extended day-ahead market. The third phase includes counting rules that must be coordinated with the CPUC and the portfolio analysis which would allow time for the analysis to be demonstrated prior to becoming part of the RA requirements.

Phase One: (2020 for RA year 2021)

- MIC Enhancements (New initiative)
- Slow demand response

Phase Two: (2021 for RA year 2022)

- RA Import provisions
- Planned outage process enhancements
- Local studies with availability limited resources CPM clarifications
- Must offer obligations and bid insertion rules
- Flexible resource adequacy

Phase Three: (2022 for RA year 2023)

- Capacity counting rules and forced outage assessments
- Portfolio analysis to ensure system sufficiency

CAISO seeks stakeholder feedback on the proposed phases, including the order these policies must roll out and the feasibility of the proposed implementation schedule.

7. EIM Governing Body Role

For this initiative, the CAISO plans to seek approval from the 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 the CAISO's RA planning, procurement, and performance obligations. This process applies only to LSEs serving load in CAISO's BAA and the resources procured to serve that load, and does not apply to LSEs outside CAISO's BAA. The CAISO did not receive any specific feedback from stakeholders regarding the initial proposed EIM classification for this initiative. The CAISO continues to seek stakeholder feedback on this proposed decisional classification for the initiative.

8. Next Steps

The CAISO will discuss this third revised straw proposal with stakeholders during a stakeholder meeting on January 7-8, 2020. Stakeholders are asked to submit written comments by January 22, 2020 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. Unit Outage Rate Analysis Examples

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

The 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

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

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

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

Example Outage Analysis Results

The following figures provide the results of the CAISO's outage analysis for two example resources. It illustrates the magnitude of outages these example resources had over the 2018 annual and summer periods. The CAISO's analysis shows that resource availability related to forced outages varies over seasons and between resources. Significant variance in resource forced outage rates is precisely the issue the CAISO's proposed UCAP modifications are intended to capture.

Figure 21: Example Unit #1 – Seasonal outage rate analysis: summer 2018

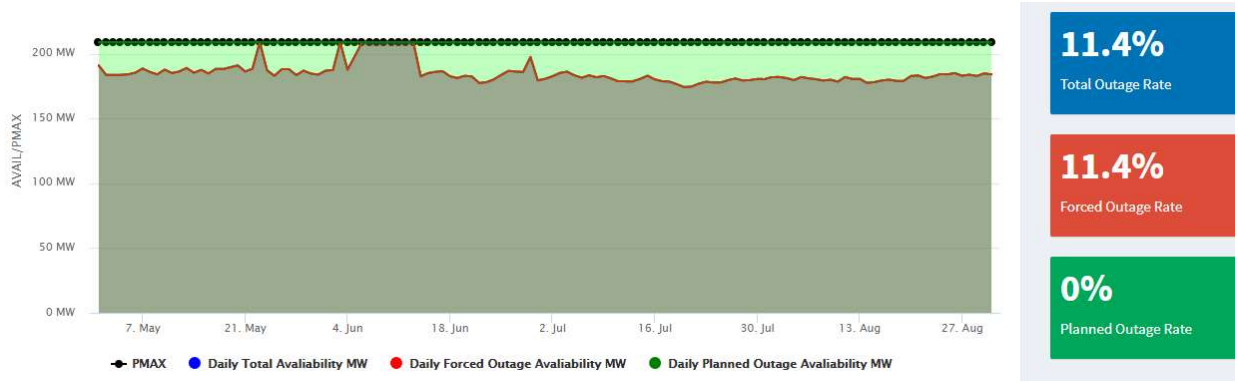


Figure 22: Example Unit #1 – Annual outage rate analysis: 2018

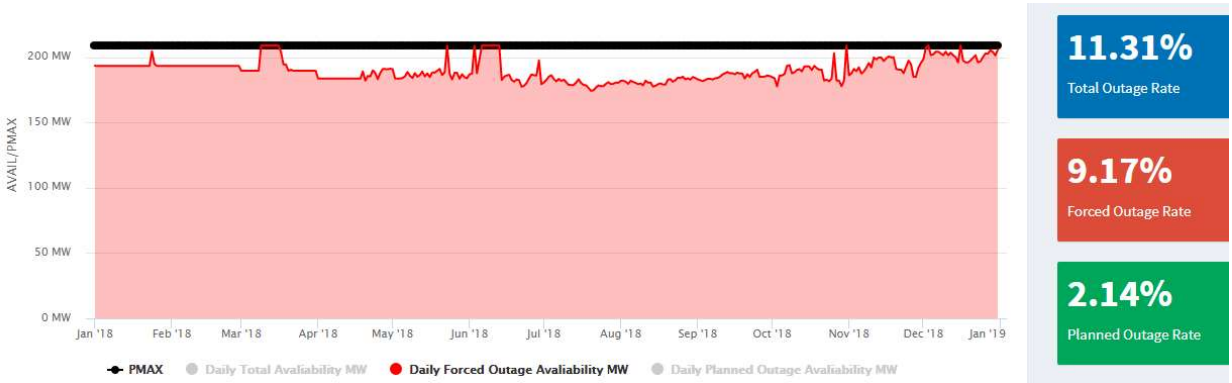


Figure 23: Example Unit #2 – Seasonal outage rate analysis: summer 2018

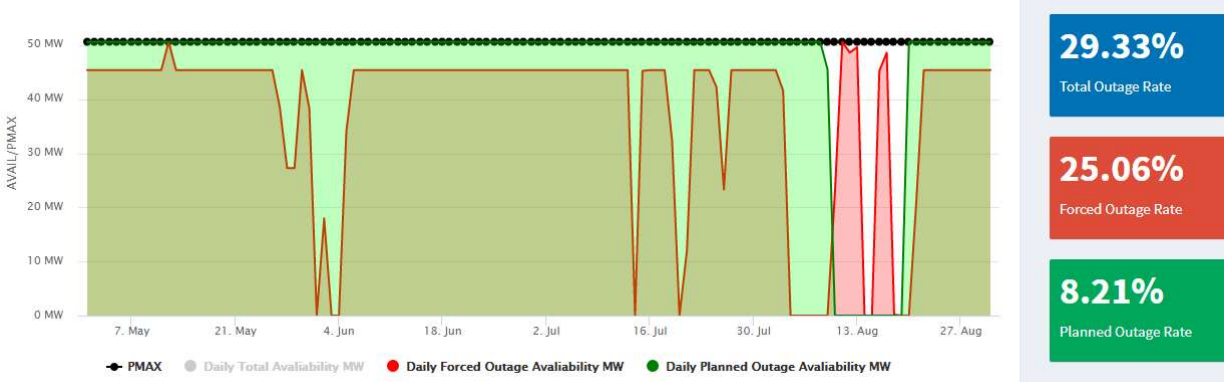
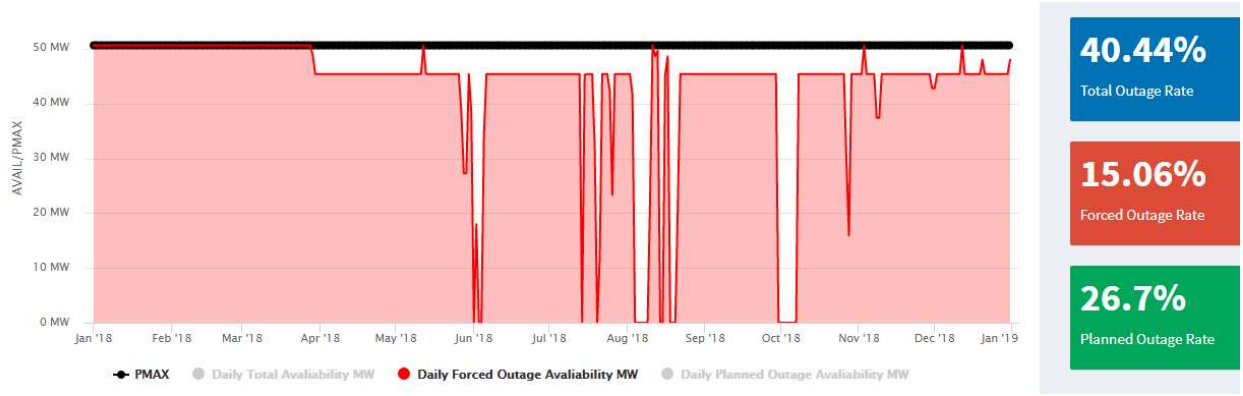


Figure 24: Example Unit #2 – Annual outage rate analysis: 2018



The example resource forced outage analysis is for illustrative purposes only and any final proposal will provide detailed calculation parameters and inputs.