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)

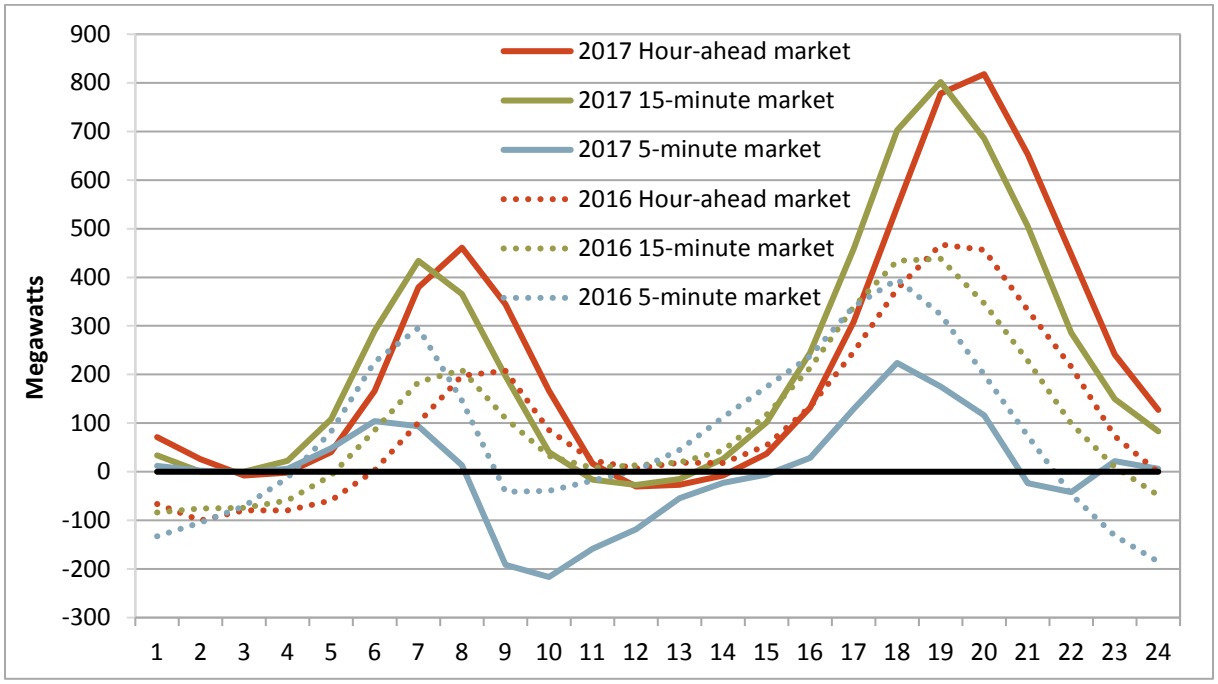
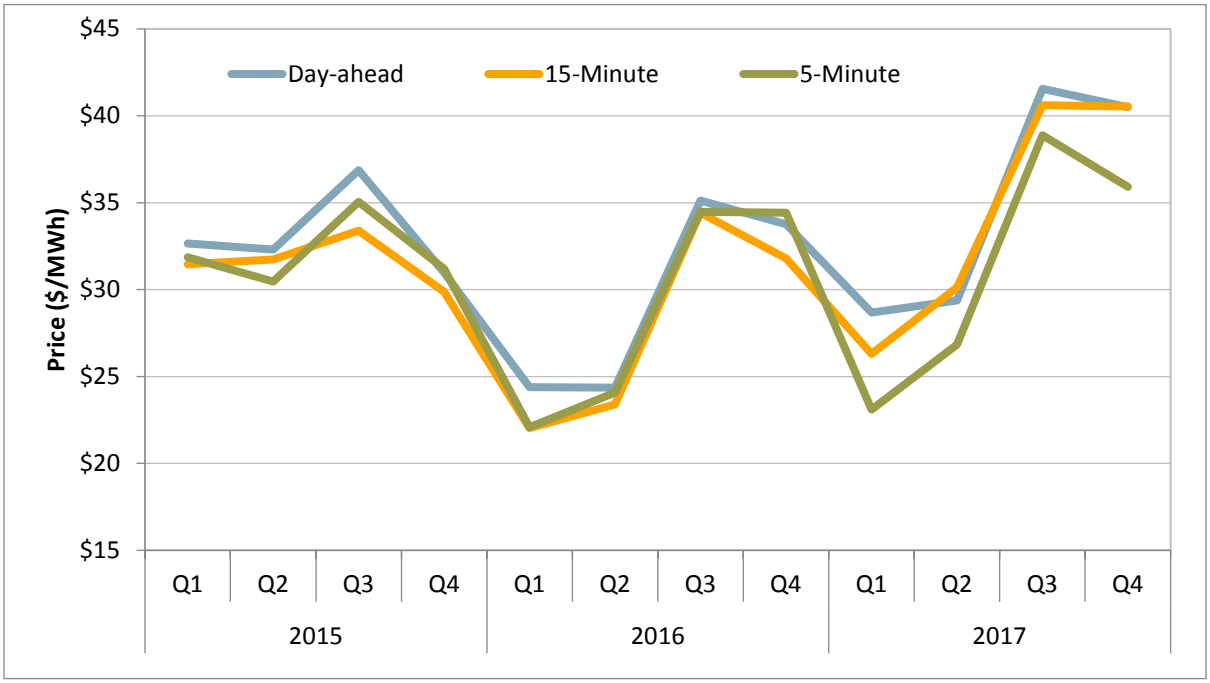


Figure 2. Average quarterly prices (all hours) – system marginal energy price



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)

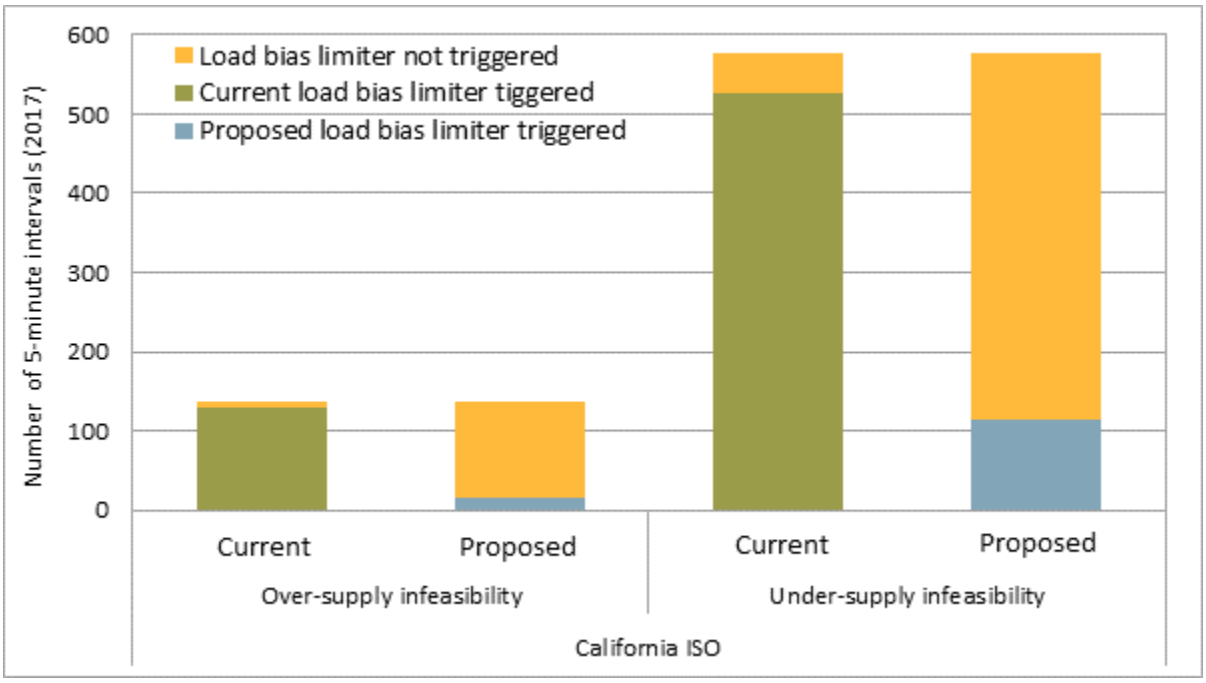
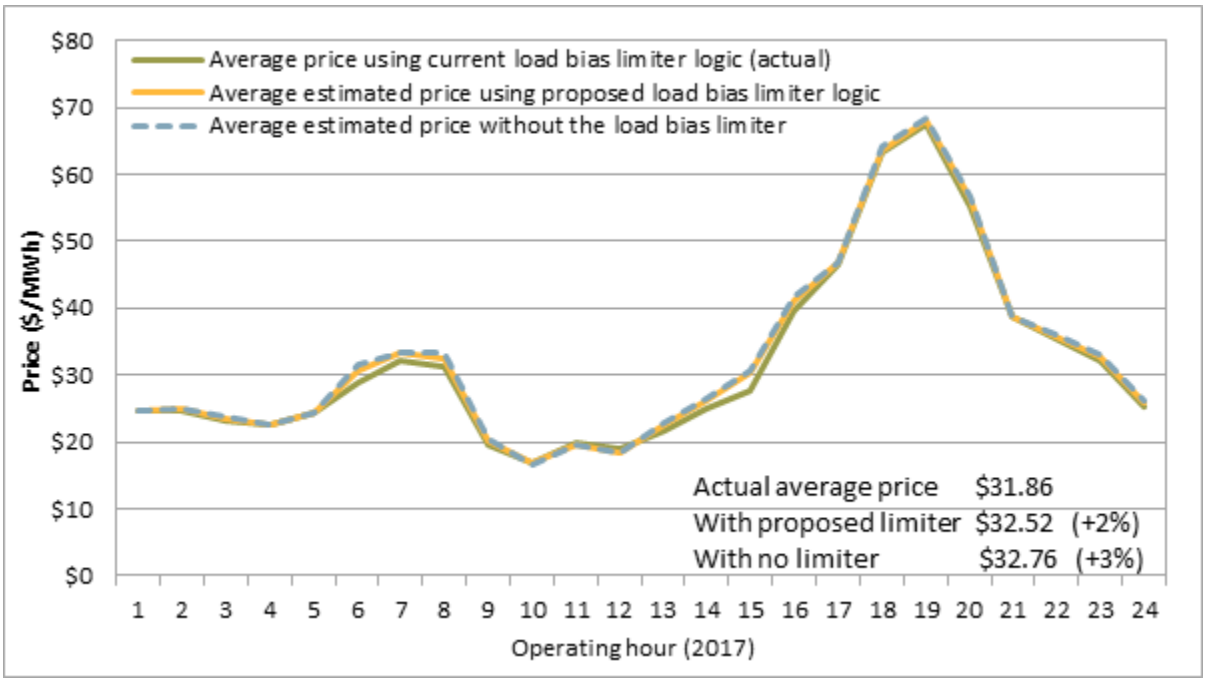


Figure 4. Price impact of current and proposed conformance limiter logic in 2017 (PG&E, 5-minute market)



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)

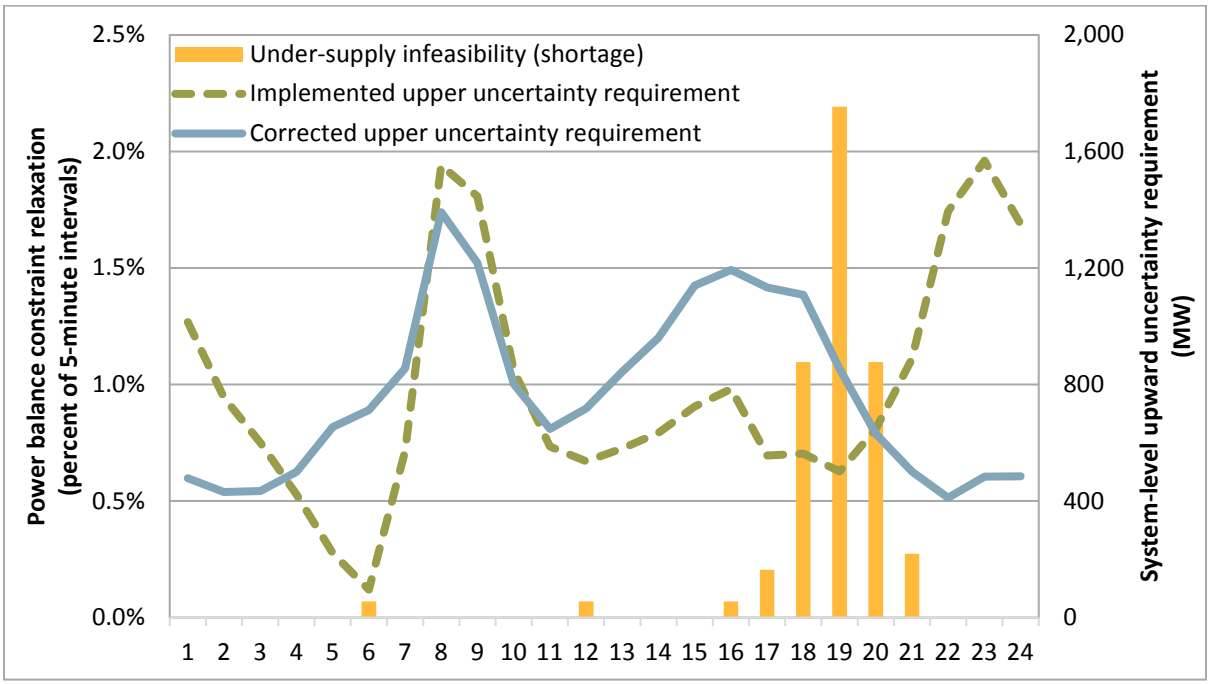
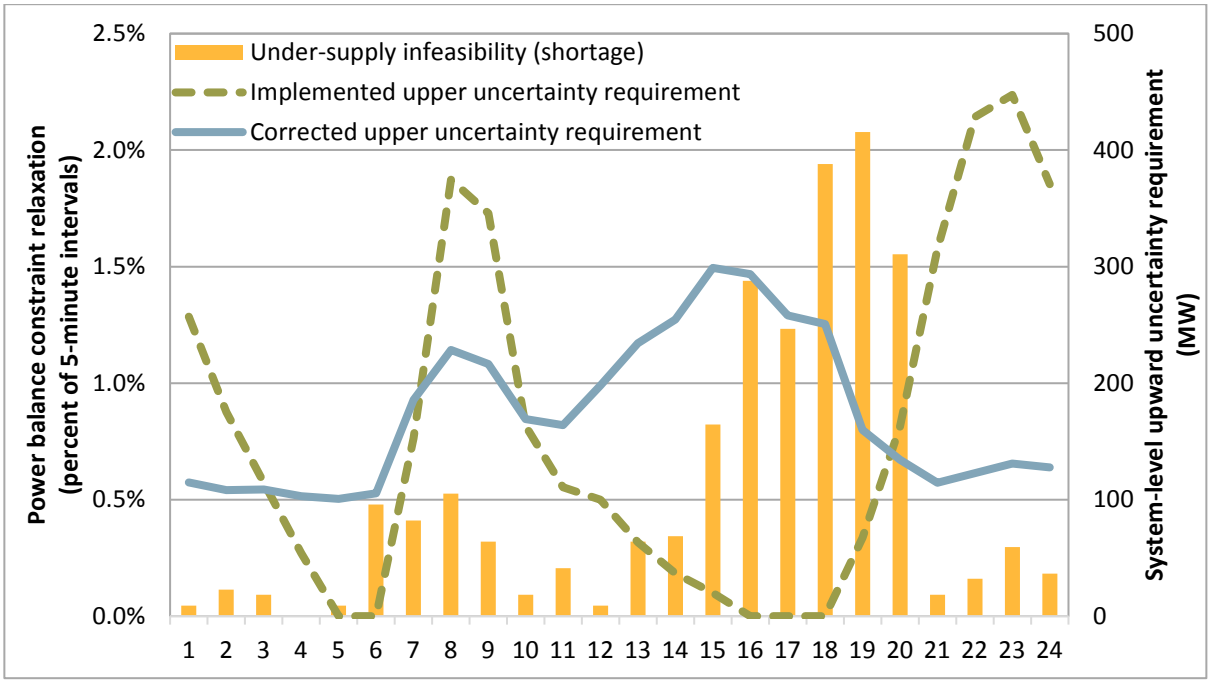


Figure 2. Frequency of 5-minute market under-supply power balance constraint relaxation (March - December, 2017)



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.