December 12, 2018

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

Re: California Independent System Operator Corporation
Docket No. ER19-____-000

Tariff Amendment to Enhance Detail on Load Forecast Conformance

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) proposes tariff revisions regarding practices for conformance of load forecasts in the balancing authority areas that participate in the CAISO markets.[1]

After the CAISO produces its load forecast for use in the CAISO markets, system operators may need to conform the load forecast[2] to ensure the markets optimize using information that best reflects system conditions and needs. This enhances the CAISO's ability to balance the system consistent with NERC reliability requirements. This practice is common to all balancing authorities, including system operators within the western energy imbalance market (EIM).[3]

The CAISO proposes to enhance its tariff by describing the load conforming practice in the real-time market and a similar practice of conforming the load forecast in the residual unit commitment (RUC) process of the day-

[1] The CAISO submits this filing pursuant to section 205 of the Federal Power Act, 16 U.S.C. § 824d, and Part 35 of the Commission's Regulations, 18 C.F.R. Part 35.

[2] The CAISO uses the terms "conform," "conforming," "conformance," and "conformed" to refer to the process by which the system operators adjust the load forecast prior to it being processed through the market clearing process to account for system conditions the operators observe. System operators conform load forecasts to maintain the system in balance. This practice supports the CAISO's ability to operate consistent with the North American Electric Reliability Corporation (NERC) reliability requirements.

[3] Capitalized terms not otherwise defined in this filing have the meanings set forth in Appendix A to the CAISO tariff as revised by this filing, and references to numbered sections are references to sections of the CAISO tariff as revised by this tariff filing, unless the context indicates otherwise.

ahead market. The CAISO also proposes to enhance its tariff with details of an additional tool it employs that allows the market to reach a feasible solution when the operator conformance may not have been intended for a specific interval.

The CAISO respectfully requests that the Commission issue an order accepting the proposed revisions by February 25, 2019 (*i.e.*, 75 days after this filing), with an effective date of February 27, 2019, for the changes.

I. Background

A. Overview of the CAISO Markets

The CAISO administers both day-ahead and real-time wholesale electricity markets. Although the day-ahead market only includes the CAISO balancing authority area, the real-time market extends to balancing authority areas participating in the EIM, which include the CAISO and currently seven EIM entities.[4]

Both of these interrelated markets ensure electricity supply is sufficient to satisfy demand in the region while maintaining the reliability of the transmission system. Both markets commit resources and schedule and dispatch them for energy, while respecting transmission security, resource characteristics, and transmission scheduling limits. The markets produce optimal schedules and dispatches, and produce locational marginal prices used for financial settlement. The day-ahead market produces schedules for the CAISO balancing authority area, for both individual internal and external resources and for non-resource specific bids for energy at the CAISO interties, *i.e*., imports and exports. The real-time market also produces schedules and dispatches for these resources, as well as for individual or aggregate resources for EIM balancing authority areas.

These schedules and financial settlement are hourly in the day-ahead market. The real-time time market consists of 15-minute schedules settled relative to day-ahead market schedules, and a 5-minute real-time dispatch settled relative to 15-minute schedules.

The CAISO tariff sets forth the rules for submitting bids and self-schedules for energy and ancillary services in the CAISO markets. The CAISO market design allows suppliers to submit separate bid components for commitment costs and for market bids for energy above minimum load for individual resources.

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[4] Currently, PacifiCorp, NV Energy, Arizona Public Service, Puget Sound Energy, Portland General Electric, Powerex Corp., and Idaho Power Company are actively participating in the EIM. Balancing Authority of Northern California will become an active participating in April 2019, while Los Angeles Department of Water & Power, City of Seattle, by and through its City Light Department, and Salt River Project will commence participation in the EIM in 2020.

Import and export bids only include an energy component. Market participants can also engage in convergence bidding (also called virtual bidding) at nodes within the CAISO's balancing authority area to speculate on price differences, hedge their physical market positions, and manage their exposure to differences between day-ahead and real-time prices. The maximum energy bid price is $1,000 per megawatt-hour (MWh).

As part of the day-ahead market, the CAISO clears the integrated forward market based on market participant supply and demand bids, as opposed to the CAISO's load forecast. The integrated forward market produces unit commitment and financially binding day-ahead energy schedules. Subsequently, the CAISO conducts the RUC process as part of the day-ahead market, which consists of a unit commitment process based on the CAISO's load forecast for its balancing authority area. This process ensures the CAISO has committed sufficient resources in the day-ahead timeframe to meet its demand forecast. The RUC process uses RUC availability bids and resource's start-up and minimum load costs that clear against the CAISO's demand forecast.

In the real-time market, which includes the EIM, the CAISO clears supply bids against its load forecast and export bids, and does not accept real-time load demand bids. CAISO system operators may also issue exceptional dispatch instructions to resources outside of the market's economic dispatch construct. Similarly, EIM entity system operators retain operational control and may manually dispatch resources within their respective balancing authority areas.

Prior to the executing the applicable market runs, the CAISO produces a CAISO Forecast of CAISO Demand for its balancing authority area, and this load forecast is used in clearing the real-time market. EIM entities for their respective balancing authority areas may use a forecast produced by the CAISO or they may produce their own forecast for use in the CAISO market. These forecasts are automated forecasts.

B. Conformance of Load Forecast in the Real-Time Market

1. Nature of Conformance of Load Forecast

System operators in the CAISO and all EIM balancing authority areas are responsible for continually maintaining a balance of supply and demand to maintain system reliability. Frequency deviations can result when the system is not balanced (*i.e.*, energy generated does not equal energy consumed), making it difficult for the CAISO and EIM balancing authority areas to comply with NERC Reliability Standard BAL-001-2 Real Power Balancing Control Performance,

which applies to all balancing authorities.[5]

The CAISO operates its balancing authority area reliably primarily through its market systems, and the CAISO seeks to produce a market solution that is feasible and supports its operational requirements. Similarly, although EIM entities retain full control and responsibility of operational requirements on their respective systems, EIM entities also expect the CAISO real-time market solution to provide a reliable and feasible schedule.

Ideally, if the CAISO had perfect foresight through its load forecast, all supply resources would follow their market dispatch, there would be no contingencies or unpredictable grid events, and the system would always remain balanced. In reality, however, although the CAISO strives to produce an accurate load forecast, a forecast by its definition is just a prediction and it will never exactly match what actually materializes. In addition, supply resources do not necessarily follow their market dispatch, and unpredictable events, such as unanticipated outages and changes in weather patterns, occur from time to time. These factors could cause the system to become unbalanced if the CAISO were to rely solely on the automated load forecast. System operators must take manual actions to respond to these system conditions and ensure the system is balanced, and in compliance with NERC reliability requirements.[6]

System operators can correct these factors, either before the market run by making conformances to the load forecast (*i.e.*, conform the load forecast) or through exceptional dispatch after the market has produced a solution. Like all system operators, the CAISO will conform the CAISO Forecast of CAISO Demand (*i.e.*, the load forecast for the CAISO balancing authority area) when possible to inform the market to move the system in the desired direction to maintain system balance. System operators will aim to move the system in the desired direction as soon as possible and reasonable so the system can commit, decommit, or keep resources on line as early as possible. By using the market solution, system operators avoid creating constraints or risking situations that may violate NERC reliability criteria.

System operators conform the load forecast to account for system conditions they observe before the CAISO uses in the market clearing process. As indicated above, the CAISO refers to this as conforming the load forecast. Conforming the load forecast to ensure the market accounts for actual system

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5 NERC Reliability Standard BAL-001-2 is available at: https://www.nerc.com/_layouts/15/PrintStandard.aspx?standardnumber=BAL-001-2&title=Real%20Power%20Balancing%20Control%20Performance&jurisdiction=null.

6 Although regulation may compensate for the imbalance, regulation is designed for imbalances that materialize within 5-minute schedules. Consequently, market dispatches should closely match demand.

conditions is not an exact science, and system operators must act quickly during the operating period to ensure the market has all the essential system conditions information in a timely manner.

System Operators may observe a number of contemporaneous factors that require conforming the load forecast to ensure the system remains balanced. For example, during the operational timeframe, the system operator may observe variable energy resources deviating significantly from their forecast, with forced outages that were not recorded in the outage management system, and load deviations based on forecasts calculations made on a five-minute basis. During the operating time and as the system operator is approaching the applicable real-time market interval, there is no feasible way to inform the market systems of each individual reason of system deviation. The system operator needs to consider all the factors quickly and simultaneously. Accordingly, the system operator will use the load forecast as the tool for steering the system in the right direction to ensure the system remains balanced despite the varying system condition.

This process of conforming the load forecast ensures the market system will produce a more feasible solution and reduce the need for manual dispatches after the market clears. Moreover, conforming the load forecast enables the system operator to increase or decrease demand evenly across the system as modeled in the market based on distribution factors. Conforming load forecast also allows the market optimization to achieve a least cost dispatch that minimizes congestion.

Any actions the system operators take in conforming the load forecast are motivated by NERC reliability requirements. The CAISO does not reflect all NERC reliability requirements or reliability standards in its tariff because NERC and the Commission already have appropriate measures in place to ensure the CAISO's compliance with those requirements. Below is a list of the type of factors that may cause the system operator to conform the load forecast. The list is not exhaustive because the system operators may have to conform for a particular system condition the CAISO has not experienced before but may also affect the reliable operations of the system.

- *Load forecast error* – System operators may observe conditions that differ from the load forecast, thus necessitating load forecast conformance.

- *System balance adjustments* – System operators must ensure system balance is within NERC criteria. The market systems do not always directly recognize deviations of area control errors that must be addressed in order to comply with NERC Standard-BAL-

001-2.[7] Therefore, the system operator may conform the load forecast to ensure the market systems produce a market solution that helps control system balance.

- *Variable energy resources deviations* – Although the CAISO uses reliable forecasts to dispatch variable energy resources, such resources may deviate from their dispatches and forecasts due to reasons such as forecast errors. Significant and persistent deviations may require a system operator to conform the load forecast so the market solution can account for such deviations.

- *Resource outages or transmission or equipment outages not entered into the outage management system* – System operators may observe certain generator or transmission equipment outages that were not entered into the outage management system, but affect bids scheduling coordinators submitted. This may arise because outages occur after the bid submission timeline. Therefore, the market system expects these resources to be available and, without a load conformance, the market system will not redispatch other resources to accommodate their unavailability, thus producing an inaccurate dispatch that could adversely affect system conditions. For example, the system operator could conform the load forecast to account for the lack of generation the system would otherwise expect to be available.

- *Generator testing* – System operators may test generators prior to the generator becoming fully connected and operational. The system operator may need to conform the load forecast to accommodate the presence of test energy to ensure the market systems produce a reliable solution.

- *Weather Changes* – The load forecast may fail to capture rapid weather changes, which can result in the market systems producing an infeasible and unreliably market solution. Operator conformances to the load forecast can steer the market outcome to meet those otherwise unknown system conditions and requirements.

- *Pumping resource schedule change* – The CAISO real-time market assumes that specific pump-storage hydro resources will follow their day-ahead market schedules. If the pump-storage resource

[7] *See e.g.,* http://www.nerc.com/_layouts/PrintStandard.aspx?standardnumber=BAL-001-2&title=Real%20Power%20Balancing%20Control%20Performance&jurisdiction=United%20States.

does not follow the day-ahead schedule, the system operator will conform the load to ensure the real-time market is aware of the schedule change.

2. Reporting of Load Conformance

Consistent with the Commission's prior directives, the CAISO collects relevant data from its own system operator actions and those of each EIM entity, for both the fifteen- and five-minute markets, regarding the frequency and magnitude of load conformance, the reason for the conformance, as well as any alternatives considered (*e.g.*, use of manual dispatch).[8] These reports document the system needs that were addressed by load conformance actions. The CAISO's Department of Market Monitoring reviews and evaluates this information and includes an analysis of the impacts of EIM entities' load forecast conformances or load bias actions on the EIM in its public Quarterly Report on Market Issues and Performance.

3. Data on Load Conformance

The Department of Market Monitoring's Q2 Report on Market Issues and Performances provides data on the CAISO's and EIM entity balancing authority areas' conformances in the real-time market for a recent period, April through June 2018.[9] The data presented indicates that the CAISO conformed its load forecast in 53% of fifteen-minute market intervals and 73% of five-minute real-time dispatch intervals. Overall, conformances averaged approximately 1-2% of the total load. The data presented also indicates that EIM balancing authority areas conformed their respective load forecasts in the fifteen-minute market at a frequency ranging among all EIM balancing authority areas from 0% to 88% of intervals. It also shows the EIM entities conformed their load forecasts in the five-minute real-time dispatch at a frequency ranging among the EIM balancing authority areas from 27% to 74% of intervals. Overall, conformances generally averaged approximately 1 to 4% of EIM entity's total load.

In addition, the CAISO analyzed the reasons for its load conformance in the real-time market. The CAISO created software to facilitate the logging load conformances in response to the Commission's directives to track and report on conformances.[10] The CAISO used this data to compile the information in Figure 1 below.

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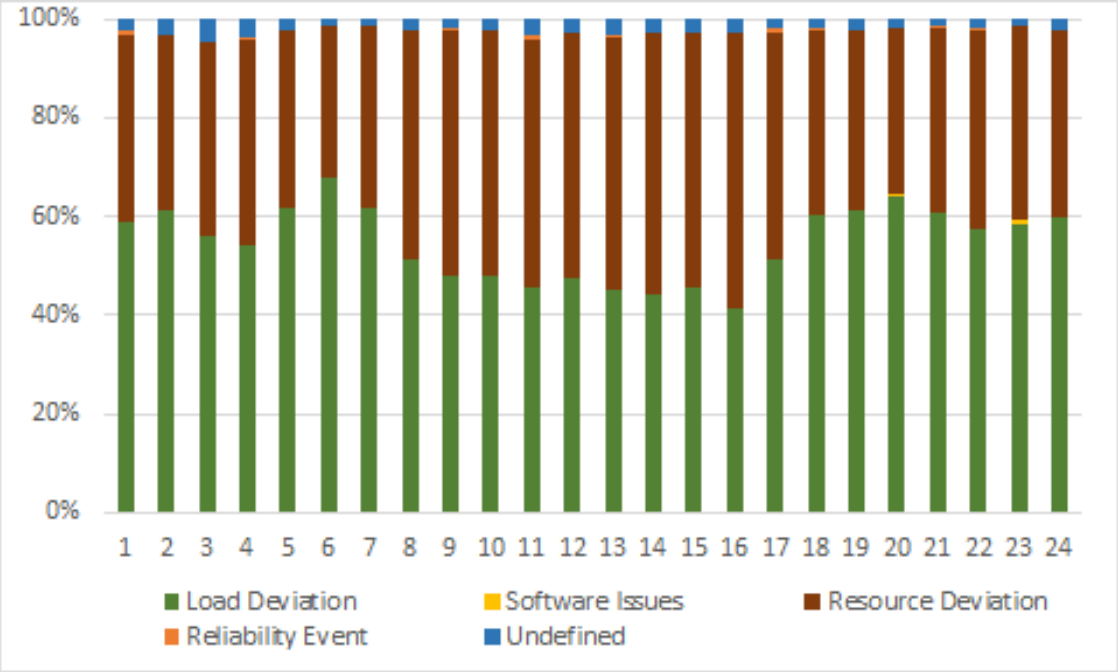
8 *California Indep. Sys. Operator Corp.*, 153 FERC ¶ 61,305 P 129 (2015).

9 CAISO Department of Market Monitoring, Q2 2018 Report on Market Issues and Performance, Aug. 20, 2018, available at: http://www.caiso.com/Documents/2018SecondQuarterReportonMarketIssuesandPerformance.pdf.

10 153 FERC ¶ 61,305.

Figure 1: Reasons for Load Conformances for 2017.



The data is Figure 1 shows the majority of conformances are for load and resource deviations. Although the CAISO system operators will select the logging category that reflects the predominant reason for making the conformance, there may be a multitude of reasons for making the conformance in a particular interval. Therefore, it is possible that in addition to load and resource deviations, there were also reliability events or software issues that contributed to the system operator's decision for making the conformance.

D. Load Conformance Limiter

1. Nature of "Coarse Adjustments" and need for Load Conformance Limiter Functionality

In 2012, the CAISO adopted the load conformance limiter tool to address issues posed by its systems limitations that result in the need to conform load forecasts in the first instance. The load conformance limiter tool is an automated functionality that ensures the system operator-initiated conformances to load forecasts that enter the market optimization do not exceed the actual market ramping capability and are consistent with actual system needs. The limiter assumes that if the system operator had been aware of the available ramping capability, the system operator would have refined the conformances to rely only on the amount of ramping capability necessary to meet the actual system conditions over a period. The magnitude nature of the conformance is a product of the system operator's best estimate of system needs. The system operator

may need to apply the conformance over multiple intervals because it is not possible for the system operator to apply the conformance with more precision and ramp the system up to where it needs to be in each interval to achieve the overall goal of balancing the system within NERC reliability requirements. These are what the CAISO refers to as "coarse adjustments." The limiter ensures the coarse adjustments do not cause a power balance constraint violation in a given interval in which the coarse adjustment exceeds the ramping capability, but the supply is not needed in that interval.

As discussed above, a system operator's objective when conforming the load forecast is to ensure the market optimizes and produces a reliable market solution. Although, system operators do not consider whether their actions affect prices, conforming the load forecast either increases or decreases demand, which will affect the prices and quantities cleared in the real-time market. This is both true when there are sufficient effective bids to clear supply bids against the demand forecast and export bids in the real-time market. When this is not the case, the market must relax a balancing authority area's power balance constraint in order to clear the market.

When the market clears without relaxing a power balance constraint, the system marginal energy cost component of locational marginal prices is set by the economic bid of the marginal resource. However, when the market must relax a power balance constraint to derive a feasible solution, the system marginal energy cost is set at the $1,000 per MWh power balance relaxation parameter that is specified in Section 27.4.3.4 of the CAISO tariff, which is pegged to the maximum energy bid in price. The CAISO enforces a power balance constraint for each of the balancing authority areas in the EIM, including the CAISO's, and one that applies for the aggregated balancing authority areas.

Over time, the CAISO has observed that it is not possible for system operators to fine-tune their conformances such that the conformance reflects the exact amount of load forecast conformance needed in a particular interval, while also ensuring that the conformance results in ramping that the market can feasibly provide. The system operator also is not able to target specifically how the system has to move to meet the targeted outcome because it is not possible for the CAISO to determine the system's exact ramping capability in every interval without actually running a security-constrained dispatch.

Accordingly, system operators estimate and conform the load forecast that approximates what they perceive to be the system need at the time and make coarse conformances based on their best estimates and judgments. The system operators often set the conformance for multiple intervals, even though the need may only be in a particular interval in the future. This occurs because in the operating period, it is not possible for the system operator to set the conformances for each interval precisely reflecting the ramping capability of the

system. The coarse adjustment is simply the fastest way for the operator to correct the upcoming market runs.

For example, a system operator may need to conform the load forecast by 500 MW to correct for an observed system balance deviation to maintain compliance with NERC reliability standard BAL-001-2. The time it takes to correct the system deviation depends on other grid conditions and the system operator's judgement of system conditions. The system operator recognizes that the 500 MW correction could occur gradually over multiple market runs and does not need to occur immediately and the system operator has thirty minutes to correct for the system balance deviation under NERC reliability standard BAL-001-2. Practically, the system operator typically inputs the conformance all at once because it is the fastest and most efficient way to make the correction. The system operator cannot risk losing time and trying to determine the precise ramp on the system to avoid an unnecessary infeasibility. Therefore, the system operator will conform the load forecast by 500 MW thereby automatically increasing the requirements. This results in the market attempting to procure 500 MW within the next market run, even though the market really does not need to dispatch the additional 500 MW in the specific one five-minute interval to address the reliability issue the system operator set out to address. If the system does not have 500 MW of available ramping capacity in the corresponding 5-minute interval, the market solution would be infeasible. The intent of the limiter is to enable the market to solve without relaxing the power balance constraint when the system operator did not intend to indicate an actual increase in load forecast for that interval.

The CAISO has recognized that the need for and accuracy of conforming the load forecast is ameliorated by market systems that can account for system needs more accurately and timely, as well as by tools that inform system operators of system conditions more accurately. Therefore, as discussed in Section III of this transmittal letter, the CAISO has undertaken significant efforts to enhance its systems and better enable system operators to conform load accurately.

2. Need to Enhance the Load Conformance Limiter Functionality

The CAISO analyzed load conformance data and concluded that its existing conformance tool did not reflect that system operators leave demand forecast conformances in place for several intervals the majority of the time when they conform the load forecast. Figure 2 below summarizes this data.

Figure 2: CAISO Real-Time Dispatch Conformance Change between consecutive Intervals in 2017.

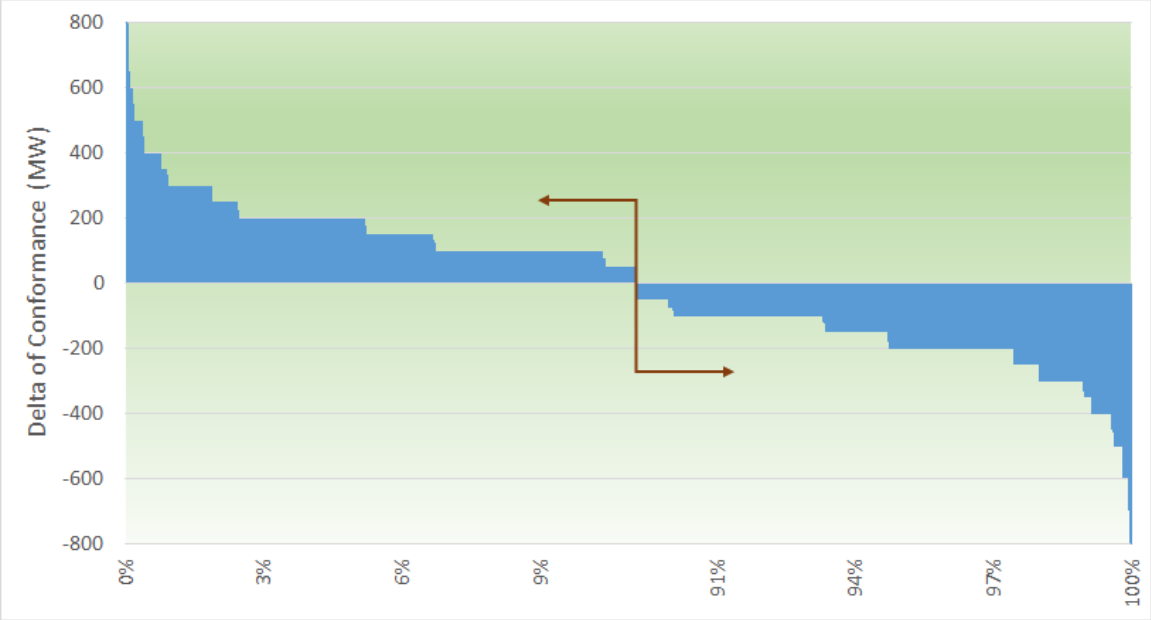


Figure 2 presents data for CAISO balancing authority area load forecast conformances in the five-minute real-time dispatch and only includes intervals in which the system operators conformed the demand forecast. It shows the percentage of real-time dispatch intervals in which there was a change in conformance between intervals. In 10 percent of the intervals (*i.e.*, 0-10 percent on the horizontal axis), there was a positive change in conformance from one interval to another. In the other 10 percent (*i.e.*, 90 to 100 percent on the horizontal axis), there was a negative change in conformance from one interval to the other. In the remaining 80 percent of the intervals (*i.e.*, 10 to 90 percent) there was no change in conformance from one interval to another.[11]

The data presented in Figure 2 shows that in most cases the system operators place conformances over multiple intervals and do not make frequent changes between consecutive intervals. This is because, as described above, system operators make coarse adjustments over multiple intervals to reach their targeted outcome. The data indicates that in 80 percent of the intervals the load conformance carries over from the previous interval. This means that the first

[11] A positive MW change indicates the conformance requirement increased between intervals (*i.e.*, conformance was addressing under-supply). A negative MW change the conformance requirement decreased between intervals (*i.e.*, addressing over-supply). Approximately 10 percent of intervals had a positive conformance change (or positive difference in conformance from one interval to the other) (shown to the left of the red arrow) and 10 percent of intervals had a negative conformance change (shown to the right of the red arrow). The straight red line represents a break in the graph in which there was no change in conformance.

interval in which the conformance occurs is not because the system operator actually intends to indicate that the load forecast needs to increase by the amount of conformance in that particular interval. Rather, as discussed above, the conformance in that interval came as part of the coarse adjustments that system operators have to make.

The current limiter functionality is limited because it only considers information from the current binding interval. This limitation prevents the limiter from recognizing changes between intervals. The limiter functionality should recognize if there is a change in the conformance between intervals. The ability to recognize if there is a change is necessary because in a given interval the conformance value may be the remainder value from a previous interval or because the system operator applied the overall conformance to multiple intervals, but it was not necessary in all intervals. This could trigger false price scarcity signals in those subsequent intervals.

Currently, the limiter only addresses infeasibilities when the infeasibility and conformance are in the same direction. This is problematic because the logic of the limiter does not recognize changes between intervals. Presently, the limiter only triggers when the load conformance entered by the system operator exceeds, and is in the same direction as, the infeasibility. This is based on an assumption that if the conformance is in the opposite direction of the infeasibility, then the conformance is not contributing to the infeasibility. This poses a problem because the conformance could be in the opposite direction in a given interval, but the relative change of conformance from one interval to the next could be contributing to the infeasibility, even if the conformance is not intended for a particular interval. This limitation reinforces the need to enhance the limiter so that it considers information regarding the conformance from one interval to another.

The current load conformance limiter logic is described in the formulas presented below.

The current limiter solves for C_i. The limiter will trigger for under supply, as indicated by a positive power balance constraint infeasibility, when the infeasibility and conformance are both positive and the value of C_i is less than 0:

$$Ci = (PBCinf - Confi)$$

If $C_i < 0$, limiter triggers.

If $C_i > 0$, limiter does not trigger.

The limiter will trigger for oversupply, as indicated by a negative power balance constraint infeasibility, when the infeasibility and conformance are both negative and the value of C_i is greater than 0:

$$Ci = (PBCinf - Confi)$$

If $C_i > 0$, limiter triggers.
If $C_i < 0$, limiter does not trigger.

Where:

i	is the index for current market interval
C_i	is the remaining available capability to absorb power balance constraint infeasibilities in the current interval
PBC_{inf}	is the power balance constraint infeasibility for the current interval (positive is shortage of power, negative is excess power)
$Conf_i$	is the load conformance for the current interval (positive increases load forecast, negative decreases load forecast)

Examples A, B, and C, which are included in Attachment C to this transmittal letter, illustrate the shortfalls in the current load bias limiter logic. Example A illustrates a case where the current limiter does not trigger but should because the system operator's load forecast conformance exceeds the difference in the infeasibility between the intervals. Example B illustrates a case where the current limiter triggers but should not because the power balance infeasibility is less than the change in the amount of load conformance. Example C illustrates a case where the current limiter triggers but should not because there is no change in the amount of load forecast conformance.

C. The RUC Net Short Process

The CAISO conducts the RUC process for the CAISO balancing authority area as part of the day-ahead market after it completes the integrated forward market. The CAISO produces an hourly CAISO Forecast of CAISO Demand for the next day at the start of the day and uses that forecast for the RUC process. The RUC clears availability bids against the next day's hourly CAISO Forecast of CAISO Demand less the energy scheduled in the integrated forward market, and accounting for other factors, such as load forecast error, and estimated incremental real-time market bids including those from variable energy resources.

The CAISO tariff specifies that the CAISO may consider factors such as load forecast error and expected resource performance in considering the CAISO Forecast of CAISO Demand and RUC procurement target. However, the CAISO tariff does not specify how system operators will conform the forecast to

incorporate such information. The CAISO system operators may conform the hourly CAISO Forecast of CAISO Demand when there is reason to believe that the forecast will not result in RUC committing sufficient capacity to meet system needs. In doing so, the system operator will employ what is referred to as the "RUC net short" process, which modifies the CAISO demand forecast to ensure sufficient capacity is procured to address anticipated real-time conditions.

Similar to the real-time load forecast conformance, system operators consider current information on system conditions and requirements to determine whether to deploy the RUC net short process and the magnitude of the conformance they make to the CAISO Forecast of CAISO Demand to be used in the RUC. For example, system operators will consider factors such as: (1) discrepancies in demand forecast; (2) weather patterns that are expected to continue or change with the next trade day; (3) generator outages not reflected in the outage management system change the availability of resources from when they were bid into the day ahead market; (4) fire that threatens transmission; (5) reliability concerns that may require additional capacity because the generation committed by the market will not meet the demand anticipated by the system operator; or (6) results from the reliability coordinator next-day engineering studies.

D. Stakeholder Initiative on Imbalance Conformance Enhancement

The CAISO released a technical bulletin in November 2016 in response to concerns by market participants regarding the role of the load conformance limiter and how it might affect prices. Initially, the CAISO considered changing the load conformance limiter without amending the tariff because the tariff already authorizes the CAISO to establish its load forecast. The CAISO held a conference call on January 11, 2017, to discuss the information provided in the technical bulletin. After that stakeholder discussion, the CAISO agreed to launch an official stakeholder initiative to consider tariff modifications to provide more details in the tariff regarding load forecast conformance practices and the role of the load forecast conformance limiter.

On November 29, 2017, the CAISO issued an issue paper and straw proposal that described its load forecast conformance practices, the existing load conformance limiter functionality, and the proposed enhancements to the limiter. The CAISO held a stakeholder call on December 8, 2017, and received comments from stakeholders on December 22, 2017. The CAISO posted a draft final proposal on January 30, 2018, followed by a conference call February 6, 2018, and received comments on February 20, 2018. The Board of Governors approved the CAISO's proposal on May 16, 2018

On August 31, 2018, the CAISO held a stakeholder call to discuss the proposed tariff language and responded to comments submitted by participants on August 24, 2018.

II. Proposed Tariff Revisions

A. Conformance of Load Forecast

The CAISO tariff provides the CAISO, and in some cases the EIM entity, the authority to formulate the load forecast. At present, the CAISO tariff does not describe the real-time market load forecast conformances system operators can make to the forecast to reflect actual system conditions. The CAISO proposes to describe in new CAISO tariff section 27.12 the load conforming practices that both CAISO and EIM system operators may perform for their respective balancing authority areas. As described above, the system operators conform the load forecast to improve the quality of the real-time market dispatch and commitment solutions in order for CAISO and EIM entity system operators to better reliably maintain their respective systems with NERC and Western Electric Coordinating Council (WECC) reliability criteria.

The CAISO proposes to enhance the detail in the tariff and describe in the tariff the types of reasons that can result in load forecast conformance. This will provide greater clarity regarding how the CAISO may conform the load forecast to produce feasible and reliable market dispatches. The proposed amendments will (1) clarify that operators may conform the load forecast and (2) identify the types of factors system operators may consider when they have determined there is a need to conform the load forecast. New CAISO tariff section 27.12 will include a description of the factors system operators consider when conforming the load forecast described above in section I.B.1 of this transmittal letter.

The proposed tariff changes are just and reasonable and will provide greater transparency for market participants. System operators are responsible for maintaining their balancing authority areas reliable consistent with NERC and WECC reliability criteria. Maintaining the system in balance and consistent with NERC criteria, such as reliability standard-BAL-001-2,[12] requires system operators to maintain situational awareness and take manual actions to ensure the dispatches support these requirements. The proposed tariff provisions clarify the CAISO's load forecast conformance authority to enable the CAISO to comply with NERC reliability standards.

[12] *See e.g.,* http://www.nerc.com/_layouts/PrintStandard.aspx?standardnumber=BAL-001-2&title=Real%20Power%20Balancing%20Control%20Performance&jurisdiction=United%20States.

The CAISO and EIM system operators count on the CAISO real-time market systems to produce a dispatch solution that is feasible and considers actual system conditions. System operations benefit from a market solution that is feasible and accounts for all system conditions to the maximum extent possible, even if system operators are prepared to take manual actions if the real-time market produces a solution that does not support system reliability. As discussed above, load forecast conformance is often the only tool system operators can use expeditiously to ensure the market systems produce a dispatch solution that supports reliable operations. To neglect taking action prior to the market clearing would be inconsistent with fundamental purpose of security constrained economic dispatch and unit commitment, which are designed to ensure the market solutions reflect actual system conditions and produce feasible and reliable solutions. The proposed tariff revisions clarify the CAISO's authority to undertake these actions and provide greater clarity and transparency regarding the types of circumstances in which the CAISO might undertake such actions.

B. Load Conformance Limiter Functionality

The CAISO proposes to add to new CAISO tariff section 27.12.2, which is a description of the load conformance limiter functionality. The proposed tariff description will reflect the enhancements the CAISO developed with stakeholders. The enhanced logic of the load conformance limiter addresses the issues with the current logic discussed above in section I.D.2 of this transmittal letter.

The limiter logic will be enhanced as follows:

(1) The logic will consider the change in load forecast conformances between market intervals rather than the amount of the load conformance in the current interval. This enhancement will result in triggering the limiter only in response to the "coarse adjustments," as described in section I.D.2 of this transmittal letter, and not triggering the limiter if a power balance infeasibility is not in response to a conformance. In contrast to the current limiter, this enhancement will also result in the limiter appropriately triggering the limiter when a change in the load forecast conformance results in an infeasibility, even when the absolute value of the conformance is in the opposite direction of the infeasibility (*e.g.,* the system operator makes an conformance that decreases the load forecast conformance by a smaller amount leading to a power balance infeasibility because of a power shortage).

(2) The logic will consider the amount of load forecast conformance and the amount of power balance infeasibility from both the current and previous intervals, rather than just the current interval. This enhancement will result the limiter trigger in intervals following an interval in which the system operator made a load forecast that resulted in an infeasibility that will remain for subsequent intervals. This is in contrast to the current limiter logic that only considers the load conformance and infeasibility amounts in a single interval.

The enhanced logic is described by the following formulas:

The limiter will solve for C_i. The limiter will trigger for under supply, as indicated by a positive power balance constraint infeasibility, when the value of C_i is less than 0:

$$C_i = (PBC\_inf_i - PBC\_inf_{i-1}) - (Conf_i - Conf_{i-1}) + \max(0, C_{i-1})$$

If $C_i < 0$, limiter triggers.
If $C_i > 0$, limiter does not trigger.

The limiter will trigger for oversupply, as indicated by a negative power balance constraint infeasibility, when the value of C_i is greater than 0:

$$C_i = (PBC\_inf_i - PBC\_inf_{i-1}) - (Conf_i - Conf_{i-1}) + \min(0, C_{i-1})$$

If $C_i > 0$, limiter triggers.
If $C_i < 0$, limiter does not trigger.

Where:

i	is the index for current market interval
$(i-1)$	is the previous market interval
C_i	is the remaining available capability to absorb power balance constraint infeasibilities in the current interval (*i.e.*, the system's ramping capability)
$(PBC\_inf_i - PBC\_inf_{i-1})$	is the change of power balance constraint infeasibility between current and previous market intervals
$(Conf_i - Conf_{i-1})$	is the change of load conformance between current and previous market intervals

$\max(0, C_{i-1})$	is the carry-over from previous market interval in shortfall of available capability to absorb power balance constraint infeasibility that was not due to load conformance

If in any interval the power balance constraint infeasibility results in a value of 0, C_i is reset to 0.

An examination of these formulas shows that the enhanced logic will consider the magnitude of the load conformance change between the current and previous market interval as compared to the amount of power balance constraint infeasibility. It also shows that it will also recognize power balance constraint infeasibilities in the current interval that result from a load conformance change in a previous interval. Finally, it shows it will identify whether a power balance constraint infeasibility in the current interval resulted from a load conformance change in a previous interval, or whether it resulted from a power balance infeasibility in a previous interval and not due to a load conformance change. In the latter case, the enhanced logic will not trigger the limiter.

The CAISO provides examples of how the enhanced load conformance limiter will function in Attachment C to this transmittal letter. Example D illustrates how the enhanced load conformance limiter logic will result in the limiter triggering appropriately when a change in the load forecast conformance results in an infeasibility even when the absolute value of the conformance is in the opposite direction of the infeasibility. Examples E and F illustrate how the enhanced logic will more appropriately trigger the limiter based on the change in load forecast conformances between market intervals rather than on the amount of load forecast conformance in the current interval.

The enhanced load conformance limiter is just and reasonable because it will improve the accuracy of the limiter and will not have any adverse effects. The enhancements will continue to prevent prices being set by the pricing parameters during infeasibilities where there is likely no scarcity, and the "scarcity" is created solely by the coarseness of the operator load conformances. However the enhancements will reduce the likelihood that the limiter will artificially prevent triggering scarcity pricing based on the pricing parameters when there is possible scarcity conditions in a given interval, and the power balance constraint infeasibility in an interval is not a carryover from the a load conformance change in a prior interval. The process of conforming to maintain reliability stays the same and the enhanced limiter logic will ensure the limiter is triggered (or not triggered) appropriately.

C. Compliance with FERC Order No. 825.

The Commission accepted the CAISO's filing in compliance with Order No. 825,[13] in which the Commission required each ISO and RTO to trigger shortage pricing for any interval in which a shortage of energy or operating reserves is indicated during the pricing of resources for that interval.[14]

The CAISO's filing in compliance with Order No. 825 showed that its tariff includes pricing provisions to address shortages of energy and operating reserves, including immediately triggering price caps for energy, and immediately using scarcity reserve demand curves for operating reserves (and other ancillary services), regardless of the duration or cause of such shortages. Pursuant to these tariff provisions, in any 15-minute interval of the fifteen minute market, the CAISO's market systems will co-optimize the procurement of energy and ancillary services based on submitted supply bids and the forecast of demand and its ancillary services requirements.

In any given interval, if effective supply bids are insufficient to clear forecasted demand, scarcity pricing will immediately trigger, thereby indicating a shortage of supply for that applicable interval. The CAISO market does not wait to trigger the scarcity signal only after it has observed the insufficiency for any number of intervals. Similarly, if ancillary services bids are insufficient to meet the ancillary services procurement target, ancillary services scarcity pricing will immediately trigger for that interval. Thus, as required by Order No. 825, the CAISO's market systems immediately trigger shortage pricing for any interval in which there is a shortage of energy or operating reserves.

This tariff amendment does not change the CAISO's compliance with Order No. 825. The CAISO recognizes that changes made to the load forecast can increase demands on the system, which may impact prices. This can be triggered both by the load conformance made by the system operator as well as the load conformance limiter used to reduce the risk of such conformances that create false scarcity signals. A faulty load forecast conformance can cause false scarcity or prevent prices from reflecting scarce conditions. The load conformance limiter can reduce the occurrences of faulty load forecast conformance, but it can also at times be triggered after the fact when it has discovered there was actual scarcity in the system.[15] However, both the

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13 Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators, 155 FERC ¶ 61,267 (2016) (Order No. 825).

14 *Id.* at P 162.

15 The Commission clarified that it did not intend to impose shortage pricing if a shortage occurs during an interval for which prices and dispatch decisions have already been set. Specifically, the Commission did not intend to impose *ex post* pricing in which the CAISO would be required to adjust prices. *Id.* at P. 167.

conformance and the limiter are necessary to ensure the market recognizes actual system conditions accurately and produces a reliable and feasible set of dispatches and commitments. Once the inputs are included in the market clearing process, the CAISO does not prevent price scarcity signals from being triggered.

D. Clarifications to Adjustments to Load Forecast in the RUC Process

The CAISO also proposes to clarify tariff provisions describing its authority to conform the CAISO Forecast of CAISO Demand or procurement target used in the residual unit commitment process. Currently, the CAISO tariff describes the CAISO's authority to establish the CAISO Forecast of CAISO Demand and then procure in the RUC process any additional capacity based on the next day's hourly forecast of CAISO demand less the energy scheduled in the integrated forward market (and accounting for other factors, as appropriate, such as load error and other factors such as estimated incremental real-time market bids including those from variable energy resources).[16] The CAISO tariff also describes the conformances the CAISO may make to the procurement target to account for certain factors. The CAISO proposes to provide more detail in the tariff regarding one of the conformance it may make to the forecast due to anticipated real-time system conditions.[17]

The process the CAISO system operators follow to determine whether they must conform the CAISO Forecast of CAISO Demand so the RUC procures additional capacity needed to meet real-time system conditions is very similar to the process they follow in the real-time to conform the load forecast. After the CAISO runs the integrated forward market, the system operator may determine that the integrated forward market did not procure sufficient capacity to address anticipated real-time conditions. To ensure there is enough capacity for the next trade date, the system operator will employ the "RUC net short" process. Through the RUC net short process the system operator will conform the CAISO Forecast of CAISO Demand to procure additional capacity to better reflect overall system conditions. This conformance to the forecast involves conforming the load forecast to be used in the RUC process.

The CAISO has the authority to set the CAISO Forecast of CAISO Demand as it deems appropriate and therefore already has the authority to conform it as necessary.[18] The CAISO merely proposes to add detail in the tariff to reflect the use of the RUC net short process in its tariff, which will stipulate the

16 *See* CAISO tariff section 31.5.3.

17 *See e.g.*, CAISO tariff section 31.5.3.1.

18 *See* Proposed CAISO tariff section 31.5.3.1.1.

kind of conditions the CAISO system operators consider in applying the process. Similar to the real-time market conformance process, the CAISO conforms for imbalance in the day-ahead market to consider issues such as:

- Load forecast error
- Uncertainty introduced with extreme weather pattern that is expected to continue or change with the next trade day
- Generator outage resulting in a different availability than was bid into the day ahead market
- Fire danger that threatens transmission lines and/or corridors
- Reliability concern that the generation committed will not meet the anticipated demand
- Reliability Coordinator (RC) next-day analysis

III. Enhancements to Operator Tools that will Reduce the Need for the Limiter in the Future

The CAISO recognizes that the load conformance limiter is needed in large part because of the limitations system operators have in conforming the load forecast precisely during the operating period. Over the past several years the CAISO has worked to improve the tools available to system operators and provide better situational awareness and the ability to conform load in a more targeted, precise, and timely manner. The CAISO will continue pursuing market design changes and other measures to improve the quality of load conformance or reduce the need for the manual imbalance conformance performed by system operators. Once the CAISO implements these improvements, it expects the load forecast conformances will be less coarse in nature and it will diminish the need for the conformance limiter. Therefore, the CAISO is pursuing the following improvements and intends to disable the conformance limiter feature in the real-time market in approximately two years.

The following efforts are currently underway or have been implemented, and the CAISO expects that these measures will reduce the need for imbalance conformances in the future. However, until the necessary tools are in place, the CAISO must rely on load conformance to ensure system reliability.

- **Real-time dispatch persistence market model enhancement:** A forecasting enhancement for registered eligible intermittent resources (EIRs)[19] (*i.e.*, variable energy resources) that will shorten the time cycle to produce a forecast for EIRs resulting in improved accuracy for the real-time dispatch timeframes. More accurate EIR forecasts will

[19] EIRs are variable energy resources that have a participating generator agreement with the CAISO and are working towards a reliable forecast for participating in the CAISO markets.

minimize the need for conformance in the real time market. This improvement was implemented in April 2018.

- **Day-ahead market enhancements:** A policy initiative aimed at increasing reliability by providing fifteen-minute granularity in the day-ahead market and a day-ahead flexible reserve product. This will enable the CAISO to procure energy and capacity to follow the net load forecast curve more closely. A more accurate day-ahead market will lessen the pressure on the real-time market to make up for deviations that occur. These enhancements will minimize the need for conformance in both the day-ahead and real-time markets. The CAISO has commenced the stakeholder process and expects to implement the first stage of these enhancements (*i.e.,* fifteen-minute granularity alone) in the fall of 2020, and the remaining improvements by the end of 2021.

- **Flexible ramping product improvements:** The CAISO is in the processes of making technology improvements to the flexible ramping product procurement process. This effort will ensure there is adequate flexible ramping product award available and deliverable. These improvements have been implemented throughout 2018 and help minimize the need for conformance in the real time market.

The CAISO also is undertaking the following efforts that are focused on improving system operator situational awareness and system operator tools and processes. These tools are intended to ameliorate the nature load conformances.

- **Imbalance conformance tool:** Build a tool that compiles inputs based on real-time grid conditions and estimates a conformance value that may be appropriate. This tool can ensure the conformance requirement input into the market is more accurate. The CAISO is currently working on a test version of this tool and undergoing validation of its performance.

- **Ramping capacity tool:** Build a tool that approximates ramping capacity available for each CAISO market run. This will provide transparency and more situation awareness for the system operator and reduce the need for the limiter. If the ramping capacity tool shows 500 MW is available in the next 5-minute market run, the system operator will determine if that amount is adequate or not. The ramping capacity tool improves situational awareness and enhances the quality of load conformances, which in turn will decrease the need for the conformance limiter. The CAISO expects to implement this tool in the Fall of 2019.

The CAISO intends to disable the imbalance conformance limiter feature in two years, following implementation of improved operational tools that will reduce the need for system operators to make coarse adjustment conformance. Over time, with the improvements to its market design and system operator tools, the CAISO could operate without the limiter in place. The CAISO intends to conduct a stakeholder process in approximately two years from the effectiveness of the proposed tariff provisions to review whether disabling the load conformance limiter is just and reasonable, and it will propose appropriate amendments to the CAISO tariff following that process.

IV. Discussion of Issues Raised during the Stakeholder Process

A. Authority to Conform Imbalances

Stakeholders supported the CAISO's proposal to enhance its tariff by describing its load forecast practices in both the RUC process and the real-time market. In addition, stakeholders supported the CAISO's load conformance authority. After discussing the frequency and nature of load conformance, several stakeholders proposed a stakeholder process to evaluate the factors that lead to the frequent and persistent use of upward imbalance conformance in the CAISO balancing authority area. Stakeholders pointed to the CAISO Department of Market Monitoring's (DMM) comments in this stakeholder initiative in which the DMM reported that the data showed that the CAISO is frequently and persistently conforming the load forecast upwards. Stakeholders expressed concern that the persistent conformance may be in response to shortcomings of existing CAISO market processes. The CAISO discussed these concerns with stakeholders during the policy development process. Since that time, the CAISO has made some of the enhancements identified in Section III above. Between 2017 and 2018, the magnitude of CAISO conformances has dropped by nearly 40 percent.

The CAISO continuously evaluates its market processes to identify root causes of issues observed and makes necessary enhancements to address these issues. If these efforts require changes to business practices or tariff provisions, the CAISO conducts robust stakeholder processes to identify solutions and resolve the issues. The CAISO should be able to address such issues through its existing processes, including its annual stakeholder roadmap process, and not be required to bypass those processes and undertake a specific initiative to address the root causes of every reason why system operators might conform imbalances. In any event, as discussed above, the CAISO is already developing tools and market enhancements that will either enhance the accuracy of or decrease the need for conformance over time.

B. Imbalance Conformance Limiter

Stakeholders submitted numerous comments regarding the CAISO's proposed changes to the imbalance conformance limiter enhancement, and the CAISO made several modifications to address them. Although there was general support for the limiter enhancements, two parties continued to object to the proposed enhancements to the imbalance limiter, albeit for contrasting reasons. One stakeholder objected to the CAISO's authority to use the limiter and requested that the CAISO either cease using the limiter or phase it out no later than Fall 2020. This stakeholder believes the limiter prevents a system operator's manual load conformance from triggering shortage pricing where there may be a genuine shortage of supply. In contrast, another stakeholder objected to the imbalance conformance limiter enhancement because it believed the enhancement might increase the number of transient real-time price spikes that do not necessarily reflect actual shortage conditions. This stakeholder opposed the proposal to remove the conformance limiter from use in the real-time market and claims the limiter is important to ensure price stability.

As discussed above, the CAISO believes the proposed enhancement to the limiter is necessary because it enables the CAISO to trigger the limiter more accurately based on conformance changes between intervals and not just based on the conformance in a given interval as it does today. The CAISO understands that using conformance and the limiter affect pricing, and that any change in the forecast can affect the final market solution. However, system operator-initiated conformances and the CAISO's use of the limiter are not motivated by the desire to trigger or avoid price spikes. In both cases, the CAISO is simply making changes to the forecast so the outcomes are more consistent with actual system needs.

The proposed enhancements will reduce the frequency with which the limiter triggers and may reduce the number of instances where the pricing parameters are triggered and prices are set at the price caps. However, it is necessary to ensure that when there truly is insufficient supply to meet the demand, the prices should signal that scarcity. The enhancement refines the current conformance limiter tool to reduce those instances in which the conformance limiter was masking those scarce conditions.

To address both sets of concerns, the CAISO is proposing to disable the load conformance limiter feature in two years after implementing more operator tool enhancements to ensure that the conformances made are more accurate. The CAISO is committed to this deadline because it is confident that it will have less need for the limiter once it implements these other enhancements. However, the CAISO will first evaluate whether the improvements have in fact diminished the need to have the limiter and will make any necessary tariff changes.

IV. Effective Date

The CAISO respectfully requests that the Commission issue an order by February 25, 2018 (*i.e.*, 75 days after the date of this filing), accepting the tariff revisions in this filing effective February 27, 2018.

VI. Communications

Pursuant to Rule 203(b)(3),[20] the CAISO respectfully requests that all correspondence and other communications concerning this filing be served upon the following:

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VII. Service

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

VIII. Contents of Filing

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

Attachment A	Clean CAISO tariff sheets incorporating this tariff amendment;
Attachment B	Red-lined document showing the revisions contained in this tariff amendment;
Attachment C	Examples of Existing Load Conformance Limiter;

[20] 18 C.F.R. § 385.203(b)(3).

Attachment D	Imbalance Conformance Enhancement Revised Draft Final Proposal, dated March 14, 2018;
Attachment E	Memorandum of Keith Casey, Vice President, Market & Infrastructure Development, to Board of Governors on Imbalance Conformance Enhancement, dated May 9, 2018;
Attachment F	Summary of Submitted Stakeholder Comments and Management Response, dated May 9, 2018; and
Attachment G	Department of Market Monitoring Comments to Board of Governors on Imbalance Conformance Enhancement, dated May 9, 2018.

IX. Conclusion

For the reasons set forth in this filing, the CAISO respectfully requests that the Commission issue an order accepting the tariff revisions contained in this filing effective February 27, 2018, and with an order by February 25, 2018.

Respectfully submitted,

/s/ Anna McKenna

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Attachment A – Clean Tariff

Detail Enhancement on Load Forecast Conformance

California Independent System Operator Corporation

27.12 Operator Imbalance Conformance

27.12.1 Operator Conformance in the Real-Time Market

The CAISO Operator may conform the CAISO Forecast of CAISO Demand prior to executing a Real-Time Market run to obtain a Real-Time Market solution that is feasible and accounts for known system conditions for reliable operations. The EIM Entity operator may conform the EIM Demand forecast prior to the CAISO executing a Real-Time Market run to obtain a Real-Time Market solution that is feasible and accounts for known system conditions of the respective EIM Entity's Balancing Authority Area for reliable operations. System operators conform the CAISO Forecast of CAISO Demand or EIM Demand through an adjustment of the respective forecast. The CAISO or EIM Entity operators will consider factors such as: load forecast discrepancies; Area Control Error adjustments; Variable Energy Resource deviations; resource outages not entered in the Outage Management System; generator testing; reliability curtailments due to transmission or equipment outages; weather changes; and pumping resource schedule changes. The CAISO and the EIM Entity will log Operator conformances.

27.12.2 Conformance Limiter in the Real-Time Market

The CAISO will limit an Operator conformance in the Real-time Market to ensure the conformance does not trigger shortage or surplus pricing for any interval in which there is no shortage or surplus of Energy indicated during the pricing of resources for that interval. The conformance limiter logic will: (1) be based on the conformance and ramping capability shortages or surplus changes between intervals; (2) consider information from current and previous intervals; (3) not require that the conformance is the same direction of the shortages or surpluses of ramp capability; and (4) consider the conformance magnitude in previous intervals and whether the limiter was applied in the corresponding intervals.

* * * * *

31.5.3 RUC Procurement Target

The procurement target for RUC in any given Trading Hour will be determined based on the next day's hourly CAISO Forecast of CAISO Demand less the Energy scheduled in the Day-Ahead Schedule, and accounting for other factors, as appropriate, such as Demand Forecast error and estimated incremental

RTM Bids including those from Participating Intermittent Resources. The adjustments listed in Sections 31.5.3.1 to 31.5.3.1.6 will be made to the CAISO Forecast of CAISO Demand to account for the conditions as provided therein. Adjustments may be made on a RUC Zone basis to ensure that RUC results in adequate local capacity procurement. The RUC procurement target setting procedure is designed to meet the requirements of reliable grid operation without unnecessary over-procurement of RUC Capacity or over-commitment of resources. Additional detail on the process for setting the RUC procurement target is specified in the Business Practice Manuals.

31.5.3.1 CAISO Operator Review & Adjustment

The CAISO Operator reviews the CAISO Forecast of CAISO Demand and all calculated adjustments as provided in Sections 31.5.3.1.1 through 31.5.3.1.6. The CAISO Operator shall accept, modify, or reject such adjustments based on Good Utility Practice. If the CAISO Operator determines it must modify the CAISO Forecast of CAISO Demand, the CAISO Operator shall log sufficient information as to reason, Operating Hour, and specific modification(s) made to the CAISO Forecast of CAISO Demand.

31.5.3.1.1 RUC Net Short Conditions

The CAISO Operator may conform the CAISO Forecast of CAISO Demand in the event the CAISO Operator has determined that additional capacity may need to be procured in RUC to meet anticipated Real-Time system conditions. The CAISO Operator will consider factors such as: CAISO Forecast of CAISO Demand error; weather pattern that is expected to continue or change within the next Trading Day; generator outage resulting in different Supply availability than was bid into the Day-Ahead Market; fire that threatens transmission lines and/or corridors; the expectation that the amount of Generation committed in the IFM will not be sufficient to meet the anticipated Demand; and Reliability Coordinator next-day analysis of system conditions.

31.5.3.1.2 Demand Response Adjustments.

The CAISO shall account for Demand response that is clearly communicated to the CAISO as certain to be curtailed for the next Trading Day only for the two following types of Demand response: (1) Demand response triggered by a staged System Emergency event; and (2) Demand response that is triggered by a price or an event known in advance. If an LSE informs the CAISO of anticipated Demand response prior to Market Close of the DAM, the CAISO Forecast of CAISO Demand used as the RUC procurement

target will be reduced accordingly.

31.5.3.1.3 MSS Adjustment

As specified in section 31.5.2.1, MSS Operators are permitted to make an annual election to opt-in or opt-out of RUC participation. If the MSS Operator opts-in to the RUC procurement process, the CAISO considers the CAISO's Demand Forecast of the MSS Demand in setting the RUC procurement target. If an MSS Operator opts-out of the RUC procurement process, the CAISO does not consider the CAISO's Demand Forecast of the MSS Demand in setting the RUC procurement target. An MSS Operator that has elected to opt-out of RUC, or has elected to Load follow and therefore has also elected to opt-out of RUC, is required to provide sufficient resources in the Day-Ahead Market, and in the case of a Load following MSS Operator, follow its Load within the MSS Deviation Band. To reflect these options and to prevent committing additional capacity or resources for any differences between the CAISO Demand Forecast for the MSS and the MSS Self-Scheduled quantities in the IFM, the CAISO replaces the CAISO Demand Forecast for such MSS with the quantity of Demand in Self-Schedules submitted by the Scheduling Coordinator for the MSS in the IFM.

31.5.3.1.4 Eligible Intermittent Resource Adjustment

Scheduling Coordinators for Eligible Intermittent Resources may submit Bids, including Self-Schedules, in the Day-Ahead Market and the quantity ultimately scheduled from Eligible Intermittent Resources may differ from the CAISO forecasted deliveries from the Eligible Intermittent Resources. The CAISO may adjust the forecasted Demand either up or down for such differences by RUC Zone in which the Eligible Intermittent Resource resides. To the extent the scheduled quantity for an Eligible Intermittent Resource in the IFM is less than the quantity forecasted by CAISO, the CAISO makes a Supply side adjustment in RUC by using the CAISO forecasted quantity for the Eligible Intermittent Resource as the expected delivered quantity. To the extent the scheduled quantity for an Eligible Intermittent Resource in the IFM is greater than the quantity forecasted by the CAISO, the CAISO makes a Demand side adjustment to the RUC Zone Demand equal to the difference between the Day-Ahead Schedule and the CAISO forecasted quantity.

31.5.3.1.5 Real-Time Expected Incremental Supply Self-Schedule Adjustment

In order to avoid over procurement of RUC, the CAISO shall, using a similar-day approach, estimate the RTM Self-Schedules for resources that usually submit RTM Self-Schedules that are greater than their Day-Ahead Schedules. The CAISO Operator may set the length of the Self-Schedule moving average window. Initially this moving average window shall be set by default to seven (7) days; in which case the weekday estimate is based on the average of five (5) most recent weekdays and the weekend estimate is based on the average of the two (2) most recent weekend days. To the extent weather conditions differ significantly from the historical days, additional adjustment may be necessary. After determining the estimate of Real-Time Self-Schedules, using a similar day forecasting approach, the CAISO adjusts the CAISO Forecast of CAISO Demand of a RUC Zone based on the forecasted quantity changes in Supply as a result of Self-Schedules submitted in the RTM. This adjustment for forecasted Real-Time Self-Schedules may result in positive or negative adjustments. Demand adjustments to the CAISO Forecast of CAISO Demand result when there is a net forecast decrease in Real-Time Self-Schedule Supply relative to the Day-Ahead Schedule Supply. Supply adjustments to the individual resources occur when there is a net forecast increase in Real-Time Self-Schedule Supply relative to the Day-Ahead Schedule Supply of the individual resource.

31.5.3.1.6 Day-Ahead Ancillary Service Procurement Deficiency Adjustment

While the CAISO intends to procure one hundred percent (100%) of its forecasted Operating Reserve requirement in the IFM based on the CAISO Forecast of CAISO Demand as specified in Section 8.3.1, the CAISO shall make adjustments to the CAISO Forecast of CAISO Demand used in RUC to ensure sufficient capacity is available or resources committed in cases that the CAISO is unable to procure one hundred percent (100%) of its forecasted Operating Reserve requirement in the IFM; provided, however, that the CAISO shall not procure specific Ancillary Services products in RUC, nor will the RUC optimization consider AS-related performance requirements of available capacity.

31.5.3.2 RUC Zones

31.5.3.2.1 Use of RUC Zones

The CAISO shall adjust the CAISO Forecast of CAISO Demand by RUC Zone for the conditions described in Sections 31.5.3.1.2 through 31.5.3.1.6. If any adjustments are made throughout the affected

RUC Zone, such adjustments will be made consistent with the subset of system LDFs for the Nodes that define the RUC Zone(s). The CAISO will adjust the CAISO Forecast of CAISO Demand of each affected RUC Zone, preserving the LDFs within each RUC Zone, but the relative weighting of the LDFs across the system will deviate from the original LDFs. RUC costs will be pooled together to establish the RUC Compensation Costs. As described in Section 11. 6.1, Settlement of RUC Compensation Costs will not be on a RUC Zone basis.

31.5.3.2.2 Designation of RUC Zones

The CAISO shall define RUC Zones as areas that represent UDC or MSS Service Areas, Local Capacity Areas, or any other collection of Nodes. RUC Zones will be designated by the CAISO as necessary and to the extent that the CAISO has developed sufficient data on historical CAISO Demand and weather conditions to allow it to perform Demand Forecasts. Once the CAISO has established RUC zones, the mapping of RUC Zones to Nodes shall be static data and shall be maintained in the Master File. The CAISO may add new Nodes to a RUC Zone if new Nodes are added to the FNM. The status of each RUC Zone shall remain active for as long as the CAISO maintains regional forecasting capabilities, but once a RUC Zone is designated the CAISO will only adjust the CAISO Forecast of CAISO Demand as necessary to address RUC procurement constraints and not as a normal course for all CAISO Market functions. The actual RUC Zones used by the CAISO in its operation of RUC are posted on the CAISO Website.

* * * * *

- RUC Zone

A forecast region representing a UDC or MSS Service Area, Local Capacity Area, or other collection of Nodes for which the CAISO has developed sufficient historical CAISO Demand and relevant weather data to perform a Demand Forecast for such area, for which as further provided in Section 31.5.3.2 the CAISO may adjust the CAISO Forecast of CAISO Demand to ensure that the RUC process produces adequate local capacity procurement.

Attachment B – Marked Tariff

Detail Enhancement on Load Forecast Conformance

California Independent System Operator Corporation

27.12 Operator Imbalance Conformance

27.12.1 Operator Conformance in the Real-Time Market

The CAISO Operator may conform the CAISO Forecast of CAISO Demand prior to executing a Real-Time Market run to obtain a Real-Time Market solution that is feasible and accounts for known system conditions for reliable operations. The EIM Entity operator may conform the EIM Demand forecast prior to the CAISO executing a Real-Time Market run to obtain a Real-Time Market solution that is feasible and accounts for known system conditions of the respective EIM Entity's Balancing Authority Area for reliable operations. System operators conform the CAISO Forecast of CAISO Demand or EIM Demand through an adjustment of the respective forecast. The CAISO or EIM Entity operators will consider factors such as: load forecast discrepancies; Area Control Error adjustments; Variable Energy Resource deviations; resource outages not entered in the Outage Management System; generator testing; reliability curtailments due to transmission or equipment outages; weather changes; and pumping resource schedule changes. The CAISO and the EIM Entity will log Operator conformances.

27.12.2 Conformance Limiter in the Real-Time Market

The CAISO will limit an Operator conformance in the Real-time Market to ensure the conformance does not trigger shortage or surplus pricing for any interval in which there is no shortage or surplus of Energy indicated during the pricing of resources for that interval. The conformance limiter logic will: (1) be based on the conformance and ramping capability shortages or surplus changes between intervals; (2) consider information from current and previous intervals; (3) not require that the conformance is the same direction of the shortages or surpluses of ramp capability; and (4) consider the conformance magnitude in previous intervals and whether the limiter was applied in the corresponding intervals.

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31.5.3 RUC Procurement Target

The procurement target for RUC in any given Trading Hour will be determined based on the next day's hourly CAISO Forecast o~~O~~f CAISO Demand less the Energy scheduled in the Day-Ahead Schedule, and accounting for other factors, as appropriate, such as Demand Forecast error and estimated incremental

RTM Bids including those from Participating Intermittent Resources. The adjustments listed in Sections 31.5.3.1 to 31.5.3.1.6 will be made to the CAISO Forecast oOf CAISO Demand to account for the conditions as provided therein. Adjustments may be made on a RUC Zone basis to ensure that RUC results in adequate local capacity procurement. The RUC procurement target setting procedure is designed to meet the requirements of reliable grid operation without unnecessary over-procurement of RUC Capacity or over-commitment of resources. Additional detail on the process for setting the RUC procurement target is specified in the Business Practice Manuals.

31.5.3.1 CAISO Operator Review & Adjustment

The CAISO Operator reviews the CAISO Forecast of CAISO Demand and all calculated adjustments as provided in Sections 31.5.3.1.12 through 31.5.3.1.6. The CAISO Operator shall accept, modify, or reject such adjustments based on Good Utility Practice. If the CAISO Operator determines it must modify the CAISO Forecast of CAISO Demandor reject adjustments, the CAISO Operator shall log sufficient information as to reason, Operating Hour, and specific modification(s) made to the CAISO Forecast of CAISO Demandcalculated adjustments.

31.5.3.1.1 RUC Net Short Conditions

The CAISO Operator may conform the CAISO Forecast of CAISO Demand in the event the CAISO Operator has determined that additional capacity may need to be procured in RUC to meet anticipated Real-Time system conditions. The CAISO Operator will consider factors such as: CAISO Forecast of CAISO Demand error; weather pattern that is expected to continue or change within the next Trading Day; generator outage resulting in different Supply availability than was bid into the Day-Ahead Market; fire that threatens transmission lines and/or corridors; the expectation that the amount of Generation committed in the IFM will not be sufficient to meet the anticipated Demand; and Reliability Coordinator next-day analysis of system conditions.

31.5.3.1.2 Demand Response Adjustments.

The CAISO shall account for Demand response that is clearly communicated to the CAISO as certain to be curtailed for the next Trading Day only for the two following types of Demand response: (1) Demand response triggered by a staged System Emergency event; and (2) Demand response that is triggered by a price or an event known in advance. If an LSE informs the CAISO of anticipated Demand response

prior to Market Close of the DAM, the CAISO Forecast of CAISO Demand used as the RUC procurement target will be reduced accordingly.

31.5.3.1.3 MSS Adjustment

As specified in section 31.5.2.1, MSS Operators are permitted to make an annual election to opt-in or opt-out of RUC participation. If the MSS Operator opts-in to the RUC procurement process, the CAISO considers the CAISO's Demand Forecast of the MSS Demand in setting the RUC procurement target. If an MSS Operator opts-out of the RUC procurement process, the CAISO does not consider the CAISO's Demand Forecast of the MSS Demand in setting the RUC procurement target. An MSS Operator that has elected to opt-out of RUC, or has elected to Load follow and therefore has also elected to opt-out of RUC, is required to provide sufficient resources in the Day-Ahead Market, and in the case of a Load following MSS Operator, follow its Load within the MSS Deviation Band. To reflect these options and to prevent committing additional capacity or resources for any differences between the CAISO Demand Forecast for the MSS and the MSS Self-Scheduled quantities in the IFM, the CAISO replaces the CAISO Demand Forecast for such MSS with the quantity of Demand in Self-Schedules submitted by the Scheduling Coordinator for the MSS in the IFM.

31.5.3.1.4 Eligible Intermittent Resource Adjustment

Scheduling Coordinators for Eligible Intermittent Resources may submit Bids, including Self-Schedules, in the Day-Ahead Market and the quantity ultimately scheduled from Eligible Intermittent Resources may differ from the CAISO forecasted deliveries from the Eligible Intermittent Resources. The CAISO may adjust the forecasted Demand either up or down for such differences by RUC Zone in which the Eligible Intermittent Resource resides. To the extent the scheduled quantity for an Eligible Intermittent Resource in the IFM is less th~~en~~an the quantity forecasted by CAISO, the CAISO makes a Supply side adjustment in RUC by using the CAISO forecasted quantity for the Eligible Intermittent Resource as the expected delivered quantity. To the extent the scheduled quantity for an Eligible Intermittent Resource in the IFM is greater than the quantity forecasted by the CAISO, the CAISO makes a Demand side adjustment to the RUC Zone Demand equal to the difference between the Day-Ahead Schedule and the CAISO forecasted quantity.

31.5.3.1.5 Real-Time Expected Incremental Supply Self-Schedule Adjustment

In order to avoid over procurement of RUC, the CAISO shall, using a similar-day approach, estimate the RTM Self-Schedules for resources that usually submit RTM Self-Schedules that are greater than their Day-Ahead Schedules. The CAISO Operator may set the length of the Self-Schedule moving average window. Initially this moving average window shall be set by default to seven (7) days; in which case the weekday estimate is based on the average of five (5) most recent weekdays and the weekend estimate is based on the average of the two (2) most recent weekend days. To the extent weather conditions differ significantly from the historical days, additional adjustment may be necessary. After determining the estimate of Real-Time Self-Schedules, using a similar day forecasting approach, the CAISO adjusts the CAISO Forecast oOf CAISO Demand of a RUC Zone based on the forecasted quantity changes in Supply as a result of Self-Schedules submitted in the RTM. This adjustment for forecasted Real-Time Self- Schedules may result in positive or negative adjustments. Demand adjustments to the CAISO Forecast oOf CAISO Demand result when there is a net forecast decrease in Real-Time Self-Schedule Supply relative to the Day-Ahead Schedule Supply. Supply adjustments to the individual resources occur when there is a net forecast increase in Real-Time Self-Schedule Supply relative to the Day-Ahead Schedule Supply of the individual resource.

31.5.3.1.6 Day-Ahead Ancillary Service Procurement Deficiency Adjustment

While the CAISO intends to procure one hundred percent (100%) of its forecasted Operating Reserve requirement in the IFM based on the CAISO Forecast of CAISO Demand as specified in Section 8.3.1, the CAISO shall make adjustments to the CAISO Forecast of CAISO Demand used in RUC to ensure sufficient capacity is available or resources committed in cases that the CAISO is unable to procure one hundred percent (100%) of its forecasted Operating Reserve requirement in the IFM; provided, however, that the CAISO shall not procure specific Ancillary Services products in RUC, nor will the RUC optimization consider AS-related performance requirements of available capacity.

31.5.3.27 RUC Zones

31.5.3.27.1 Use of RUC Zones

The CAISO shall adjust the CAISO Forecast of CAISO Demand by RUC Zone for the conditions described in Sections 31.5.3.1.2 through 31.5.3.1.6. If any adjustments are made throughout the affected

RUC Zone, such adjustments will be made consistent with the subset of system LDFs for the Nodes that define the RUC Zone(s). The CAISO will adjust the CAISO Forecast of CAISO Demand of each affected RUC Zone, preserving the LDFs within each RUC Zone, but the relative weighting of the LDFs across the system will deviate from the original LDFs. RUC costs will be pooled together to establish the RUC Compensation Costs. As described in Section 11. 6.1, Settlement of RUC Compensation Costs will not be on a RUC Zone basis.

31.5.3.2~~7~~.2 Designation of RUC Zones

The CAISO shall define RUC Zones as areas that represent UDC or MSS Service Areas, Local Capacity Areas, or any other collection of Nodes. RUC Zones will be designated by the CAISO as necessary and to the extent that the CAISO has developed sufficient data on historical CAISO Demand and weather conditions to allow it to perform Demand Forecasts. Once the CAISO has established RUC zones, the mapping of RUC Zones to Nodes shall be static data and shall be maintained in the Master File. The CAISO may add new Nodes to a RUC Zone if new Nodes are added to the FNM. The status of each RUC Zone shall remain active for as long as the CAISO maintains regional forecasting capabilities, but once a RUC Zone is designated the CAISO will only adjust the CAISO Forecast of CAISO Demand as necessary to address RUC procurement constraints and not as a normal course for all CAISO Market functions. The actual RUC Zones used by the CAISO in its operation of RUC are posted on the CAISO Website.

* * * * *

- RUC Zone

A forecast region representing a UDC or MSS Service Area, Local Capacity Area, or other collection of Nodes for which the CAISO has developed sufficient historical CAISO Demand and relevant weather data to perform a Demand Forecast for such area, for which as further provided in Section 31.5.3.2~~7~~ the CAISO may adjust the CAISO Forecast of CAISO Demand to ensure that the RUC process produces adequate local capacity procurement.

Attachment C – Examples of Existing Load Conformance Limiter

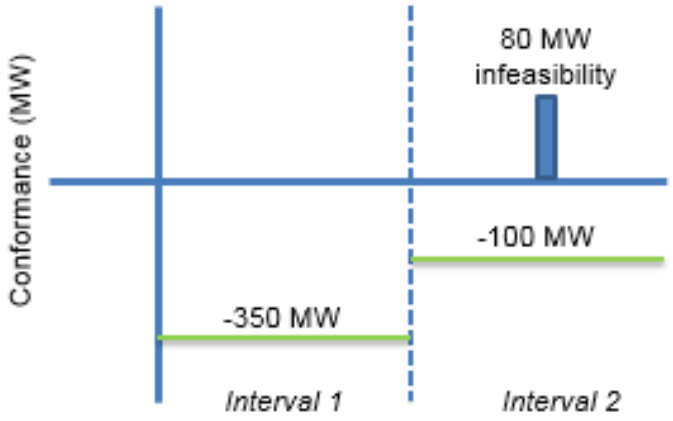
Detail Enhancement on Load Forecast Conformance

California Independent System Operator Corporation

Attachment C: Examples of Current Load Conformance Limiter

The workings of the current limiter logic are illustrated by Examples A, B and C below.

Example A

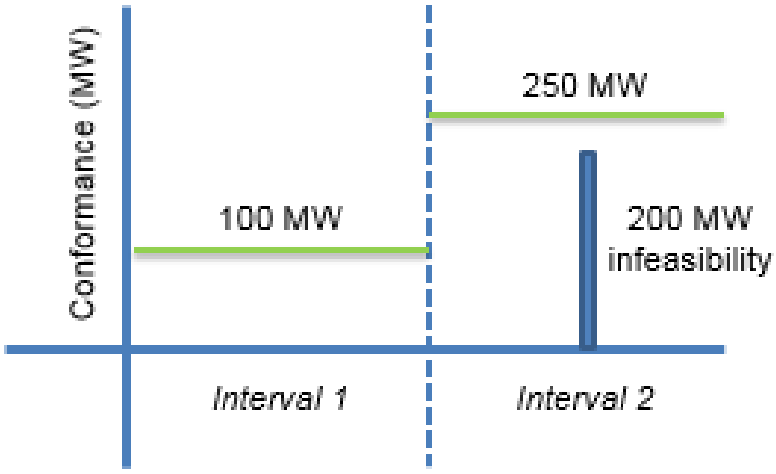


In this example, the difference in conformance between interval 1 and 2 is greater than the difference in infeasibility between intervals 1 and 2. The limiter is not triggered.

A system operator conforms the load forecast to by negative 350 MW for interval 1. The market detects no infeasibility for interval 1. In interval 2, the system operator conforms the load forecast by negative 100 MW. The market detects an infeasibility of +80 MW (under supply) for the interval 2.

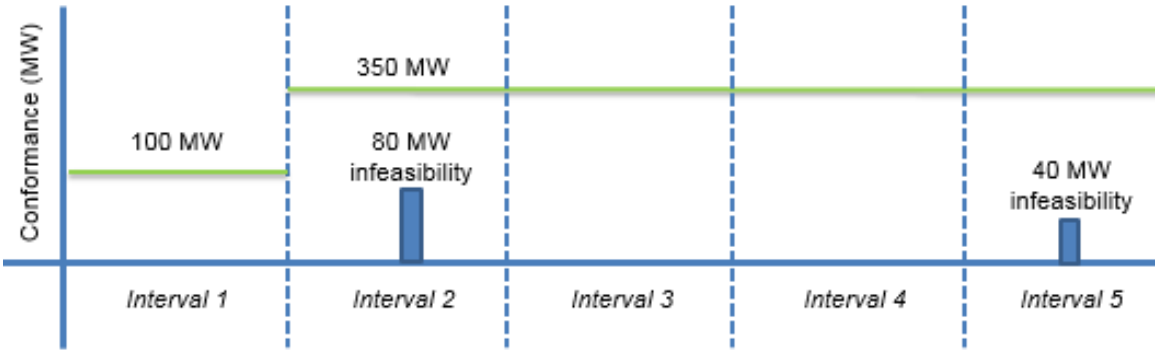
Based on current logic, the limiter would not apply because the conformance in the given interval is negative and the infeasibility is positive. Because the current limiter logic looks only the information in a given interval, there is an assumption that negative conformance cannot result in a positive infeasibility and therefore the limiter need not trigger. In reality, the difference between the conformance in interval 1 and interval 2 is an increase of 250 MW (*i.e.*, difference in conformance equal to negative -100 and negative 350. This is greater than the market infeasibility of 80 MW. The limiter should trigger when the conformance change is greater than the infeasibility (*i.e.*, the system operator requirement is greater than available ramping capacity). It is fair to assume that if the system operator knew exactly what the system was capable of providing in that interval, and the forecast did not actually increase by that amount in that interval, they would not have increased the load forecast as much. However, because the system operator faces limitations in how they can make the conformances during the operating time frame, the system operator's conformance of the load forecast from one interval to another may simply be due to the "coarse adjustments" they may make. The CAISO is proposing to enhance the limiter so that it would trigger in this case.

Example B



In this example, a system operator conforms the load forecast to a value of positive 100 MW for interval 1. The market calculates no infeasibility for interval 1. In the current interval, interval 2, the system operator conforms the load forecast to a value of positive 250 MW. The market calculates an infeasibility of positive 200 MW (*i.e.*, under supply) for interval 2. Based on current logic, the limiter would apply because the conformance is positive, the infeasibility is positive, and the conformance value is greater than the infeasibility. By looking at only one interval, the limiter assumes the infeasibility is a result of that interval alone. In actuality, the difference between interval 1 and interval 2 is an increase of 150 MW (conformance delta = 250 MW – 100 MW). This does not exceed the 200 MW infeasibility for that interval. The limiter should not apply because the difference in conformance between the two intervals is less than the infeasibility. In other words, the available ramping capability on the system is greater than the system operator's conformance requirement between the two intervals and therefore the limiter should not trigger. The CAISO is proposing to enhance the limiter so that it would trigger in this scenario.

Example C



A system operator conforms the load forecast by 100 MW in interval 1 and by 350 MW for the following intervals. The market calculates an infeasibility of 80 MW for interval 2 and an infeasibility of 40 MW for interval 5. In this example, the limiter would correctly trigger for the infeasibility in interval 2 because the conformance is positive, the infeasibility is positive, and the conformance value is greater than the infeasibility.

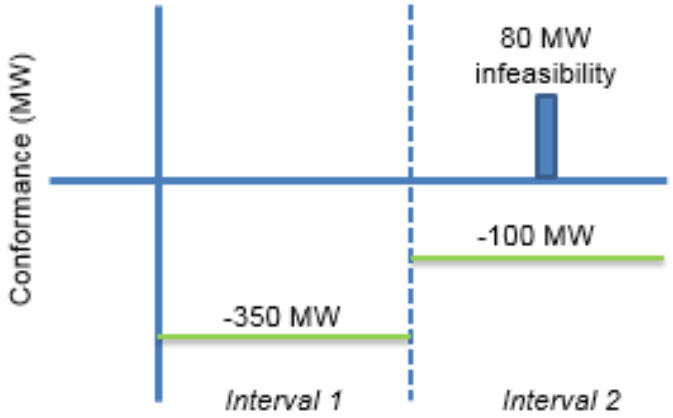
In the subsequent intervals there is no infeasibility indicating there is adequate ramping capacity on the system for the 350 MW conformance requirement. However, in interval 5, the limiter is triggered because the 40 MW infeasibility is less than the 350 MW conformance. In actuality, the conformance requirement has not increased from the previous interval (*i.e.*, the difference between 350 MW and 350 MW conformance is zero) and is less that the infeasibility in interval 5. In other words, the ramping capability on the system is greater than the system operator's conformance requirement and therefore the limiter should not trigger.

PROPOSED LOGIC:

To enhance the effectiveness of the load conformance limiter, the CAISO developed an enhancement for the limiter tool logic through its stakeholder process that will prevent the limiter from triggering incorrectly. The enhancement will modify the load conformance logic so that the limiter will consider conformance and infeasibility changes between intervals and will not be limited to information from the current interval. The limiter logic will consider the magnitude of the conformance in previous intervals and whether the limiter was applied in the corresponding intervals. This will address the current issue identified that the limiter often triggers based on information from a single interval even though the conformances may carry over from interval to interval.

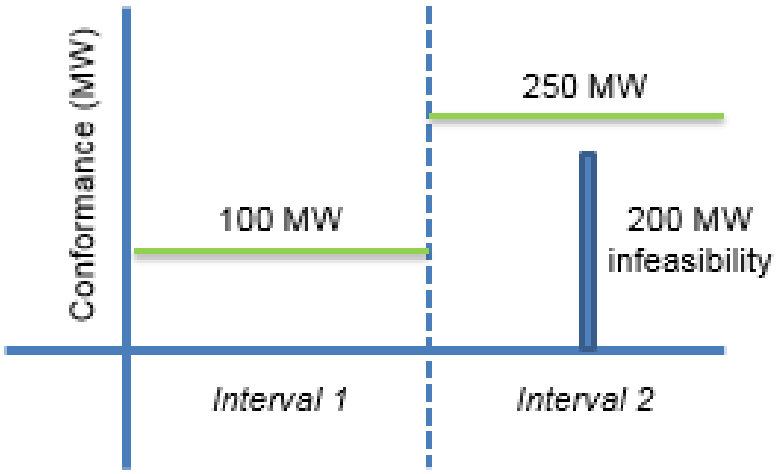
The next three examples illustrate how the enhanced limiter logic will work.

Example D



Assume the same conditions as in Example A above. Under the new logic, the limiter would trigger because the limiter would now consider the changes in conformance between intervals and not only the direction of the conformance relative to the infeasibility. The change in the system operator conformance between intervals 1 and 2 is larger than the ramping capability on the system and the limiter should trigger. Therefore, even if the conformance and the infeasibility are in different directions, the new limiter will trigger. This ensures is because the limiter recognizes the changes between intervals instead of relying solely on information from one independent intervals.

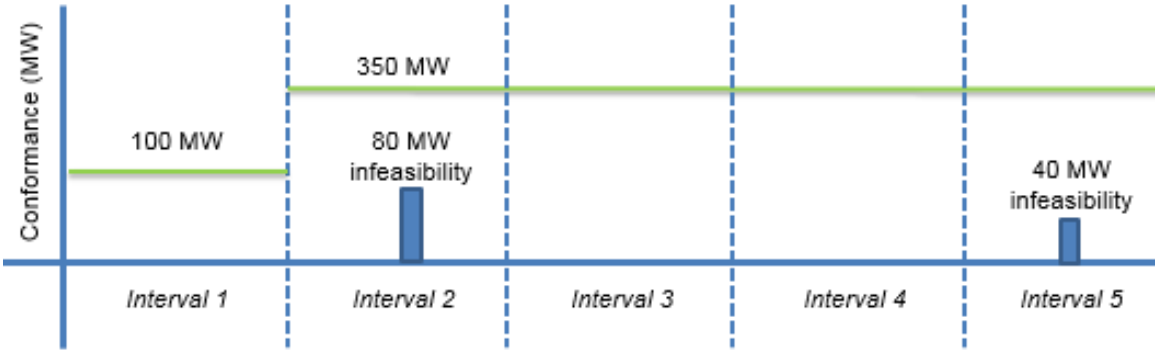
Example E



Assume the same conditions as in Example B above, the new logic would now consider the information between the two intervals. In this example because the difference in conformance between the two intervals is less than the infeasibility, the

new limiter would not trigger. Said differently, the system operator's conformance between intervals 1 and 2 is less than the ramping capability on the system and therefore the limiter does not need to trigger.

Example F



Assume the same conditions as in Example C above. In intervals 3 and 4 there is power balance constraint infeasibility. In interval 2, the limiter triggers because the change in conformance from the previous interval is greater than the power balance constraint infeasibility. In interval 5, however, there is no change in conformance from the previous interval and therefore the limiter does not trigger because the conformance there is a carryover from the prior interval. The conformance requirement from the system operator does not change between interval 4 & 5; therefore there is adequate ramping capability in interval 5 and the limiter should not trigger.

Attachment D – Revised Draft Final Proposal

Detail Enhancement on Load Forecast Conformance

California Independent System Operator Corporation

Imbalance Conformance Enhancements

Revised Draft Final Proposal

March 14, 2018

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Imbalance Conformance Enhancements
Revised Draft Final Proposal

Table of Contents

1. Purpose

The purpose of this initiative is to describe how and why conformance is necessary to meet system reliability needs when imbalance occurs. The California Independent System Operator Corporation (ISO) proposes enhancements for the imbalance conformance limiter used in the ISO's real time market. The proposal put forth in this paper expands upon the Issue Paper/Straw Proposal and includes stakeholder feedback. The scope has been expanded to improve the conforming process, which will enable the conformance limiter to be sunset in two years.

2. Scope Changes from Issue Paper/Straw Proposal

2.1. Original Scope

The scope proposed in the Issue Paper/Straw Proposal[1] included:

- Clarification of the ISO's authority to conform for imbalance in the real-time market,
- Clarification of the ISO's authority to conform for imbalance in the day ahead market through the residual unit commitment (RUC) net short process, and
- Implementation of enhancements to improve the imbalance conformance limiter currently used in the real-time market.

2.2. Expanded Scope

Based on stakeholder feedback (see Section 3.2: Conforming – Stakeholder Comments and Response and Section 4.3: Conformance Limiter – Stakeholder Comments and Response) the scope of this initiative has been expanded. In addition to the original scope, this initiative will address:

- Improvements to the conformance process in the ISO BAA, and
- Removal of the conformance limiter from the real-time market within approximately two years.

2.3. Revised Draft Final Proposal Scope

Based on stakeholder feedback, the ISO has made the following changes to the draft final proposal:

- The ISO will complete data analysis to support removal of the limiter.
- Authority of the EIM operator to conform will be included in proposed tariff changes.

[1] Reference the Issue Paper/Straw Proposal, section 3: http://www.caiso.com/Documents/IssuePaper-StrawProposal-ImbalanceConformanceEnhancements.pdf

- Pricing impacts of the enhanced imbalance conformance limiter can be found in Appendix B.
- The EIM categorization of this proposal has changed. Please reference Section 5.2: EIM Governing Body Role.
-

3. Conforming

This section explains the importance and necessity of conforming. In addition, stakeholder comments related to conforming are summarized. The ISO responds to stakeholder comments, proposes a revised scope, and provides data to support the proposal.

Stakeholder comments, the ISO response, and the revised proposal related to the conformance limiter are addressed in Section 4.

3.1. Background

Grid operators in the ISO and EIM balancing authority areas are responsible for continually balancing supply and demand to maintain system reliability. When the system is not balanced (i.e. energy generated does not equal energy consumed), area control error (ACE) will increase or decrease from zero, which can cause frequency deviations.

To maintain system balance, the market system will commit units and dispatch them up or down to match the load forecast. If the forecast is correct, all generating units follow their dispatch, and there are no contingencies or unpredictable grid events, the system will remain balanced. In reality, however, the forecast is not always accurate, generating units do not necessarily follow their market dispatch, and unpredictable events such as unanticipated outages occur. This can result in an unbalanced system, which the ISO operators must manually correct. The ISO uses the term “conforming” to refer to the process of updating the load forecast to account for observed system conditions.

Conforming is not an exact science and must be completed quickly to ensure the market is aware of system conditions in a timely manner. There is no feasible way for the grid operator to quickly and simultaneously inform the market of each individual reason for deviations from forecasted system conditions. It would be impossible to manually update the VER deviations, generator outages, *and* load deviations (for example) every five minutes with 100% accuracy. Therefore, the adjusting the load forecast allows the operator to use an aggregated value and correct for various system changes in an expedited manner. Using the load forecast enables the conformance to be dispersed evenly across the system based on distribution factors without causing congestion.

In summary, the load forecast is used as a tool for conforming imbalance energy needs even though the reason for the conformance, in some cases, is not related to the accuracy of the load forecast itself. Conformance is needed to balance the continually changing system conditions and the load forecast provides a quick and effective tool to maintain reliability.

Conforming is a standard practice for ISOs and balancing authorities (BAs). With this initiative, the ISO proposes to clarify the authority of the ISO to conform in the real-time market and through the RUC net short process in the day ahead market. These clarifications will provide needed transparency.

3.2. Summary of Stakeholder Comments

Stakeholder comments were submitted in response to the Issue Paper/Straw proposal, which was published on November 29, 2017 and discussed during a stakeholder call on December 8, 2017. These stakeholders submitted written comments: Arizona Public Service (APS), Department of Market Monitoring (DMM), Pacific Gas & Electric (PG&E), Portland General Electric (PGE), Public Generating Pool (PGP), Powerex, Southern California Edison (SCE), and Six Cities.

All stakeholders supported the proposed tariff clarifications. The ISO will continue to move forward with tariff revisions to clarify the authority of the ISO to conform in the real time and day ahead markets.

In addition, there was general support from stakeholders to review the process of conforming specifically in the ISO balancing authority area. For example, Pacific Gas & Electric requests: "To the extent that imbalance conformances are used to correct for shortcomings in the energy market design including VER forecasts, the CAISO should prioritize enhancements to those market-based designs."[2] The Public Generating Pool requested the scope be expanded to address, "The high frequency, large magnitude and same direction of conformances in the CAISO BAA."[3] These sentiments were mimicked by other stakeholders including PGE, Powerex, and SCE.

In response to stakeholder comments, the ISO agrees to expand the scope of this initiative. The ISO proposes tool enhancements to improve the conforming process. Section 3.4: Conforming – Revised Proposal explains the revised proposal, which includes analysis of the current conformance process.

3.3. ISO Response to Stakeholder Comments

Stakeholders commented on the frequency, magnitude, and pattern in which the ISO conforms. Figure 1 was cited by Powerex and originally published in the DMM Q3 2017 report. It shows a conformance trend. The magnitude of the trend has roughly doubled between 2016 and 2017.

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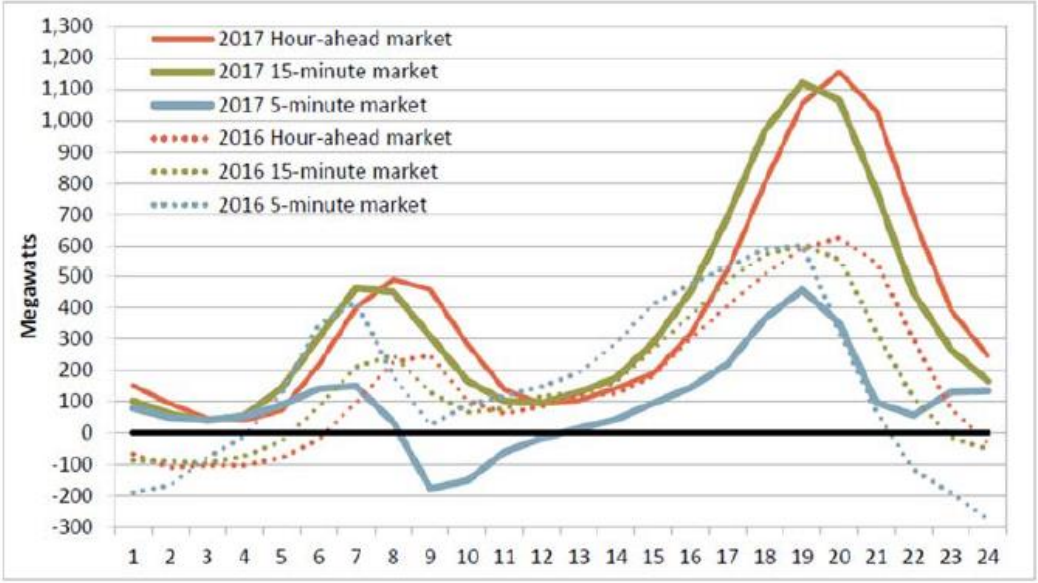
2 PG&E written comments in response to the ISO's Issue Paper/Straw Proposal: http://www.caiso.com/Documents/PG-EComments-ImbalanceConformanceEnhancements-IssuePaper-StrawProposal.pdf

3 PGP written comments in response to the ISO's Issue Paper/Straw Proposal: http://www.caiso.com/Documents/PGPComments-ImbalanceConformanceEnhancements-IssuePaper-StrawProposal.pdf

Figure 1: Average ISO conformance from Q3 2016 & 2017



In addition to the trend and magnitude, Powerex points out that the ISO conforms with greater frequency than the majority of participating EIM entities as shown in Figure 2.[4]

Figure 2: Average frequency and magnitude of conformance for EIM Entities (July – September 2017)

	Positive load adjustments			Negative load adjustments			Average hourly bias MW
	Percent of intervals	Average MW	Percent of total load	Percent of intervals	Average MW	Percent of total load	
California ISO							
15-minute market	57%	674	2.0%	6%	-328	1.2%	367
5-minute market	48%	370	1.1%	29%	-289	1.1%	97
PacifiCorp East							
15-minute market	11%	87	1.4%	4%	-85	1.5%	7
5-minute market	37%	83	1.4%	15%	-76	1.3%	19
PacifiCorp West							
15-minute market	3%	56	2.3%	4%	-42	1.8%	0
5-minute market	6%	55	2.3%	22%	-47	2.2%	-7
NV Energy							
15-minute market	15%	90	1.5%	5%	-136	2.7%	7
5-minute market	22%	63	1.1%	32%	-105	2.1%	-20
Puget Sound Energy							
15-minute market	3%	45	1.5%	14%	-66	2.9%	-8
5-minute market	4%	51	1.8%	21%	-65	2.8%	-11
Arizona Public Service							
15-minute market	91%	155	3.5%	4%	-317	8.0%	129
5-minute market	90%	155	3.5%	4%	-356	9.1%	126

[4] Powerex written comments in response to the ISO's Issue Paper/Straw Proposal: http://www.caiso.com/Documents/PowerexComments-ImbalanceConformanceEnhancements-IssuePaper-StrawProposal.pdf

Frequency of Conforming: Based on data published in the DMM Q3 2017 quarterly report, it appears the ISO conforms with a greater frequency (percentage of intervals) than all participating EIM entities other than Arizona Public Service. However, it is critical to note that all generators within the ISO BAA are participating resources. In comparison, EIM entities can select which resources are participating or non-participating. Therefore, EIM entities can use non-participating resources or other tools at their disposal, such as manual out-of-market dispatches, to account for unpredictable system conditions. They are not limited to conforming using the ISO markets. Both manual dispatches and movement of non-participating resources minimize the need for market conformance. The use of manual dispatches and movement of non-participating resources are not captured in Figured 2. It is therefore it is not a fair comparison to analyze the frequency of conformance in the ISO to the frequency of conformance in other EIM entities.

Additionally, the ISO has over 17,000 MW of solar and wind generation connected to the bulk electric grid. The ISO typically has 30% of its supply generated by renewable resources. As a result, the ISO experiences more variable energy resources (VERs) deviations compared to many neighboring balancing authority areas. When a VER deviation occurs, it is often corrected with an operator conformance. The larger amount of VERs in the ISO compared to other EIM BAAs is a direct correlation to the increase in conformance.

The ISO is addressing VER deviations and improving market inputs with the Real-Time Dispatch Persistence Market Model Enhancement.[5] Implementation of these enhancements will minimize the need for operators to conform for VER deviations. This will decrease the frequency with which the ISO conforms.

Magnitude of Conforming: It was stated in stakeholder comments that the ISO conforms with a large magnitude. However, the magnitude of conformance as a percentage of load is roughly 1% - 2%. This is comparable to other EIM entities as shown in Figure 2.

Pattern of Conforming: Figure 1 identifies a pattern of conformance that occurs daily in the ISO. The trend follows the load curve and has doubled within the last calendar year. The most significant contributing factor for the increase in conformance between 2016 and 2017 is the large increase in renewable energy in the ISO's BAA. Based on current market design, any renewable deviation must be compensated for with a conformance input. The increase in renewable output across the ISO BAA has contributed to the conformance increase. The Real-Time Dispatch Persistence Market Model

[5] Additional information for the Real-Time Dispatch Persistence Market Model Enhancement effort can be found in the Market Notice published on December 7, 2017: http://www.caiso.com/Documents/RenewableForecastingReal-TimeDispatchPersistenceMarketModelEnhancement.html

Enhancements will allow the market to recognize VER deviations more quickly and therefore will reduce the need to conform for renewable deviation.

In addition to the other initiatives in progress, the ISO agrees with stakeholders that if the conformance trend is known and predictable, the need for the conformance should be addressed with automation or tool enhancements to eliminate the need for a manual operator action. The revised proposal includes tool and system improvements/enhancements to address the regular pattern with which the ISO conforms.

Flexible Ramping Product: PG&E asked the ISO to expand the scope of this initiative to include analysis of flexible ramping product and reserves. Specifically, PG&E asks if the ISO is procuring enough flexible ramping product to ensure operational needs are met. They imply with an increased amount of flexing ramping resources available, the ISO may not need to conform as frequently.

The ISO is updating the Business Practice Manual (BPM) for Market Operations. With this update, the ISO will change the procurement process for flexible ramping product.[6] The design change will ensure flexible ramping product can be awarded in another EIM balancing authority area if there is available transfer capability that can be used if dispatched in a subsequent market run. It is anticipated that improvements to the flexible ramping procurement process will decrease the need for conformance in the ISO BAA. These changes will be discussed at the Market Surveillance Committee meeting on February 2, 2018.[7]

Because these enhancements are already being addressed by the ISO, this initiative will not be broadened to include the procurement process for flexible ramping product or reserves.

Reason for Conformance: Many stakeholders requested data from the ISO to identify the reasons why conformance occurs in the real-time market. Figure 3 shows the reason for conformance in the real time dispatch (RTD) market, as input by the operator, for the 2017 calendar year.

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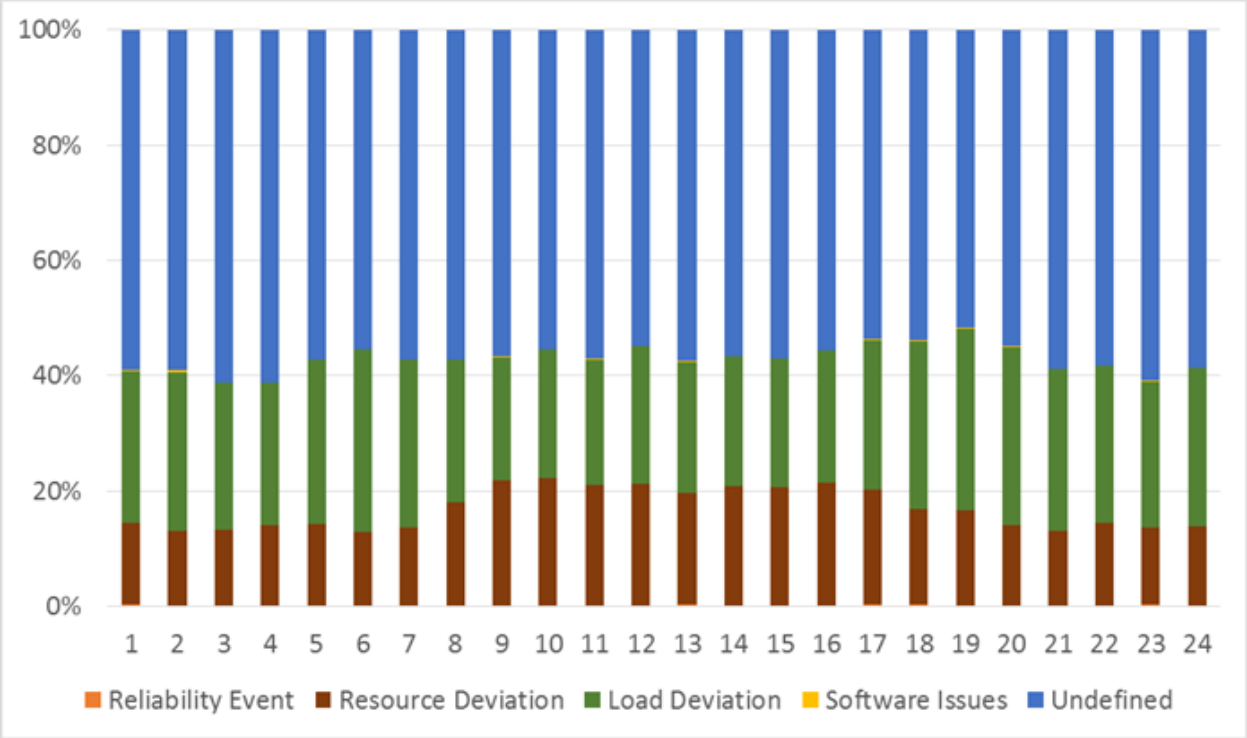
6 Reference section 7.1.3: *Flexible Ramping Product* of the BPM for Market Operations: https://bpmcm.caiso.com/BPM%20Document%20Library/Market%20Operations/BPM_for_Market%20Operations_V54_clean.doc

7 MSC meetings are open to the public. To access information for the February 2, 2018 MSC meeting, go the calendar on the ISO's website: http://www.caiso.com/Pages/Calendar.aspx?IsDlg=true

Figure 3: Reason for RTD conformance in the ISO - 2017



As explained in the Issue Paper, conformance occurs for various reasons. The operator typically inputs a conformance for multiple grid occurrences and the action of the operator physically inputting the conformance requirement must occur quickly. For these reasons, about 60% of RTD conformances were input when an "undefined" reason.

The ISO recognizes there is a need for increased transparency related to the conformance process. Currently, the Department of Market Monitoring (DMM) publishes conformance information on a quarterly basis. With the implementation of this initiative, the ISO will increase transparency by providing conformance information in the *Monthly Market Performance Report* in the "Market Interventions" section.[8] Additionally, the ISO will update the menu of reasons available to the operator when a conformance occurs and attempt to decrease the number of "undefined" conformances.

Conformance vs. Exceptional Dispatch: When an operator adjusts the conformance, the market will use this new input in the next market optimization run and re-dispatch generation accordingly. An exceptional dispatch (ED) is a transaction outside of the market optimized dispatch. The ISO has made efforts to decrease the frequency of exceptional dispatches to ensure the market optimized dispatch is used when possible. In general, a conformance will occur for unpredictable system conditions and allows the market to solve for the optimal solution. An ED occurs when there is not enough time for the

[8] The Monthly Market Performance Reports can be located on the CAISO website under Reports and Bulletins. The direct link is: http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=A9180EE4-8972-4F3B-9CB8-21D0809B645E

market to solve or there are no available bids to mitigate the constraint.

3.4. Revised Proposal

As stated in the Issue Paper/Straw Proposal, the ISO proposes to make tariff changes clarifying the ISO and EIM operator's authority to conform in the real time market. Stakeholders support increased transparency and therefore the ISO will move forward with the proposed tariff changes. In addition and based on stakeholder feedback, the ISO has expanded the scope of this initiative to include improvements to the conformance process.

Authority to conform in the Real Time Market: Currently the ISO Tariff does not explicitly specify the authority of the ISO or EIM operator to conform in the real time market; however, the tariff does gives the ISO discretion to create a load forecast it deems appropriate to maintain grid reliability. The ISO believes it would be beneficial to explicitly specify the authority of the ISO and EIM operator to make imbalance conformances and the reasons for taking such actions.

The factors for which ISO and EIM balancing area authorities may conform for imbalance include but are not limited to:

- Inaccurate load forecast
- Area control error (ACE) adjustments
- Variable energy resource (VER) deviation
- Generator outage that has not yet been input to the market
- Generator testing
- Reliability curtailments due to transmission/equipment outages
- Weather changes
- Pumping schedule changes
- Averages that do not reflect dramatic load increase or decrease

Authority to conform in the Day Ahead Market: Similar to conforming in the real time market, a version of conforming occurs in the day ahead market through the residual unit commitment (RUC) net short process.

When the results from the Integrated Forward Market (IFM) are published, the operator may realize that the RUC, which procures to the RUC Procurement target, may not obtain enough capacity to address anticipated real-time conditions. To ensure there is enough capacity for the next trade date, the operator will employ what is referred to the "RUC net short" process. RUC net short will procure additional capacity to better reflect overall system conditions. This adjustment to the forecast is a form of conformance for the day ahead market.

The ISO has the authority to set the CAISO Forecast of CAISO Demand (CFDF) as it deems appropriate. However, the tariff does not provide any details for how it sets the forecast or the activity of adjusting the forecast to reflect the system conditions (specified below) to procure additional capacity through the RUC net short process. The rationale for the adjustment is to ensure the RUC procures sufficient capacity to meet anticipated system conditions.

The ISO believes it would be beneficial to explicitly specify the authority of the ISO to make imbalance conformances in the day ahead market and the reasons for taking such actions. The factors for which ISO conforms for imbalance in the day ahead market include but are not limited to:

- Load forecast error
- Dramatic weather pattern that is expected to continue or change with the next trade day
- Generator outage resulting in a different availability than was bid into the day ahead market
- Fire danger that threatens transmission lines and/or corridors
- Reliability concern that the generation committed will not meet the anticipated demand
- Reliability Coordinator (RC) next-day analysis

Improvements to the Conformance Process: The ISO is continually committed to tool, market, and process improvements to ensure reliable operation of the bulk electric grid. This includes improvements to the conformance process and the tools used for conforming. The following efforts are currently underway and will minimize the need for manual conformance by the operator.

- *Real-Time Dispatch Persistence Market Model Enhancement*: A forecasting enhancement for registered eligible intermittent resources (EIRs) that will shorten the time cycle to produce a forecast for EIRs resulting in improved accuracy for the RTD timeframes. More accurate renewable forecasts will minimize the need for conformance in the real time market.

- *Day Ahead Market Enhancements*: A policy initiative aimed at increasing reliability by providing fifteen minute granularity in the day ahead market and a day ahead flexible reserve product. This will enable the procurement of energy and capacity to more closely follow the net load forecast curve. A more accurate day ahead market will take pressure off of the real-time market to make up for deviations that occur. Enhancements to the day ahead market will minimize the need for conformance in both the day ahead and real time markets.

- *Flexible Ramping Product Improvements*: The ISO is in the processes of making technology improvements to the flexible ramping product procurement process. This effort will ensure there is adequate flexible ramping product award available and deliverable. These improvements will minimize the need for conformance in the real time market.

The items listed above are separate efforts that will all indirectly reduce the need for conformance in the ISO BAA. In addition to these items and as a result of this initiative, the ISO proposes specific improvements to the imbalance conformance tools and process.

The ISO commits to improve the imbalance conformance process with tool enhancements:

- *Imbalance Conformance Tool*: Build a tool that compiles inputs based on real time grid conditions and estimates a conformance value that may be appropriate. This tool can ensure the conformance requirement that is input into the market is accurate. Ultimately, this tool may be automatically used as a market input essentially eliminating the need for real-time conformance based on systematic variations such as ACE, renewables, and load forecast error.

- *Ramping Capacity Tool:* Build a tool that displays the ramping capacity available for each market run. This will provide transparency for the operator and reduce the need for the limiter. If the ramping capacity tool shows 500 MW is available in the next 5-minute market run, the operator will determine if that amount is adequate or not. He will no longer need to "guess" what is available and over-estimate the conformance requirement in hopes of procuring everything available. If the operator needs more than is available, he will still input that amount which will then accurately trigger penalty prices. The Ramping Capacity Tool improves situational awareness and decreases the need for the limiter.

These tool improvements will increase situational awareness and address the coarse conformances currently input by the operator.

4. Conformance Limiter

4.1. Background

Conforming is done for reliability reasons. The grid operator's primary objective is to ensure grid reliability with disregard to how this may impact prices throughout the balancing area. Said explicitly, the grid operator does not conform to influence market pricing. However, the conformance either increases or decreases the demand requirement recognized by the market. The market outcome determines pricing and quantities cleared, which therefore may be indirectly affected by the conformance.

If the conformance requirement exceeds the ramping capability in a single interval, the market result will be infeasible, the power balance constraint will relax, and prices will administratively set at the relevant penalty price. In order to avoid invalid price spikes, which can occur when an operator overestimates the conformance requirement or inputs a coarse adjustment, the conformance limiter will trigger. When triggered, the limiter allows the market to solve by reducing the conformance to the

feasible ramp that is available based on economic bids. The clearing price is then set based on the bid stack instead of the penalty price.

The primary reasons the limiter is necessary is that conformance requirements are typically coarse and over-estimated. A coarse and/or over-estimated adjustment often results in an artificial market infeasibility and a corresponding penalty price. The limiter ensures this does not occur.

Coarse Adjustment:

Operators typically input coarse adjustments because they cannot input a ramping timeline to align with the conformance. Generally, the coarse adjustment does not reflect the actual system need and is simply the fastest way for the operator to correct the upcoming market runs. The limiter will protect against invalid price spikes resulting from the coarse adjustment.

To explain a coarse adjustment, imagine an operator needs to conform by 500 MW to correct for an ACE deviation. The time it takes to correct for the deviation ACE depends on other grid conditions and the preference of the operator. In theory, the 500 MW correction could occur gradually over multiple market runs. According to the NERC standards, the operator has 30 minutes to correct for the ACE deviation. In reality, however, the operator typically inputs the correction all at once because it is the fastest and most efficient way to make the correction.

The operator does not have the tools or time available at his disposal to "ramp" the adjustment into the market. Therefore, he puts the entire 500 MW requirement into the market at once. This requirement results in the market attempting to procure 500 MW within the next market run. Does the market really need to make the 500 MW adjustment in one five minute interval? Likely not. Yet the operator is unable to take the time to input the 500 MW in 100 MW intervals over the next few market runs. The action of putting the entire conformance requirement into one market interval, instead of ramping it in, is a "coarse" adjustment.

Over-Estimated Adjustment:

As explained in the Issue Paper/Straw Proposal, operators typically over-estimate the conformance requirement they input into the market. Conformance adjustments are made for multiple grid deviations occurring simultaneously. The limiter allows for the operator to over-estimate the conformance needed and conservatively make corrections without setting artificial price spikes.

For example, the operator will conservatively over-estimate the conformance requirement for the following scenario:

REASON FOR CONFORMANCE	ACTUAL	OPERATOR ESTIMATED
LOAD FORECAST DEVIATION	137 MW	150 MW
RENEWABLE DEVIATION	126 MW	150 MW
ACE EXCEEDANCE	75 MW	100 MW
FORCED GENERATOR OUTAGE	200 MW	200 MW
TOTAL	**538 MW**	**600 MW**

Due to time limitations, the operator rounds and conservatively over-estimates the conformance requirement that is needed.

4.2. Summary of Stakeholder Comments

The majority of stakeholders support the proposed enhancements for the conformance limiter. The enhancements will ensure the limiter triggers correctly, and are an improvement from the current limiter functionality.

The minority of stakeholders oppose the limiter enhancements. One party believes the limiter should be implemented in a two-step approach enabling the limiter to trigger more frequently therefore preventing price spikes. A small minority oppose the limiter all together stating that the limiter is fundamentally flawed and suppresses potentially valid penalty prices.

4.3. ISO Response to Stakeholder Comments

Inclusion of the Limiter in the ISO Tariff: In their written comments, PWRX requested the limiter be included in the ISO Tariff. The ISO agrees and will make revisions to include the limiter in the tariff.

Two-Step Approach: SCE has requested the limiter be implemented with a two-step approach. Existing limiter functionality would be applied in the first pass. If triggered based on the existing functionality, the enhanced logic would then be applied in a second pass. This methodology would cause the limiter triggering more frequently which SE believes would decrease price volatility in the real time market.

The ISO would like to acknowledge that the enhanced limiter logic actually reduces the frequency with which the limiter will trigger. Currently, the limiter is triggering in scenarios when it shouldn't; this will be corrected with the enhanced logic. The ISO maintains it is critical that the limiter trigger, or not trigger, based on changes between intervals. The purpose of the limiter is not to suppress prices, but to ensure invalid penalty prices do not result from an operator's coarse or over-estimated adjustment. The

enhanced limiter logic will trigger, and not trigger, correctly based on changes between market intervals. The ISO will not move forward with a two-step approach for the conformance limiter.

Stepped Penalty Prices: PG&E requested the ISO consider stepped penalty prices in conjunction with this initiative. Stepped penalty prices were investigated in the *Stepped Constraint Parameters* initiative. This initiative was ultimately closed and will not be re-addressed with this initiative. Additional information can be found on the initiative website:

http://www.caiso.com/informed/Pages/StakeholderProcesses/CompletedClosedStakeholderInitiatives/SteppedConstraintParameters.aspx

Limiter Memory Component & Missing Information: The Department of Market Monitoring (DMM) requested the ISO investigate what occurs when a memory component value is non-zero and what occurs if a required piece of information is missing.

Every time the limiter logic runs, information from the previous interval is used. This information is built up to form the memory component which allows the limiter to determine if a conformance change is the result from the current interval, or a previous change. If a non-zero value resulted in the limiter triggering for an interval, this value would then be used in the $Max(0, C_{i-1})$ (or $Min(0, C_{i-1})$) component of the limiter logic. This allows for the result from previous intervals to be used in the logic for the current interval.

Missing information will be addressed in the implementation details of this project.

Impacts of FERC Order 831: The DMM states "that while there was no significant price separation between the approaches in 2017, there could be a significant impact on prices with the implementation of FERC Order No. 831."[9] The ISO agrees.

Currently, pricing does not dramatically change based on use of the current limiter, enhanced limiter, and no limiter. This is largely because proxy demand response (PDR) resources bid into the ISO markets near the bid cap, roughly $950/MWh. Therefore, even when the limiter is triggered, a price of $950/MWh is set based on the bid cap from PDR. However, with Order Number 831, penalty prices will increase to $2000/MWh. Therefore, the limiter may have a greater impact.

If the limiter is not applied when Order Number 831 goes into effect, pricing will be set at $2000/MWh (instead of the current penalty price of $1000/MWh) anytime the operator conformance requirement

[9] DMM written comments in response to the ISO's Issue Paper/Straw Proposal: http://www.caiso.com/Documents/DMMComments-ImbalanceConformanceEnhancements-IssuePaper-StrawProposal.pdf

exceeds the available ramping capacity. This could result in increased price volatility if the limiter is not used.

Valid Scarcity Condition: Some stakeholders requested data to determine how frequently the limiter is triggered correctly or incorrectly. They agree that the limiter logic identifies scenario in which the operator incorrectly signals a scarcity condition and in these situations the limiter should trigger. However, stakeholders claim it is possible for the limiter to trigger when in reality the operator input is valid and a scarcity truly does exist. In these situations stakeholders claim the limiter should not trigger and penalty pricing should correctly result.

As discussed during the December 8th stakeholder call, it is impossible to determine when the limiter "correctly" or "incorrectly" triggers. The ISO agrees this is a shortcoming of the limiter and is part of the reasoning behind removing the limiter from the markets in approximately two years. Within those two years, the limiter will protect for course adjustments (as shown in Figure 4) and over-estimations that would result in a market infeasibility. If the limiter were removed immediately, there would be an increase in scarcity pricing when scarcity may not actually exist. Therefore, it is the best approach to ultimately remove the limiter, but this must be done in a phased and controlled approach.

4.4. Conformance Limiter Data Analysis

Data analysis was completed to quantify that operators conform with coarse adjustments. Figure 4 displays coarse conformance adjustments. Figure 5 confirms that when the limiter triggers it is typically due to the coarse adjustment in the first interval. For these reasons, the limiter is needed until the coarse adjustments are corrected. Until then, the limiter enhancements will be introduced to prevent the limiter from continuing to incorrectly trigger (Figure 5).

Figure 4: CAISO RTD conformances changes ("deltas") between intervals for 2017.

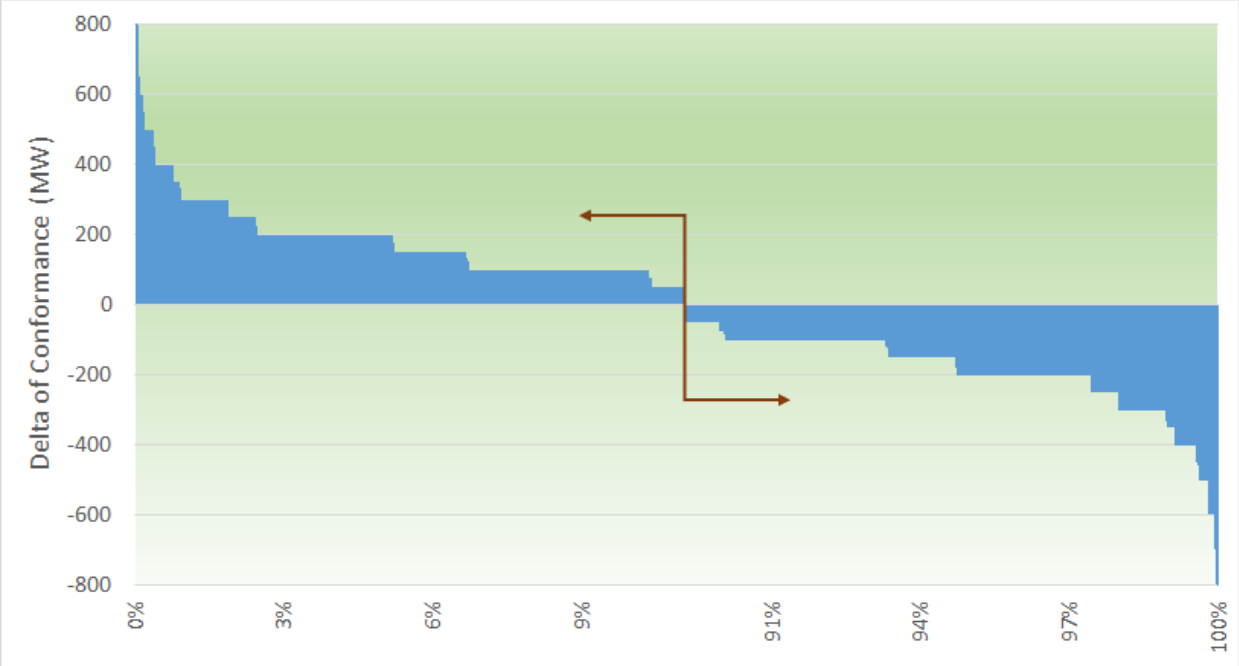


Figure 4 shows RTD intervals (CAISO, 2017) with a change in conformance between intervals. A positive conformance delta indicates the conformance requirement increased between intervals (under-supply). A negative conformance delta indicates the conformance requirement decreased between intervals (over-supply). The data compiled represents all RTD intervals for 2017 in which a conformance requirement was input in the market.

Out of all intervals with an RTD requirement, approximately 10% of intervals had a positive conformance delta (shown to the left of the red arrow) and 10% of intervals had a negative conformance delta (shown to the right of the red arrow). The straight red line represents a break in the graph (see Appendix A for full-scale graph) in which there was no delta change. 80% of RTD intervals had a conformance requirement with no change between intervals – the conformance was left over from the previous interval.

This shows that of all intervals in which imbalance conforming is being used, only 20% have a change in conformance between intervals. When a conformance delta occurs, it is a large, coarse adjustment as identified by the blocks. The delta is not gradually ramped across multiple market runs.

This data in Figure 4 proves:

1. Operators use large coarse values, and
2. Once the conformance value is input into the market, it is frequently left for subsequent intervals with no change.

As a result, the limiter is needed to protect for large coarse adjustments the first time they are input into the market.

Coarse adjustments (i.e. a conformance delta of 100 MW) likely do not represent the true grid conditions for the individual corresponding interval. A coarse adjustment is the operator's way to respond to an event or prepare for an anticipated event. The operator does not have time to ramp the change into the market and instead inputs a large requirement at one time and allows it to stay in the market for multiple intervals. The coarse adjustments are frequently the interval in which the limiter is triggered and needed (see Figure 5).

Figure 5: CAISO RTD conformances as a percentage of total RTD intervals in which the limiter is triggered.

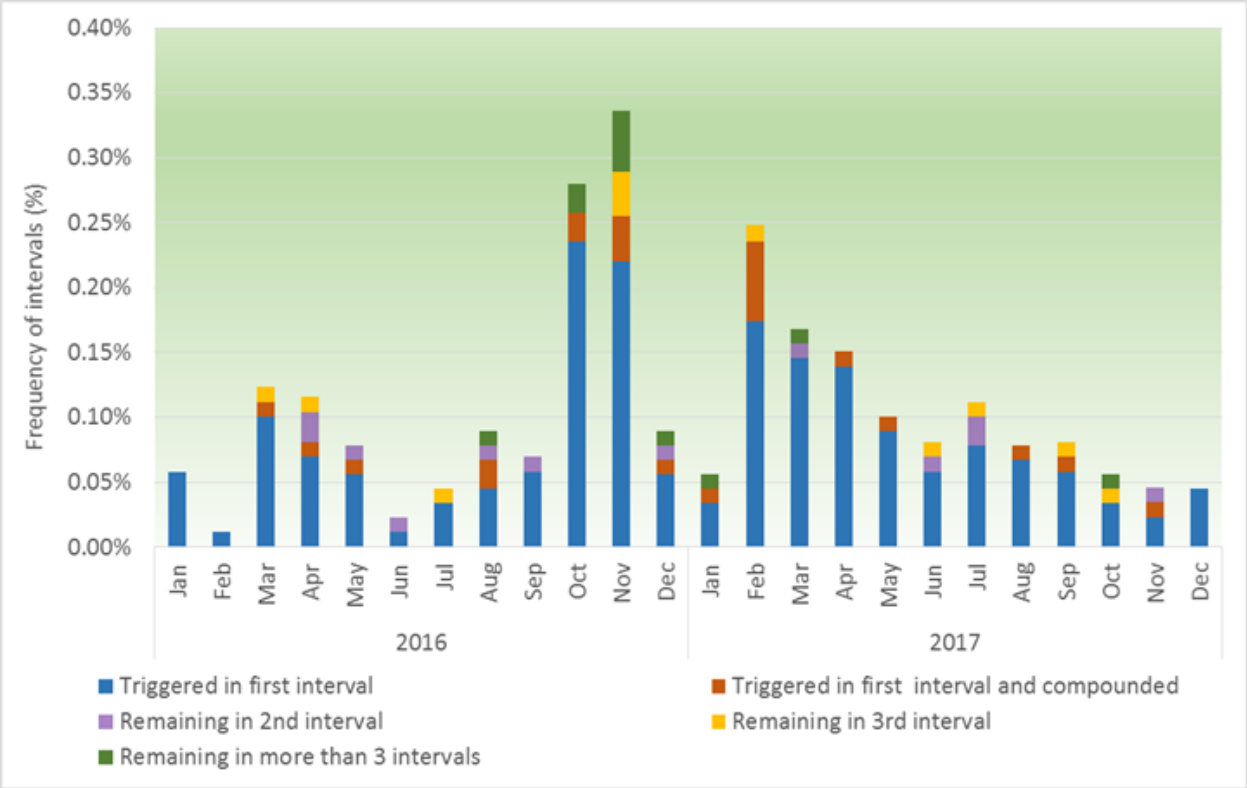


Figure 5 displays the RTD intervals in which the limiter is triggered for 2016 and 2017 in the CAISO. The colored bars represent the interval when the limiter was triggered.

- **Blue** – A conformance change from one interval to the next causes a market infeasible solution and therefore results in the limiter triggering.

- **Red** – A conformance change from one interval to the next causes a market infeasible solution and therefore results in the limiter triggering (the Blue group) **and** a new conformance delta still results in a market infeasible solution and the triggering of the limiter. The limiter triggering is a compounded /carry-over effect.

- **Purple** – A conformance change from one interval to the next causes a market infeasible solution and therefore results in the limiter triggering **and** the conformance requirement is so large that the infeasibility consecutively remains for a second interval. The limiter triggers for two intervals even though the conformance requirement was input in the first interval.

- **Yellow** – A conformance change from one interval to the next causes a market infeasible solution and therefore results in the limiter triggering **and** the conformance requirement is so large that the infeasibility consecutively remains for a second and third interval. The limiter triggers for three intervals even though the conformance requirement was input in the first interval.

- **Green** – A conformance change from one interval to the next causes a market infeasible solution and therefore results in the limiter triggering **and** the conformance requirement is so large that the infeasibility consecutively remains for four or more intervals. The limiter triggers for four or more intervals even though the conformance requirement was input in the first interval.

Figure 5 shows that the limiter is often triggered when the conformance is first entered in the market. When the conformance is large enough, the limiter will continue to trigger. In reality, the limiter should only trigger for the first interval in which the conformance requirement is “coarse” as described in Figure 4. The memory component of the enhanced limiter will prevent the limiter from continuing to trigger for subsequent intervals when the reason for the limiter triggering is due to the conformance change in the first interval.

4.5. Revised Proposal

The enhancements put forth in this proposal ensure the limiter triggers accurately. The enhancements are an improvement from the current limiter. Having the limiter in action, and ensuring it triggers correctly, is a necessity while the ISO works to improve the conforming process. When the tools and process of conforming are improved to a point that coarse over-estimations no longer occur, the limiter becomes superfluous. At that time, the limiter can be removed from the real-time market.

As stated by the Department of Market Monitoring, "It is reasonable to have a mechanism in place to limit unintended market impacts due to changes in imbalance conformance." Until the ISO can minimize the frequency of large coarse conformance adjustments, the limiter is needed. The ISO will use the next two years to make necessary changes and proposes to remove the limiter form production after the changes have been successfully implemented.

As recognized by stakeholders, the ISO will include the limiter in the tariff.

The ISO also recognizes a minority of stakeholders oppose the limiter all together. The importance of accurate penalty pricing based on scarcity conditions, as mandated by FERC in Order #825, is recognized. However, immediate removal of the limiter would likely have unintended negative consequences for the ISO and EIM Entities.

The ISO believes it is in the best interest of all parties to keep the limiter, with proposed enhancements, while the addressing the root cause of the coarse adjustments. Once the improvements have been implemented and the coarseness with which the operators are conforming have been diminished, the limiter is no longer necessary. At the time, the data analysis used for this paper will be completed again to ensure removal of the limiter will not have any adverse impacts to the market or market pricing. At that time, the limiter will be removed from the real-time market. The ISO targets a sunset date for the limiter in the Fall of 2020. Analysis will be completed prior to the removal of the limiter to ensure to adverse impacts to market pricing.

As discussed in the Issue Paper/Straw proposal, the enhanced limiter logic is as follows:

- Will be based on the conformance and infeasibility changes between intervals,
- Will not be limited to information from the current interval,
- Will not be subject to the infeasibility and the conformance being in the same direction, and
- Will consider the conformance magnitudes in previous intervals and whether the limiter was applied in the corresponding intervals.

The limiter will solve for C_i. The limiter will trigger for **under supply**, as indicated by a positive infeasibility, when the value of C_i is less than 0:

$$C_i = \left(PBC\_inf_i - PBC\_inf_{i-1}\right) - \left(Conf_i - Conf_{i-1}\right) + \max(0, C_{i-1}) \quad (1)$$

If $C_i < 0$, limiter is triggered.

If $C_i > 0$, limiter is not triggered.

The limiter will solve for C_i. The limiter will trigger for **over supply**, as indicated by a negative infeasibility, when the value of C_i is greater than 0:

$$C_i = \left(PBC\_inf_i - PBC\_inf_{i-1}\right) - \left(Conf_i - Conf_{i-1}\right) + \min(0, C_{i-1}) \quad (2)$$

If $C_i > 0$, limiter is triggered.

If $C_i < 0$, limiter is not triggered.

Where:

i	is the index for current interval
$(i-1)$	is the previous interval
C_i	is the remaining available capability to absorb power balance constraint infeasibilities in the current interval
$(PBC\_inf_i - PBC\_inf_{i-1})$	is the change of power balance constraint infeasibility between current and previous intervals
$(Conf_i - Conf_{i-1})$	is the change of load conformance between current and previous intervals
$\max(0, C_{i-1})$	is the carry-over capability from previous interval.

If in any interval the power balance constraint infeasibility results in a value of 0, C_i is reset to 0.

Examples of the current and proposed logic can be found in the Issue Paper/Straw Proposal and the presentation discussed during the December 8 stakeholder call.[10]

[10] Examples are explained in sections 3.3 and 3.4 of the Issue Paper/Straw Proposal and slides 22-28 of the stakeholder presentation:
http://www.caiso.com/Documents/IssuePaper-StrawProposal-ImbalanceConformanceEnhancements.pdf
http://www.caiso.com/Documents/Agenda-Presentation-ImbalanceConformanceEnhancements-Dec8_2017.pdf

5. Stakeholder Engagement and EIM Governing Body Role

Stakeholder input is critical for developing market design policy. The schedule proposed below allows opportunity to for stakeholder involvement and feedback. This initiative will require briefing to EIM Governing Body to support its advisory role and approval from the ISO Board of Governors.

5.1. Schedule

Table 1 lists the schedule for the Imbalance Conformance Enhancements stakeholder process.

Table 1: Schedule for Imbalance Conformance Enhancements Stakeholder Process

Item	Date
Post Issue Paper/Straw Proposal	*November 29, 2017*
Stakeholder Conference Call	*December 8, 2017*
Stakeholder Comments Due	*December 20, 2017*
Post Draft Final Proposal	January 30, 2018
Stakeholder Conference Call	February 6, 2018
Stakeholder Comments Due	February 20, 2018
Revised Draft Final Proposal	March 14, 2018
Stakeholder Comments Due	March 21, 2018
EIM Governing Body Meeting	April 24, 2018
ISO Board of Governors Meeting	May 16, 2018

The ISO will present its proposal to the respective EIM Governing Body and ISO Board of Governors when the stakeholder process has been completed. The EIM Governing Body Meeting and ISO Board of Governors proposed meeting dates are May 2, 2018 and May 16, 2018 respectively.

The ISO is committed to providing ample opportunity for stakeholder input into its market design, policy development, and implementation activities. The ISO requests stakeholders to submit written comments to InitiativeComments@caiso.com.

5.2. EIM Governing Body Role

This revised draft final proposal includes a change to the governance decisional approval necessary to authorize the CAISO to complete the tariff amendment in support of these policy changes with FERC. In the draft final proposal (published January 30, 2018), the CAISO stated the entire initiative would involve the EIM Governing Body's advisory role. Since then, and after receiving stakeholder comments, the CAISO has recognized that it will likely include in the amendments a new EIM-specific rule about conformance by the operators for EIM Entities.

In light of this change, the CAISO plans to divide the initiative into two parts for decisional purposes. It would seek approval under the EIM Governing Body's primary authority for the element of this initiative that proposes to clarify EIM operators' authority to conform for imbalance. The remainder of the initiative will continue to involve the EIM Governing Body's advisory role to the Board of Governors.

The CAISO is proposing to separate these two components for decisional purposes because, even if the EIM-specific rule were not approved by the EIM Governing Body at this time, Management would plan to file the remainder of the proposal with the Board of Governors for approval because it is a distinct clarification for the CAISO. This approach is consistent with the *Guidance for Handling Policy Initiatives within the Decisional Authority or Advisory Role of the EIM Governing Body*.[11] Section II.B addresses initiatives with severable components that CAISO management would plan to file for approval whether or not the EIM Governing Body has approved their respective components. In such a case, it states that "…any severable EIM-specific element should be separated after the conclusion of stakeholder review and directed to the EIM Governing Body for decision. The severable EIMs specific element (alone) should be directed to the EIM Governing Body as part of its primary authority. The remainder of the initiative should be classified according to the applicable rules."

Stakeholders are encouraged to submit an updated response to the EIM categorization in their written comments, particularly if they have concerns or questions.

6. Next Steps

The ISO will discuss the Draft Final Proposal during the stakeholder conference call on February 6, 2018. The ISO requests stakeholders submit written comments in response to the Imbalance Conformance Enhancements Draft Final Proposal paper and conference call by February 20, 2018.

The Imbalance Conformance Enhancements proposal will be presented to the EIM Governing Body under their advisory role on April 24, 2018. The initiative will then be presented to the ISO Board of

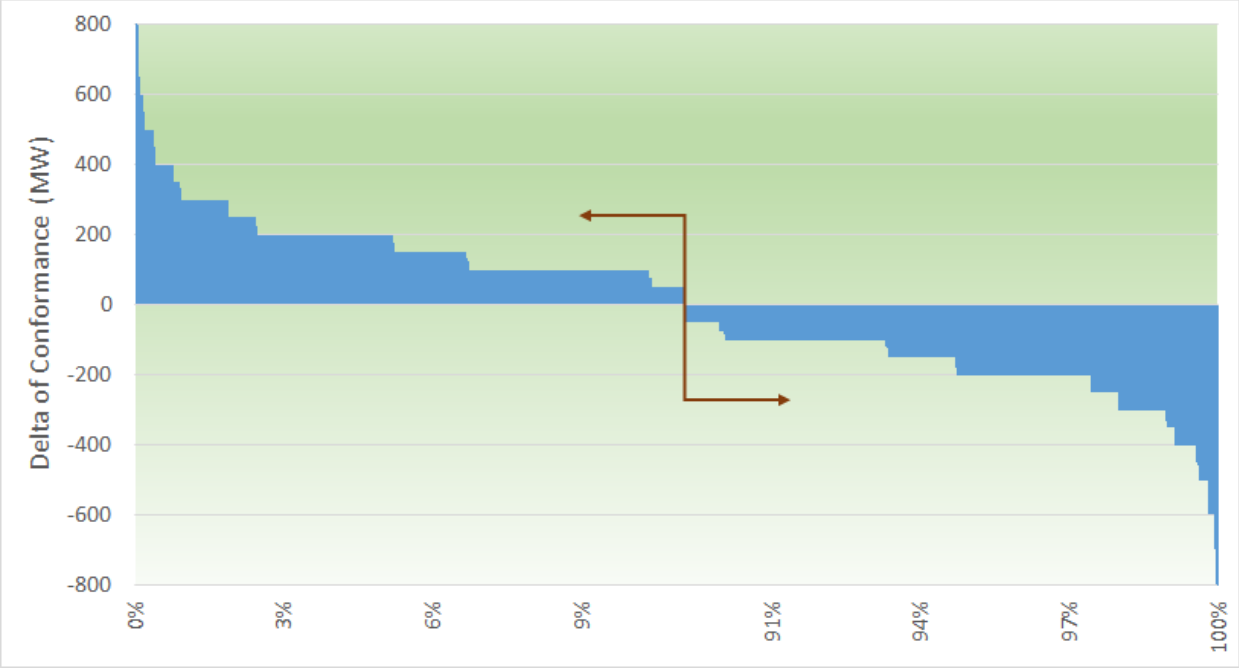
[11] Additional information related to the EIM classification for initiatives and the EIM Governing Body's advisory role can be referenced in the Guidance for Handing Policy Initiatives document at: https://www.westerneim.com/Documents/GuidanceforHandlingPolicyInitiatives-EIMGoverningBody.pdf

Governors for their approval on May 16, 2018. With support and approval of the Governing Body and Board of Governors, tariff changes will be drafted and submitted to FERC.

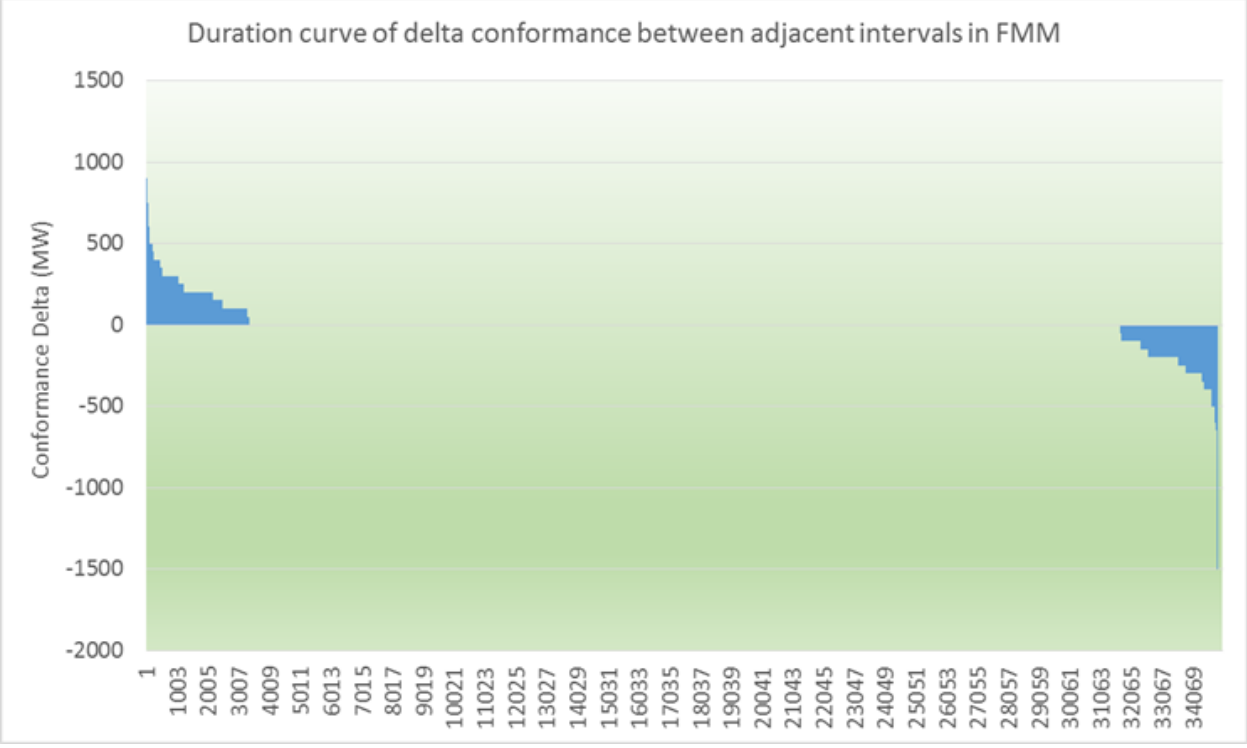
The ISO targets an implementation date for the limiter enhancements in the Fall of 2018. Improvements to the conformance process including tool enhancements and automation will begin immediately and continue through the Fall of 2019. Successful improvements to the conformance process will eliminate the need for the limiter at which time it will be removed from production. The ISO plans to sunset the limiter by the Fall of 2020.

7. Appendix A: Conformance Deltas

CAISO RTD conformances changes ("deltas") between intervals for 2017. Intervals with no conformance change have been removed, as indicated by the red arrows. X-axis indicates percentage of total RTD intervals with a conformance input.

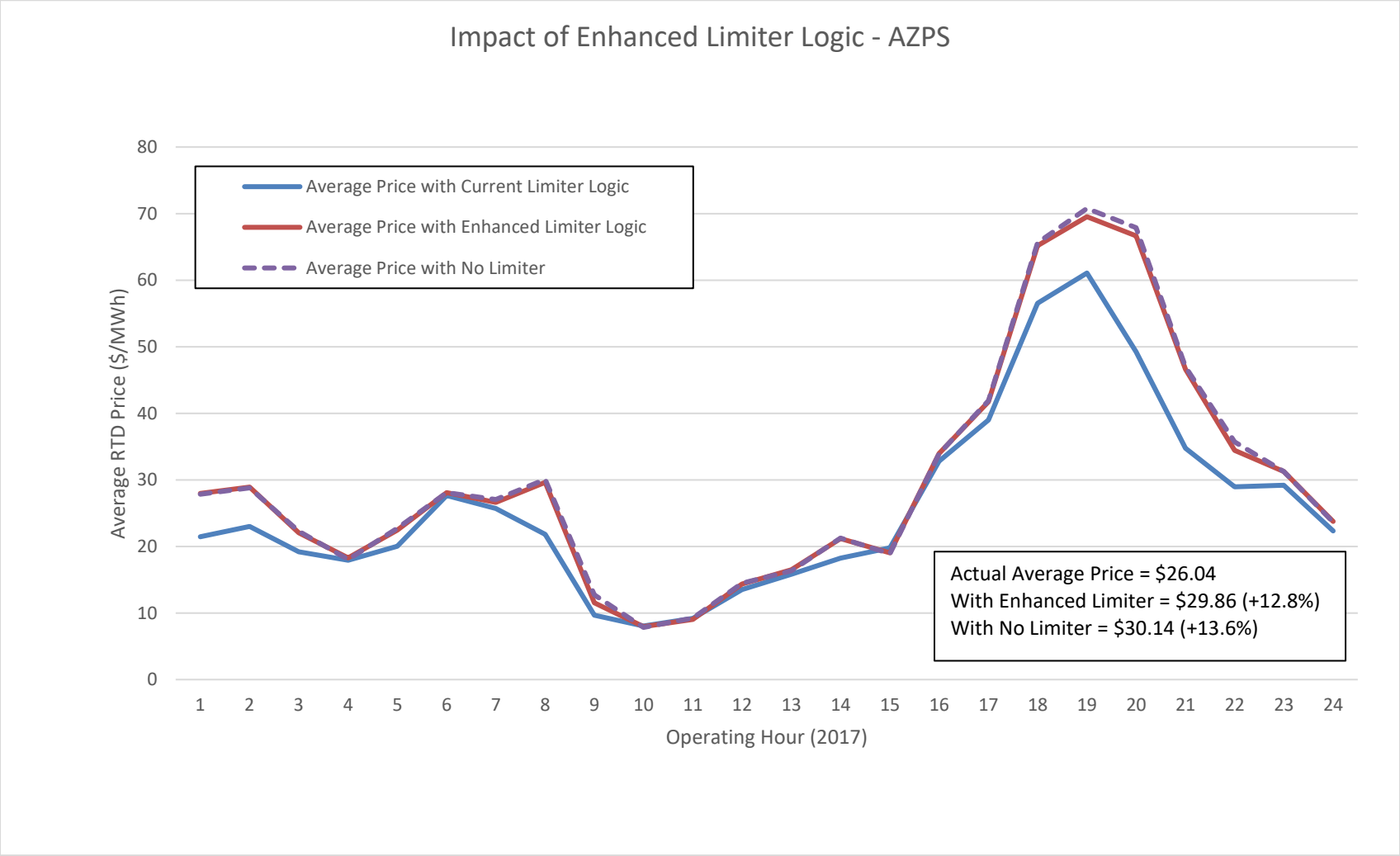


CAISO RTD conformances changes ("deltas") between intervals for 2017. Intervals with no conformance change are included. X-axis indicates the total number of RTD intervals in 2017 with a conformance input.

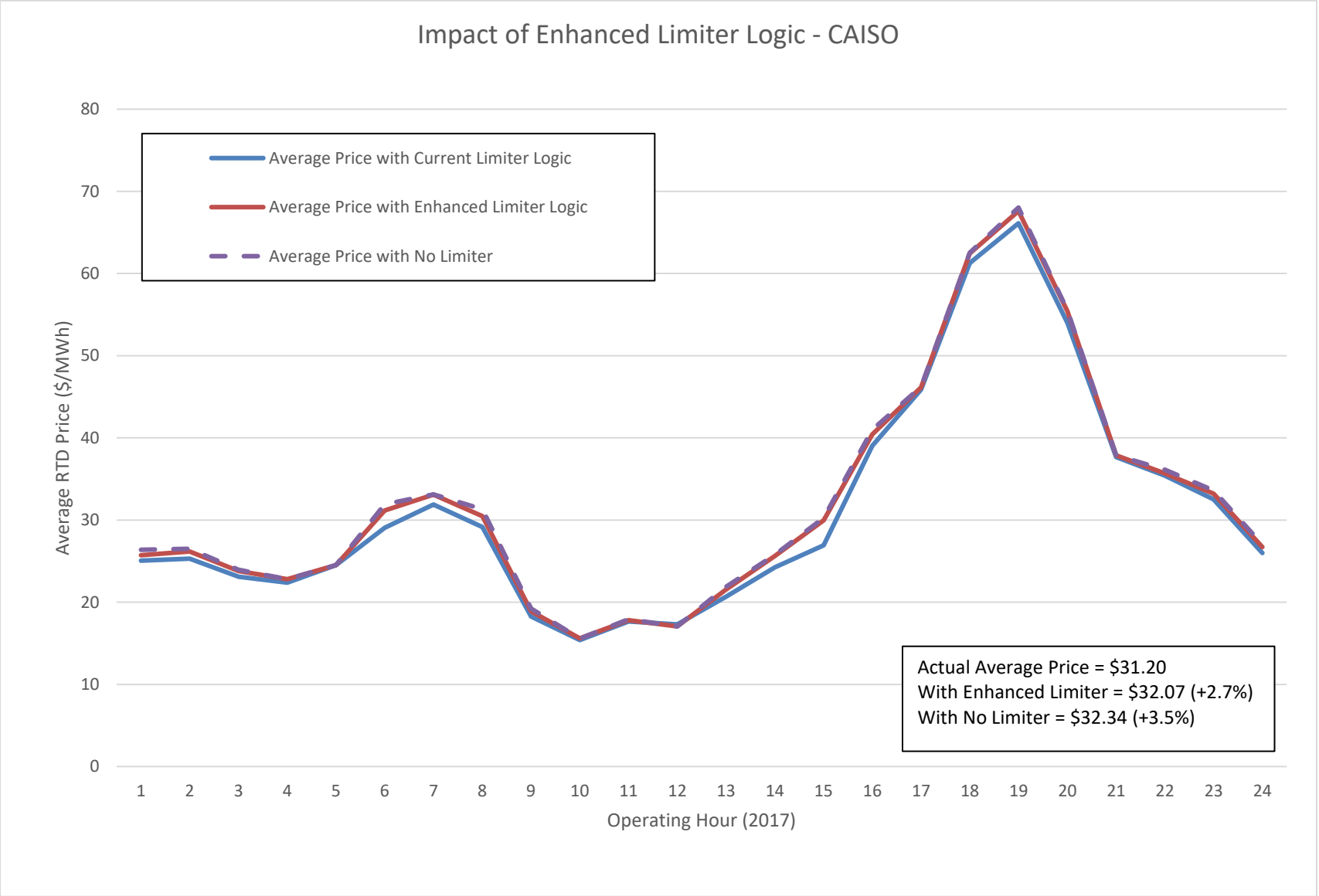


8. Appendix B: Pricing Impacts of Enhanced Conformance Limiter

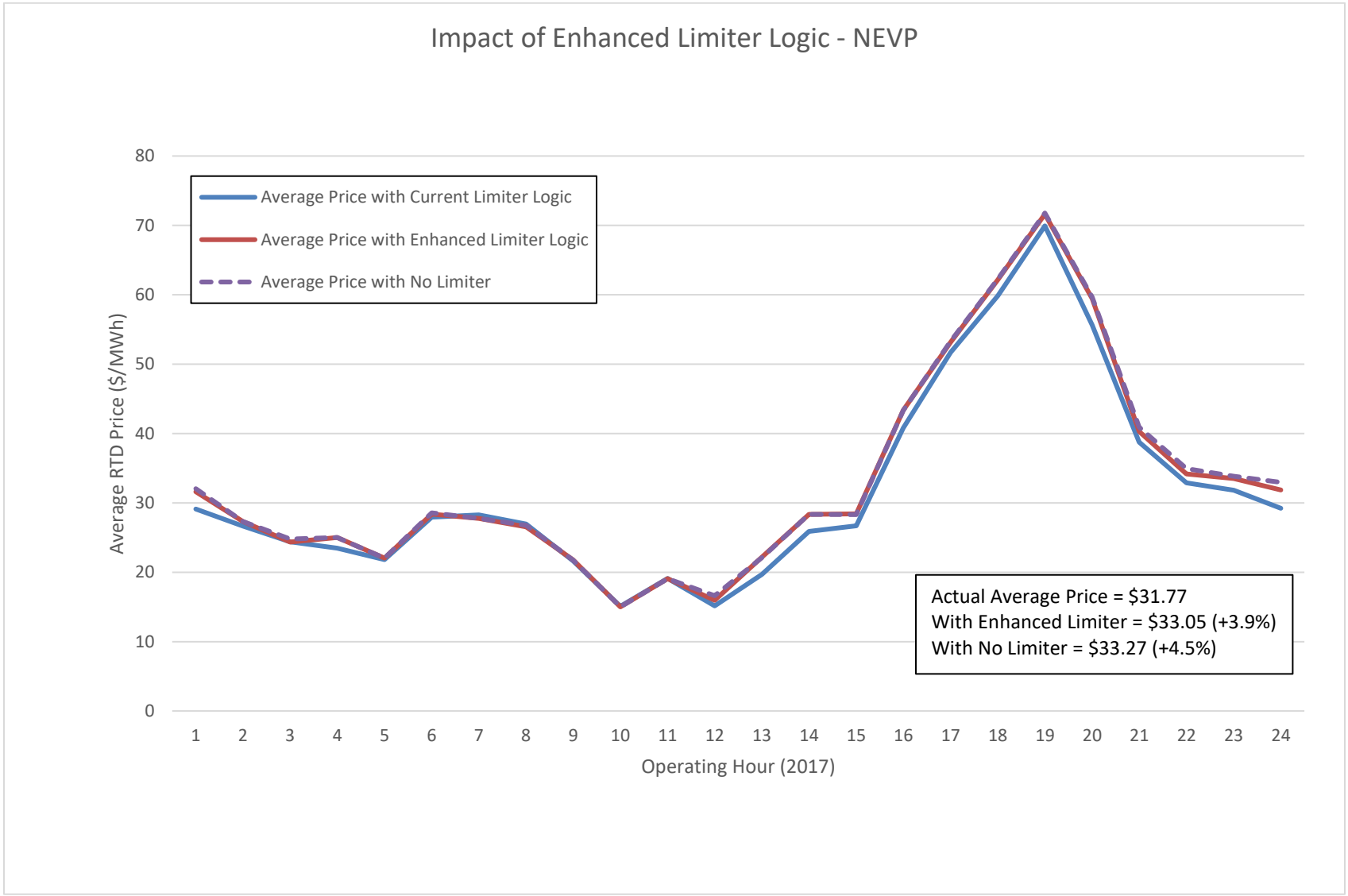
8.1. Impact of Enhanced Limiter Logic: AZPS, 2017



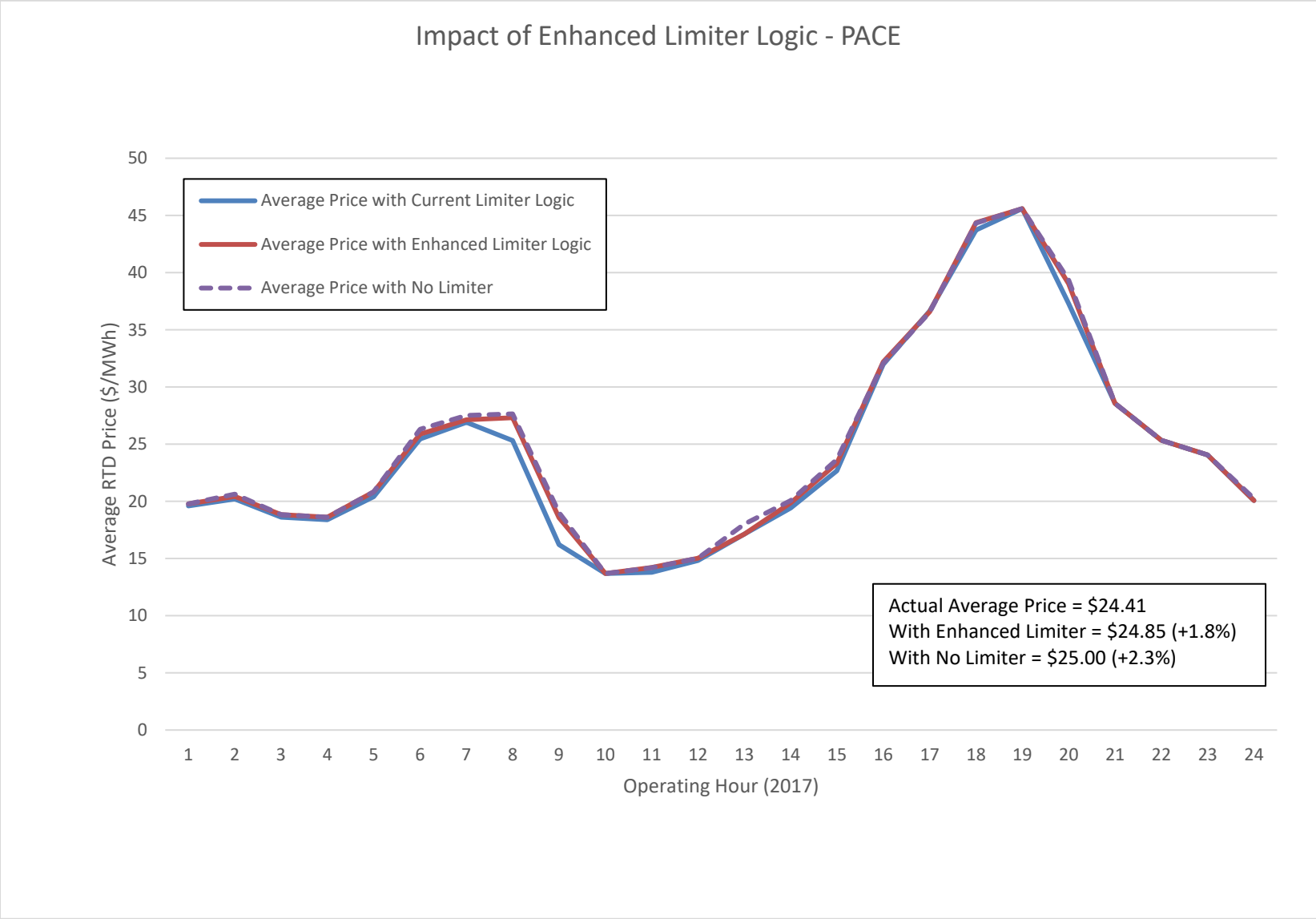
8.2. Impact of Enhanced Limiter Logic: CAISO, 2017



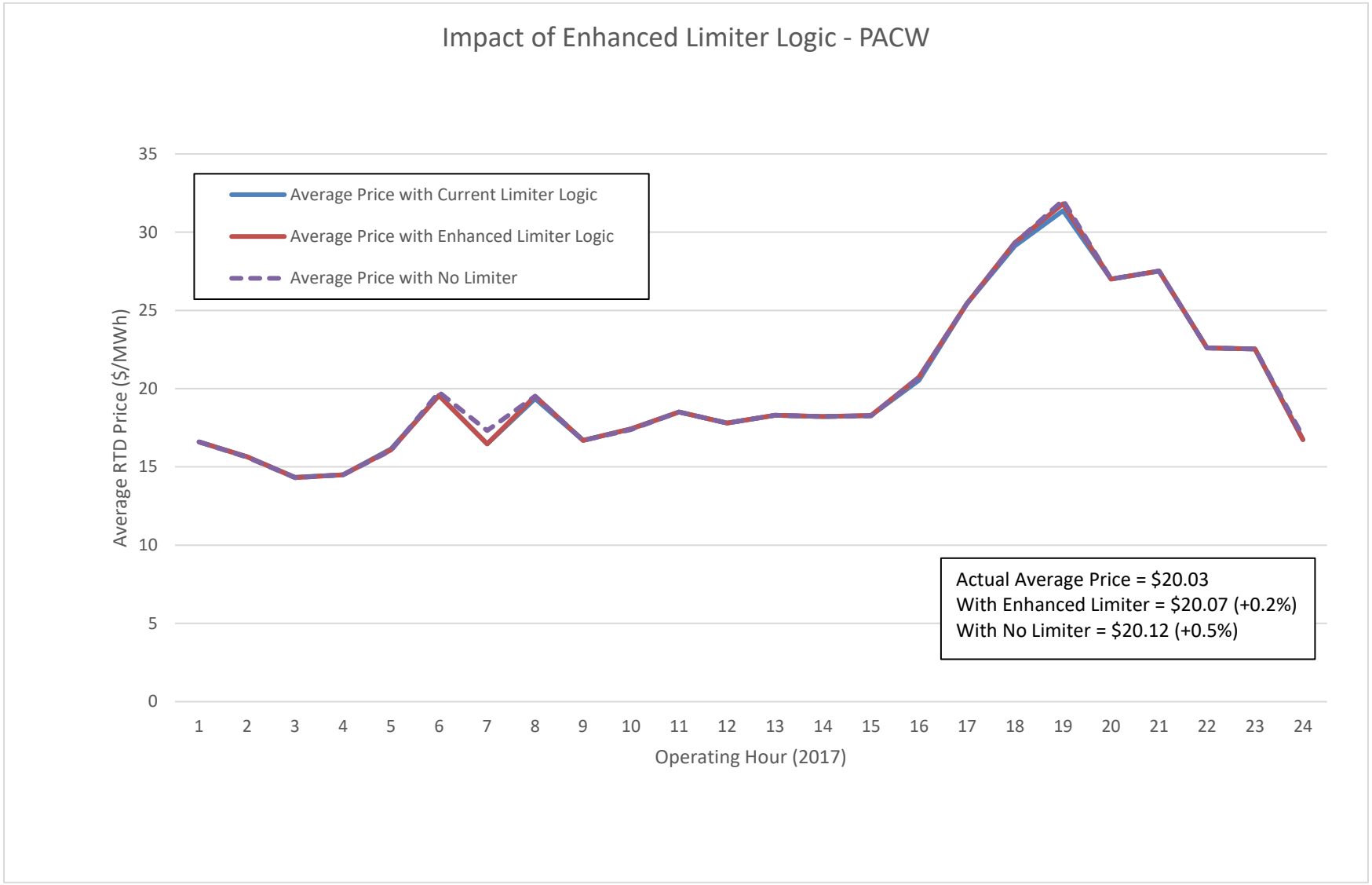
8.3. Impact of Enhanced Limiter Logic: NEVP, 2017



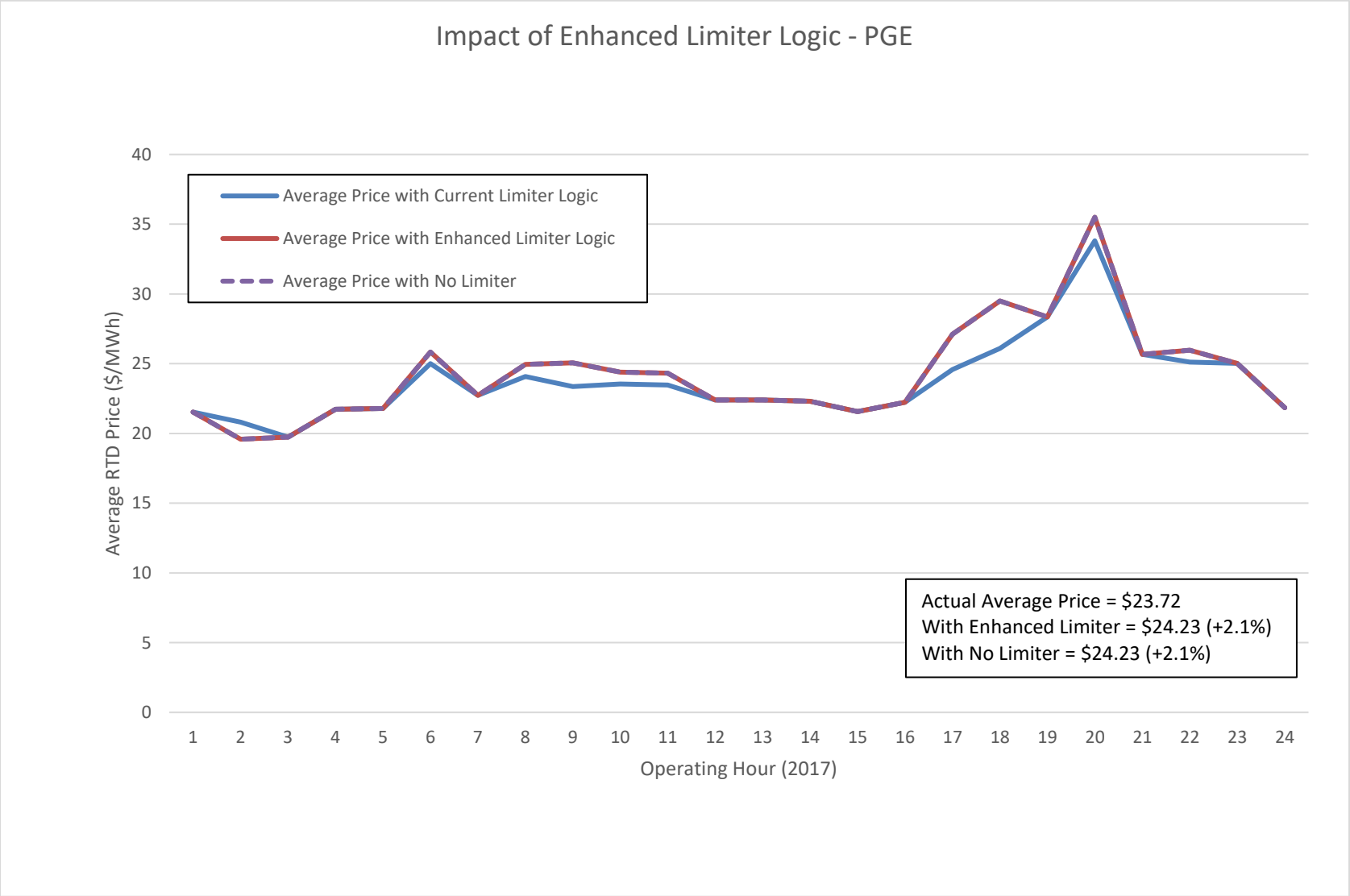
8.4. Impact of Enhanced Limiter Logic: PACE, 2017



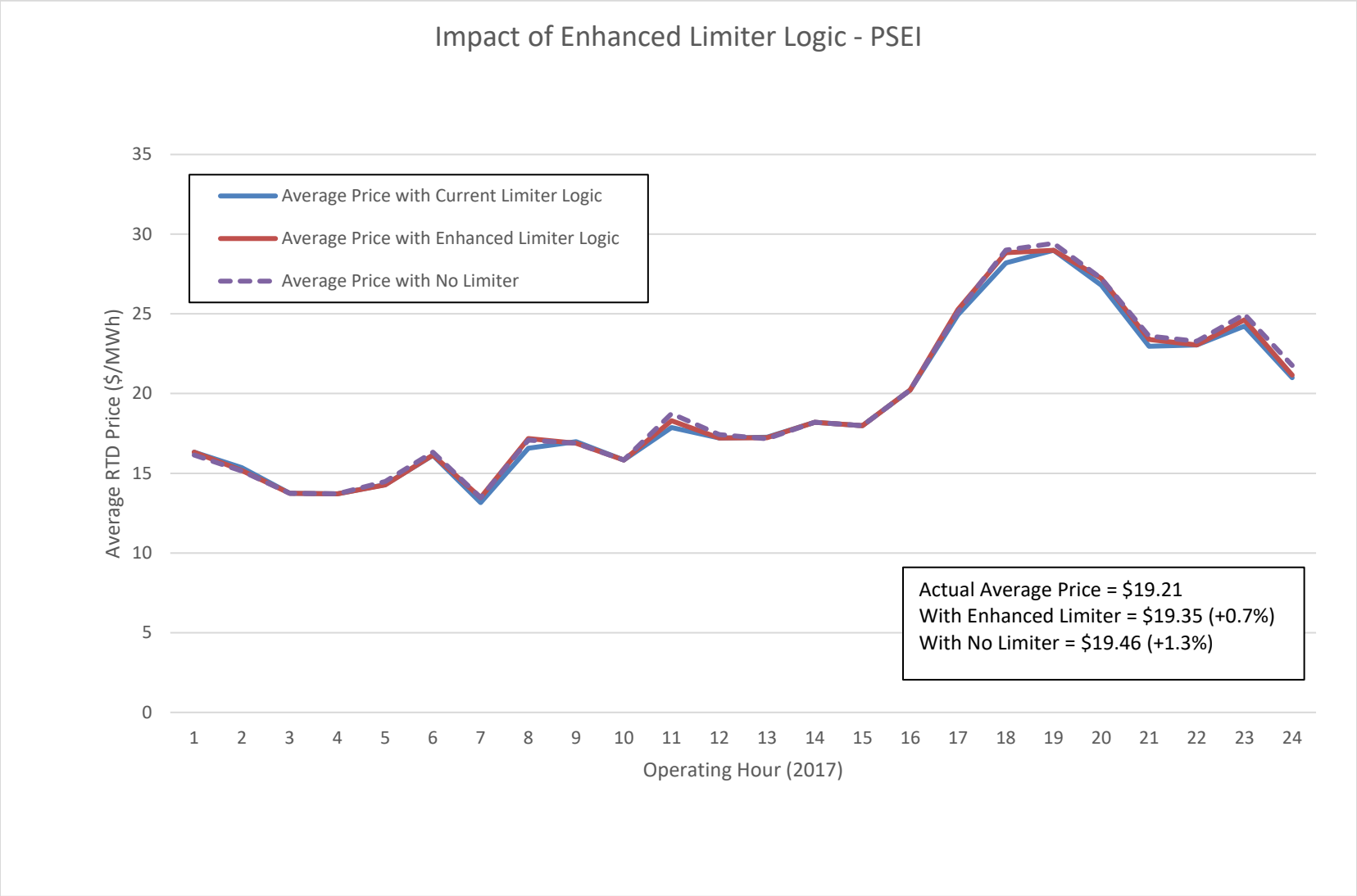
8.5. Impact of Enhanced Limiter Logic: PACW, 2017



8.6. Impact of Enhanced Limiter Logic: PGE, 2017



8.7. Impact of Enhanced Limiter Logic: PSEI, 2017



Attachment E – Board Memorandum

Detail Enhancement on Load Forecast Conformance

California Independent System Operator Corporation

Memorandum

To: ISO Board of Governors

From: Keith Casey, Vice President, Market & Infrastructure Development

Date: May 9, 2018

Re: **Decision on imbalance conformance enhancements proposal**

This memorandum requires Board action.

EXECUTIVE SUMMARY

When ISO and EIM balancing area operators observe that the load forecast input into the market is not consistent with actual system conditions, they manually adjust the load forecast input into the market to align with system conditions. The ISO refers to these load forecast adjustments as "imbalance conformance." Operators also use imbalance conformance for other reasons, such as supply deviations.

Because operator imbalance conformances are relatively imprecise, the ISO market includes an imbalance conformance limiter that limits the adjustments to what is actually available for dispatch in the real-time market. Doing so avoids having imbalance conformances that cause energy balance constraint violations that would trigger inappropriately extreme scarcity prices. Management proposes various enhancements to the imbalance conformance limiter to help ensure the market sets appropriate prices when balancing area operators make conformance adjustments.

In the interest of transparency, Management also proposes to revise the tariff to clarify ISO and EIM balancing area operators' ability to make imbalance conformance adjustments. Similarly, Management proposes to make the rules for using the imbalance conformance limiter explicit in the tariff.

The tariff revisions clarifying EIM balancing area operators' ability to make imbalance conformances, which fall within the primary approval authority of the EIM Governing Body, were approved by the Governing Body on April 24, 2018, and are on the Board's consent agenda. Management also presented the remainder of this proposal to the EIM Governing Body, which is provided as advisory input to the Board regarding this proposal as Attachment A.

Management proposes the following motion:

Moved, that the ISO Board of Governors approves the proposal to implement the imbalance conformance enhancements and the tariff clarifications authorizing imbalance conformance by ISO balancing area operators described in the memorandum dated May 9, 2018; and

Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposal described in this memorandum, including any filings that implement the overarching initiative policy but contain discrete revisions to incorporate Commission guidance in any initial ruling on the proposed tariff amendment.

DISCUSSION AND ANALYSIS

The following describes Management's proposal to enhance the imbalance conformance limiter and to clarify ISO and EIM balancing area operators' ability to make imbalance conformances.

Imbalance Conformance

The ISO real-time market dispatches supply to be in balance with the load forecast input into the market. Currently, ISO and EIM balancing area operators manually adjust the calculated load forecast when they observe it does not reflect actual system conditions. These manual adjustments are termed "imbalance conformance." Besides accounting for load forecast error, balancing area operators may also adjust the load forecast to account for factors such as generator deviations from dispatch, anticipated variable energy resource output changes, intertie schedule deviations, or supply outages. Imbalance conformance adjustments enable operators to dispatch a supply quantity that matches actual system needs.[1]

Imbalance Conformance Limiter Enhancements

The imbalance conformance limiter is a feature in the ISO market software designed to prevent unwarranted prices caused by imbalance conformance adjustments. The limiter helps ensure that operator conformance adjustments, which are typically coarse, conservative estimates, do not result in the market attempting to dispatch more supply than is available in a particular dispatch interval. The operators insert coarse adjustments because it is not practical for an operator to determine the ramping capacity available in each dispatch interval and make smaller adjustments in each market run, similar to what the market would do. Instead, the operator will make one large adjustment coinciding with one market run.

When there is insufficient upward ramping capability available to meet the forecast load for a particular interval, the market sets energy prices at a $1,000/MWh pricing

[1] The ISO also performs imbalance conformances in the day-ahead market's residual unit commitment process to more accurately reflect forecast system needs.

parameter, equal to the energy bid cap. Similarly, when there is insufficient downward ramping capability available to meet the forecast load, the market sets energy prices at a
-$150/MWh pricing parameter, equal to the energy bid floor. The imbalance conformance limiter works by limiting operator load forecast adjustments in the market's pricing run to the amount of available energy bids. This avoids triggering administratively set prices at the $1,000/MWh or -$150/MWh pricing parameters.

Management proposes to enhance the logic used to trigger the imbalance conformance limiter. The existing logic considers the current market interval in isolation and triggers the limiter whenever the imbalance conformance adjustment is greater than the amount of ramping capacity available through energy bids. This is inappropriate at times because it can trigger the limiter and limit prices when there is supply scarcity, or alternatively, over-supply, that persists for a number of intervals. This approach fails to reflect that the ISO's intent for the limiter is to avoid artificial scarcity pricing triggered by the coarseness of operator imbalance conformance adjustments.

Management's proposed enhancements to the limiter logic focus on addressing the coarseness of operator imbalance conformance adjustments. Under the proposed enhancements, the limiter will consider changes between intervals rather than only considering the current interval. The limiter will analyze the change in the imbalance conformance amount between multiple market intervals to determine when the imbalance conformance exceeds the available bid-in capacity. These enhancements increase the accuracy of the limiter and will decrease the frequency with which the limiter triggers.

Tariff Clarifications Authorizing Imbalance Conformance

Management proposes to make tariff revisions to clarify ISO and EIM balancing area operators' ability to make imbalance conformance adjustments. The tariff currently gives the ISO discretion to create a load forecast it deems appropriate to maintain grid reliability. However, Management believes the tariff language can be clarified to provide additional transparency. The tariff changes will specify the reasons for imbalance conformance adjustments, and explicitly authorize conformance by the balancing area operator.

Similarly, Management proposes to make the imbalance conformance limiter rules explicit in the tariff.

POSITIONS OF THE PARTIES

Most stakeholders generally support the imbalance conformance limiter enhancements described above, agreeing the enhancements will more appropriately trigger the limiter. However, Southern California Edison and Powerex object to the proposed enhancements.

Southern California Edison believes the proposed limiter logic enhancements should be implemented in addition to old limiter logic, stating the limiter is necessary for price stability in the real-time market. Management believes the revised logic more appropriately addresses the coarse adjustments provided by operators. The previous logic would continue to suppress prices during imbalance conformances that do not change, but last over many intervals. In this case, sustained supply dispatch, for which economic bids are not available, likely reflects actual scarcity, making scarcity prices the correct economic signal.

Powerex maintains that the proposed imbalance conformance limiter logic enhancements may inappropriately suppress scarcity pricing when the coarseness of an operator adjustment is not a factor. They point out that not all imbalance conformance adjustments are coarse adjustments, and the limiter may limit prices when there is true energy scarcity. Powerex states the limiter should be removed from the real-time market immediately.

Management acknowledges that the limiter may occasionally suppress prices when there is actual scarcity, but believes the majority of time the limiter will work to limit artificial scarcity prices caused by operators' coarse adjustments. However, because it is important to not suppress legitimate price signals, Management has committed to removing the imbalance conformance limiter in two years after developing improved operational tools that will avoid the need for operators to make coarse adjustments.

All stakeholders support the proposed tariff clarifications as valuable measures to increase transparency.

Attachment B presents a summary of stakeholder comments.

CONCLUSION

Management requests the Board of Governors approve this proposal. The proposal clarifies the ISO's authority to make imbalance conformance adjustments and provides enhancements to the imbalance conformance limiter. The enhancements to the limiter will help to align market prices with actual system conditions.

Attachment F – Summary of Submitted Stakeholder Comments

Detail Enhancement on Load Forecast Conformance

California Independent System Operator Corporation

Attachment B

Stakeholder Process: Imbalance Conformance Enhancements

Summary of Submitted Comments

Stakeholders submitted three rounds of written comments to the ISO on the following dates:

- Round One: Issue Paper/Straw Proposal comments received 12/20/17
- Round Two: Draft Final Proposal comments received 2/20/18
- Round Three: Revised Draft Final Proposal comments received 3/21/18

Parties that submitted written comments: APS (Arizona Public Service), DMM (Department of Market Monitoring), NRG (NRG Energy Inc.), NVE (NV Energy), PacifiCorp, PG&E (Pacific Gas & Electric), PGP (Public Generating Pool), PGE (Portland General Electric), Powerex, SCE (Southern California Edison), SCL (Seattle City Light), Six Cities, WPTF (Western Power Trading Forum)

Stakeholder comments are posted at:
http://www.caiso.com/informed/Pages/StakeholderProcesses/ImbalanceConformanceEnhancements.aspx

Other stakeholder efforts include:

- Issue Paper/Straw Proposal conference call, 12/8/17
- Draft Final Proposal conference call, 2/6/18
- Outreach calls with individual entities

Management proposal	Generally or Conditionally Supports	Does not Support	Management response
Tariff change to explicitly authorize imbalance conformance by the ISO.	All entities support the proposed tariff clarifications.	N/A	Currently, the tariff allows the ISO to set the ISO Forecast of ISO Demand (CFCD) as deemed appropriate and necessary to meet anticipated system conditions to maintain reliable operation of the bulk electric grid. The process of imbalance conforming is completed by changing the CFCD. Therefore, the ISO implicitly has the authority to conform for imbalance. However, Management proposes to clarify the tariff to make this authority more explicit. All entities support this clarification as it provides additional clarity and transparency.
Tariff change to explicitly authorize imbalance conformance by the EIM balancing authority areas.	All entities support the proposed tariff clarifications.	N/A	In addition to clarifying authority of the ISO to conform, Management proposes to clarify the authority of EIM balancing authority areas to conform for imbalance. These tariff changes provide additional clarity and transparency.
Implement conformance limiter enhancements and clarify tariff language regarding use of the limiter.	APS, DMM, NRG, NVE, PacifiCorp, PG&E, PGP, PG&E, PGE, SCL, Six Cities, WPTF support.	SCE – opposes the proposed limiter enhancements because they will reduce the frequency with which the limiter triggers. SCE believes the limiter is necessary to maintain price stability in the ISO markets. SCE proposes to use a combination of the current functionality *and* the proposed functionality. This would increase the frequency with which the triggers. Powerex – opposes the limiter enhancements and believes the limiter should be eliminated immediately because it may suppress legitimate scarcity prices.	The proposed limiter enhancements enable the limiter to trigger more accurately based on conformance changes between market intervals. SCE's approach will result in the limiter triggering more frequently. SCE believes this will create price stability by avoiding penalty prices. Management believes the intent of the limiter is not to avoid penalty prices, but to avoid price spikes when they are artificially induced by the operator. Management believes the limiter is appropriate under existing market and operational conditions because triggering artificial price spikes through coarse operator imbalance conformances would likely occur more frequently than true scarcity conditions. However, Management agrees with Powerex that energy prices should reflect scarcity prices even when the balancing

Management proposal	Generally or Conditionally Supports	Does not Support	Management response
			area operator has made a load conformance. To address this, Management has committed to remove the limiter in two years. Improvements to operator tools over the next two years will minimize the coarse conformances and ensure conformance requirements are more accurate.

Attachment G – Department of Market Monitoring Comments to the

Board of Governors

Detail Enhancement on Load Forecast Conformance

California Independent System Operator Corporation

Memorandum

To: ISO Board of Governors

From: Eric Hildebrandt, Executive Director, Market Monitoring

Date: May 9, 2018

Re: **Department of Market Monitoring Comments on Imbalance Conformance Enhancements Proposal**

This memorandum does not require Board action.

EXECUTIVE SUMMARY

The Department of Market Monitoring (DMM) supports Management's proposed enhancements to the imbalance conformance limiter as an improvement over the current approach. The proposed enhancement refines the conditions under which the price during relaxation of the power balance constraint is set at either the penalty price or the price of the last dispatched energy bid.

Analysis by DMM shows that under current market conditions, the imbalance conformance limiter will not have a significant impact on overall average 5-minute prices before or after Management's proposed changes. This is because for most intervals when the conformance limiter is triggered, the highest dispatched bids are currently at or near the $1,000/MWh price cap.

However, imbalance conformance and the limiter could have a much more significant impact upon implementation of changes required for FERC Order No. 831 compliance. Under Order No. 831, the penalty parameter for an under-supply infeasibility will increase to $2,000/MWh and energy offers up to $2,000/MWh from resources with verified cost-based bids, imports and virtual resources may set market energy prices.

DMM has noted that use of the imbalance conformance by ISO grid operators in the hour-ahead and 15-minute markets has increased dramatically in 2017. DMM has also recommended that the ISO make improvements to reduce the need for operators to make manual adjustments to the imbalance demand, particularly in the very predictable ramping pattern in which adjustments have been made in recent years.

This memo also summarizes several of DMM's previous recommendations concerning the use of imbalance conformance, including potential steps to reduce manual adjustments and other steps the ISO could take to mitigate the impact of manual adjustments on market prices.

BACKGROUND

As explained in Management's memo, when ISO and EIM balancing area operators observe that the load forecast input into the market is not consistent with actual system conditions, they manually adjust the load forecast input into the market to align with system conditions. The ISO now refers to these load forecast adjustments as *imbalance conformance*.[1]

Because these manual adjustments are relatively imprecise, the ISO market includes an *imbalance conformance limiter* that limits the magnitude of manual adjustments after-the-fact based on the amount of ramping supply actually available for dispatch in the real-time market. With this feature, when there is a power balance relaxation for insufficient energy and the size of the load adjustment is greater than the power balance relaxation, the imbalance conformance limiter sets the price based on the highest priced bid dispatched, rather than to the $1,000/MWh power balance relaxation penalty parameter.

Management is proposing various enhancements to the imbalance conformance limiter algorithm to help ensure the market sets appropriate prices when balancing area operators make conformance adjustments. The ISO proposal is very consistent with DMM's prior recommendations on this issue. The current methodology only considers the *magnitude* of the load adjustment relative to the amount by which the power balance constraint is relaxed in each interval. Under the revised approach, the focus of the imbalance conformance limiter would be primarily on the *change* in load adjustments from one interval to the next. DMM's on-going monitoring has found this approach is more likely to trigger the limiter when the power balance constraint is relaxed due to excessive manual adjustments rather than by an actual scarcity of ramping capacity.

ANALYSIS

Use of Manual Load Adjustments

A key trend highlighted by DMM in 2017 is the dramatic increase in use of the imbalance conformance by ISO grid operators in the hour-ahead and 15-minute markets. Figure 1 shows the average hourly imbalance conformance profile for the hour-ahead, 15-minute and 5-minute markets for 2017 and 2016.

As shown in Figure 1, while the general shape and direction of load adjustments were similar for hour-ahead and 15-minute adjustments, the magnitude of the load adjustments nearly doubled in 2017 relative to 2016. Meanwhile, the 5-minute market imbalance conformance decreased just as significantly in 2017 relative to 2016.

[1] These adjustments were previously referred to as *load bias* and the imbalance conformance limiter was referred to as the *load bias limiter*.

Figure 1. Average hourly load adjustment (2016 - 2017)

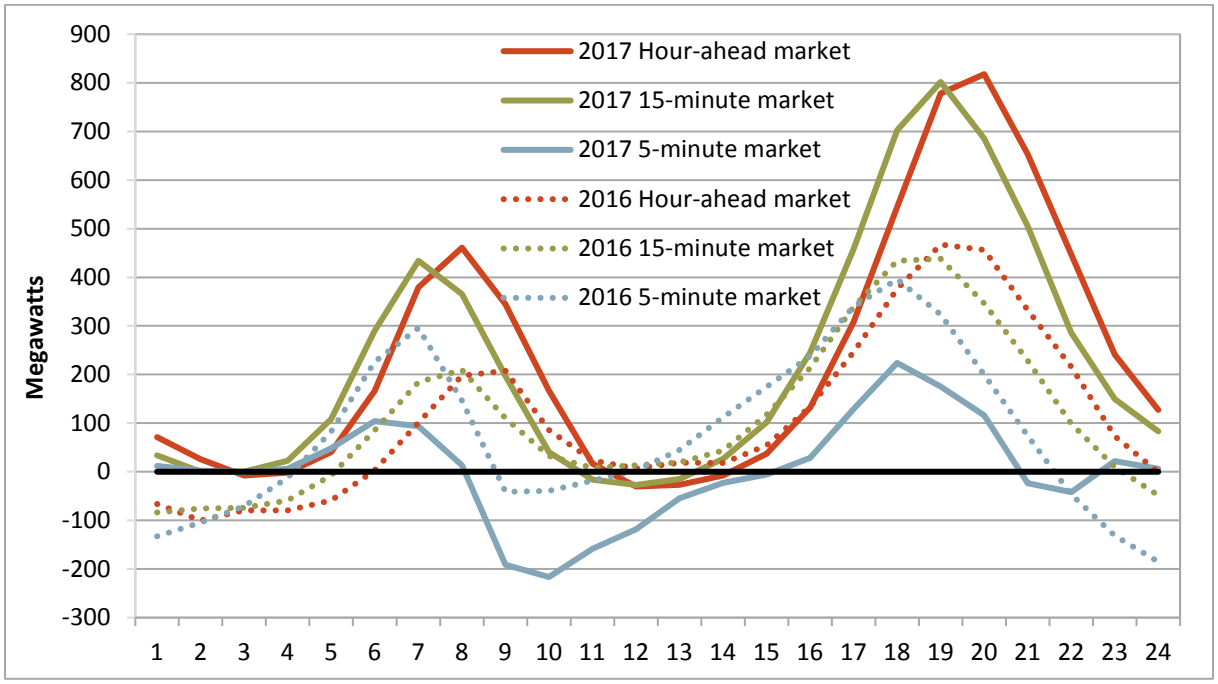
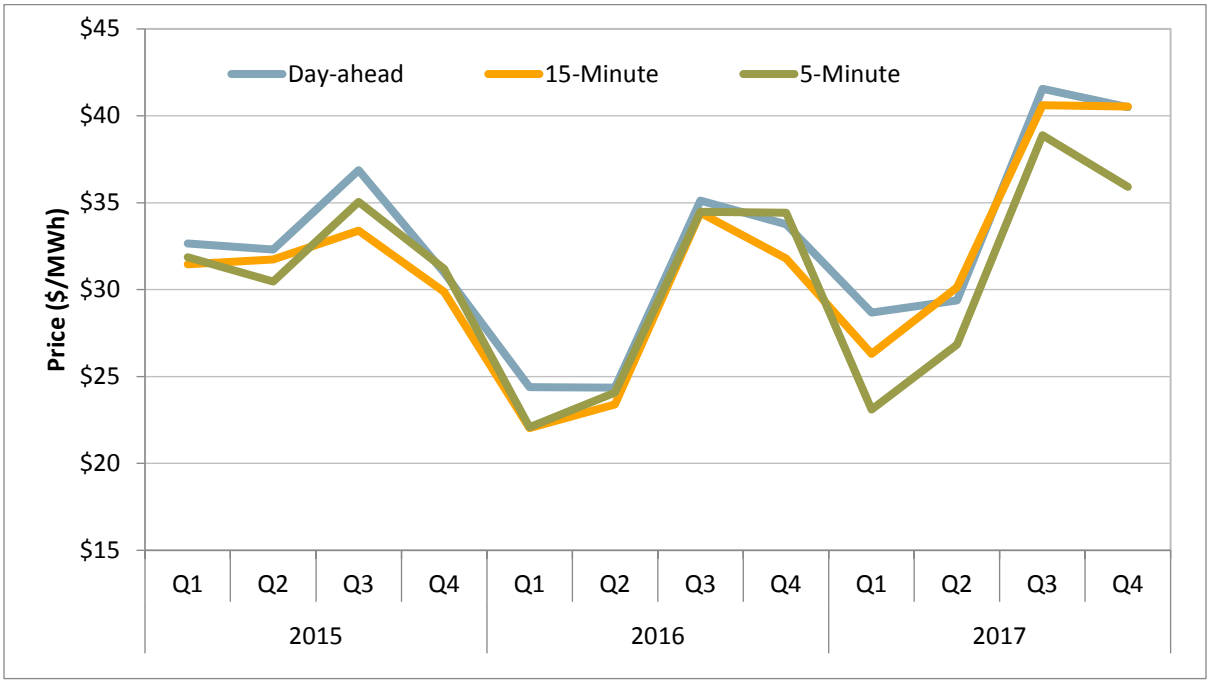


Figure 2. Average quarterly prices (all hours) – system marginal energy price



The increased use of the load conformance in the hour-ahead and 15-minute markets appears to have contributed to several trends in real-time market performance.

- As shown in Figure 2, average 15-minute prices were significantly higher than 5-minute price in all four quarters of 2017. This price trend reflects differences in manual adjustments to imbalance demand made in these markets.
- The percentage of intervals in which the power balance constraint needed to be relaxed in the 15-minute market also increased significantly in 2017, during more than 0.2 percent of intervals in the 15-minute market, a phenomenon that did not occur in prior years.
- Increased use of the load conformance by gird operators in the hour-ahead and 15-minute markets also appears to have increased the dispatch of imports and commitment of resources in these markets.

DMM has recommended that the ISO focus on identifying ways to reduce the need for operators to make manual adjustments to the imbalance demand in real-time, particularly in the very predictable pattern in which adjustments have been made in recent years.[2] DMM's review indicates that several factors may be contributing to the increased and systematic use of load conformance.

- The ISO appears to use load conformance as means to procure additional imports in the hour-ahead process to ensure more ramping capacity is available in the 15-minute and 5-minute markets.
- The pattern of load conformance also appears to represent a means of committing or de-committing additional resources in the hour-ahead or 15-minute processes to ensure more ramping capacity is available in the 5-minute market.
- Another factor contributing to increased use of load conformance by grid operators may be errors made throughout 2017 in the calculation of requirements for the amount of flexible ramping product procured by the ISO. These errors resulted in significant under procurement of ramping capacity during many key ramping hours.[3]

DMM has also noted that manual load adjustments and the limiter could have a much more significant impact on prices with the implementation of changes needed to comply with

[2] *Comments on the Imbalance Conformance Enhancement Draft Final Proposal*, Department of Market Monitoring February 20, 2018, http://www.caiso.com/Documents/DMMComments-ImbalanceConformanceEnhancements-DraftFinalProposal.pdf

[3] This issue is discussed in a later section of this memo and in a recent report by DMM: http://www.caiso.com/Documents/FlexibleRampingProductUncertaintyCalculationImplementationIssues.pdf

FERC Order No. 831. Under Order No. 831, penalty prices and energy offers that may be used in setting market energy prices will increase up to $2,000/MWh.

Price Impact of Imbalance Conformance Limiter

DMM has provided several analyses of the impacts of the imbalance conformance limiter on 5-minute market prices with and without the changes being proposed by the ISO.

DMM's analysis of 2016 data showed that average 5-minute prices would have been about $2.64/MWh (9 percent) higher if the limiter was in effect. [4] If the ISO's proposed changes were in effect, average 5-minute prides would have been $2.03/MWh (7 percent) higher. Thus, removing the limiter or applying the changes proposed by the ISO would have had a significant effect on prices in 2016.

However, more recent analysis provided by DMM in 2017 in this stakeholder process showed that the limiter had a relatively small effect on 5-minute prices – with or without the changes being proposed.[5] Figures 3 and 4 provide an updated version of this analysis based on complete 2017 data.

Figure 3 shows the frequency of the current and proposed imbalance conformance limiter in the 5-minute market during 2017. As shown in Figure 3, the current limiter triggered during about 91 percent of under-supply infeasibilities and 94 percent of over-supply infeasibilities in the 5-minute market. Meanwhile, with the proposed changes the limiter would have triggered during only about 20 percent of under-supply infeasibilities and 12 percent of over-supply infeasibilities in the 5-minute market.

As shown in Figure 4, average prices in the 5-minute market would have been about $0.66/MWh higher (2 percent) if the proposed logic was in effect in 2017. Average 5-minute prices would have been about $0.90/MWh (3 percent) higher if no conformance limiter was in effect in 2017.

The relatively limited impact of the limiter on 5-minute prices in 2017 stems from the fact that in many cases when the current limiter triggered, prices are set by dispatched bids at or near the bid cap of $1,000/MWh. When the load bias limiter resolved under-supply infeasibilities during 2017, system prices were greater than $900/MWh during about 71% of these intervals. In many of these cases, proxy demand response resources (bid in at the bid cap) were dispatched to provide energy and set the market price. In other instances, energy storage resources (batteries) or gas resources were the marginal unit.

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[4] *Comments on the Load Conformance Limiter Enhancement*, Department of Market Monitoring May 19, 2017 http://www.caiso.com/Documents/DMMComments-LoadConformanceLimiterEnhancement.pdf

[5] *Comments on the Imbalance Conformance Enhancement Straw Proposal*, Department of Market Monitoring December 20, 2017 http://www.caiso.com/Documents/DMMComments-ImbalanceConformanceEnhancements-IssuePaper-StrawProposal.pdf

Figure 3. Frequency of current and proposed conformance limiter logic being triggered in 2017 (PG&E, 5-minute market)

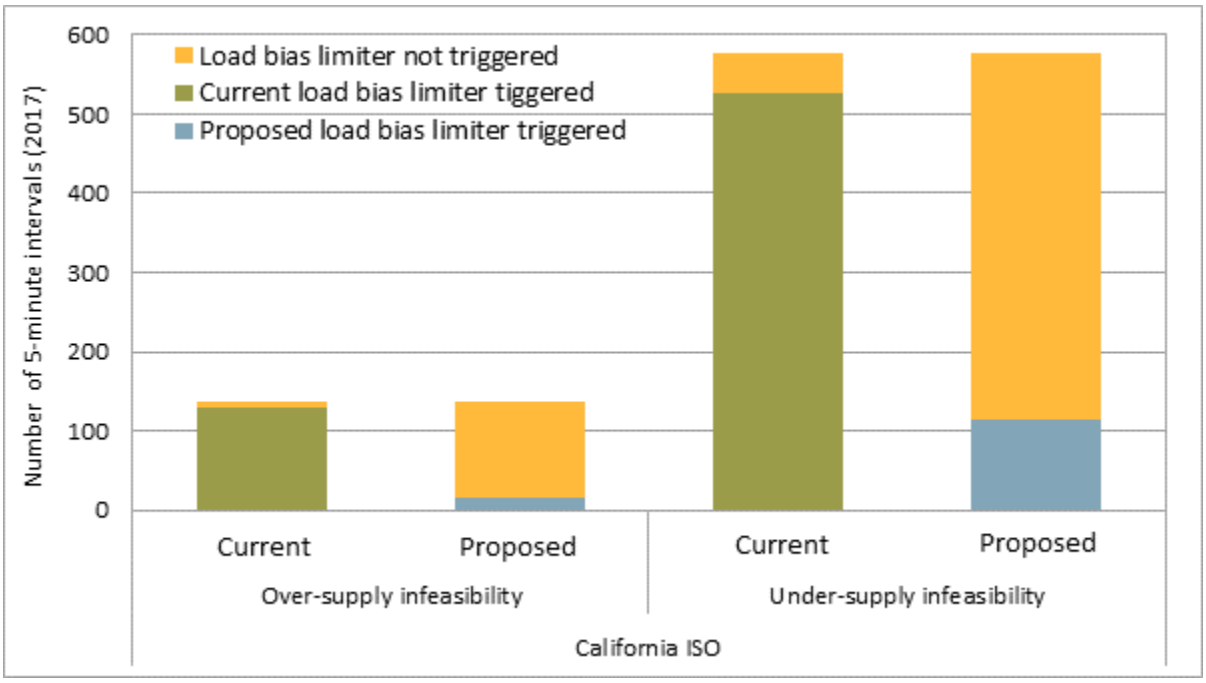
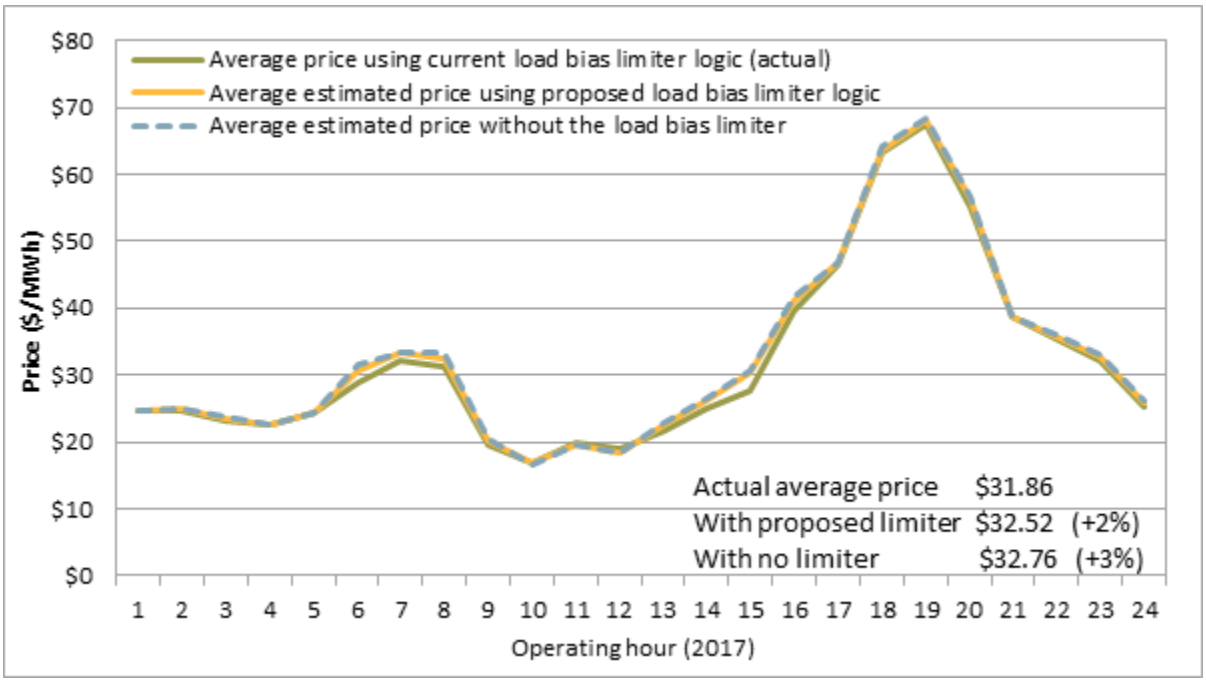


Figure 4. Price impact of current and proposed conformance limiter logic in 2017 (PG&E, 5-minute market)



DMM's 2016 Annual Report noted that most or all proxy demand response resources cannot respond to single 5-minute dispatches and recommended that the ISO develop market modeling enhancements which could more accurately reflect characteristics of resources unable to respond to isolated 5-minute dispatches.[6] DMM continues to recommend the ISO address this issue to prevent prices from being set by bids from demand response resources that are not able to respond to dispatch instructions.

Flexible Ramping Product Implementation Errors

As previously noted, one factor that may have contributed to the pattern of systematic manual load adjustments by grid operators is under and overprocurement of flexible ramping product due to implementation errors in the calculation of requirements for the flexible ramping product since implementation in November 2016. This new product was designed to help reduce the need for manual load adjustments by grid operators by procuring additional ramping capacity to address uncertainty through the market software.

Since November 2016, DMM has raised numerous concerns and questions about the implementation and performance of the flexible ramping product. In February 2018, DMM identified numerous specific errors in how the demand curves used to procure flexible capacity have been calculated. DMM has completed a report indicating that these errors caused flexible ramping requirements and procurement to be significantly lower than intended in many hours with relatively high ramping needs, and significantly higher than intended in other hours which tend to have lower ramping needs.[7] The ISO resolved many of these errors in March of 2018.

DMM's analysis shows that the overall impact of these errors on flexible ramping market results was significant. DMM estimates that prices and purchased quantities of upward ramping capacity were lower than intended in up to about half of all 15-minute intervals. During these intervals, the correct requirements averaged almost 400 MW greater than historical procurement on average (i.e. 949 MW compared to 564 MW procured).

The systematic under-procurement of flexible ramping capacity during key hours may have increased the frequency of power balance violations (Figure 5 and Figure 6). However, it is not possible to determine whether any particular power balance violation would have been resolved had the flexible ramping product been implemented correctly.

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[6] 2016 Annual Report on Market Issues and Performance, Department of Market Monitoring, May 2017, pp. 259- 261: http://www.caiso.com/Documents/2016AnnualReportonMarketIssuesandPerformance.pdf.

[7] http://www.caiso.com/Documents/FlexibleRampingProductUncertaintyCalculationImplementationIssues.pdf

Figure 1. Frequency of 15-minute market under-supply power balance constraint relaxation (March - December, 2017)

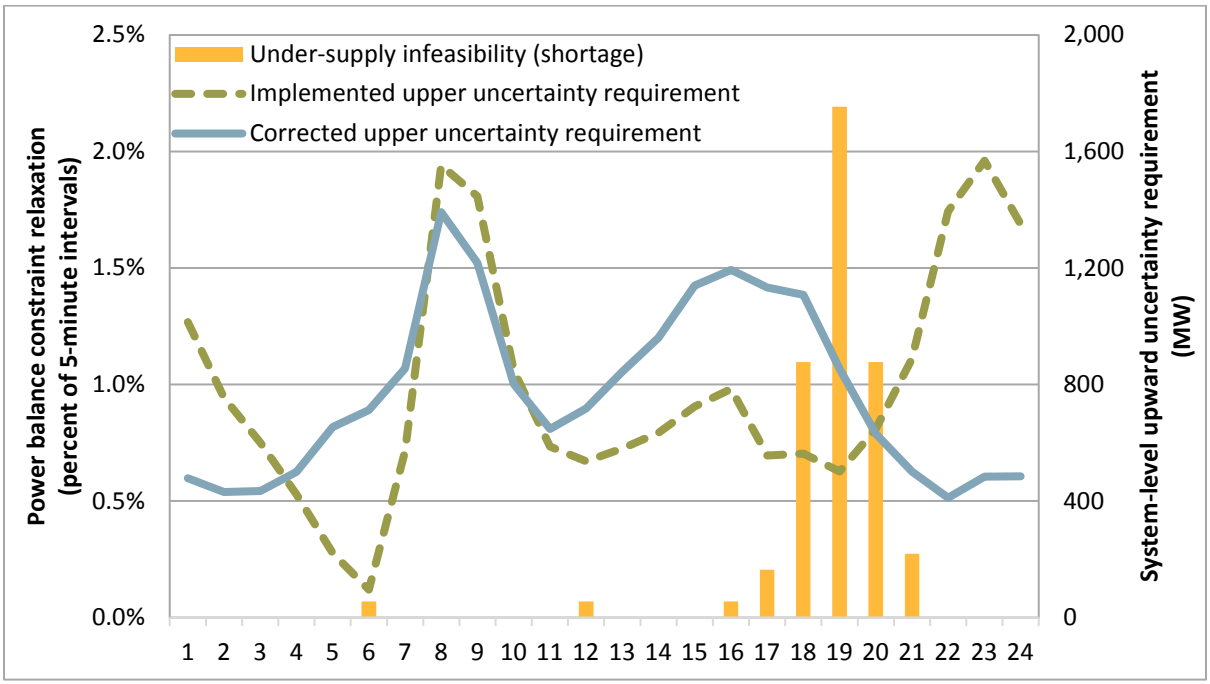
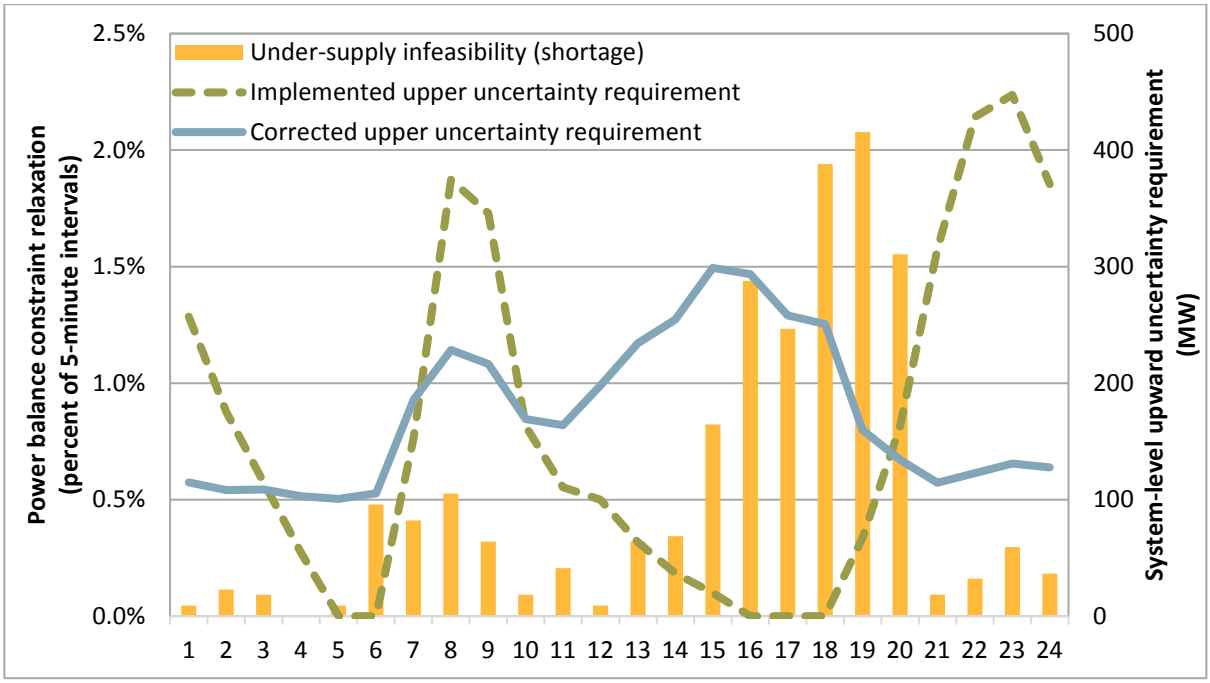


Figure 2. Frequency of 5-minute market under-supply power balance constraint relaxation (March - December, 2017)



RECOMMENDATIONS

DMM supports Management's proposed enhancements to the imbalance conformance limiter as an improvement over the current approach. The ISO proposal is very consistent with DMM's prior recommendations on this issue. Under the revised approach, the focus of the imbalance conformance limiter would be primarily on the *change* in load adjustments from one interval to the next. DMM's on-going monitoring has found this approach is more likely to trigger the limiter when the power balance constraint is relaxed due to excessive manual adjustments rather than by an actual scarcity of ramping capacity.

Analysis by DMM shows that under current market conditions, the current imbalance conformance limiter will not have a significant impact on overall average prices before or after Management's proposed changes. This is because for most intervals when the conformance limiter would be triggered, the highest dispatched bids are currently at or near the $1,000/MWh price cap. However, DMM continues to recommend the ISO takes steps to prevent prices from being set by bids from demand response resources that are not able to respond to dispatch instructions.

DMM has also recommended that the ISO make improvements to reduce the need for operators to make manual adjustments to the imbalance demand, particularly in the very predictable ramping pattern in which adjustments have been made in recent years. To the extent that large predictable load adjustments during peak net load hours persist after improvements to the conformance process are made, the root cause for continued use of the adjustments should be addressed to reduce the practice of manual load adjustments.

The ISO should specifically review the extent to which adjustments continue to be used by operators as a means to procure additional generation in the hour-ahead and 15-minute market. The ISO should seek to ensure sufficient operating margins and ramping capacity through market mechanisms such as the flexible ramping product, rather than imbalance conformance, to the extent possible.