Imbalance Conformance Enhancements

Issue Paper & Straw Proposal

November 29, 2017

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1. Purpose

The purpose of this initiative is to describe how and why conformance is used and 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 real time markets. This paper also provides examples that illustrate how the current limiter functions and how proposed enhancements will improve the limiter to ensure valid results. Additionally, the ISO outlines a stakeholder schedule and justification of the EIM categorization for this initiative.

2. Background

2.1. Naming Convention

Historically, the ISO and stakeholders have used the term "bias" instead of "conformance". However, the word *bias* does not describe what the grid operators are actually doing. In order to provide a more accurate indication of what occurs, the ISO began using the word *conformance* in 2014.

Additionally, the term "load" is frequently associated with conformance and is used as operations jargon. For example, grid operators will commonly use the term "load conforming" (or previously "load biasing"). The use of the word *load* is a result of the fact that the grid operators use the load forecast as the tool to conform the imbalance energy to system conditions they observe. Although the grid operators use the load forecast as the tool to conform imbalance energy to observed system conditions needs, they do not conform the forecast only to correct for observed forecast error.

This initiative uses the term "imbalance conforming" (and variations of the term, e.g. imbalance conformance) as it is an accurate representation of the reasons for conforming the load forecast.

2.2. Initiative History and References

This initiative came to fruition as a result of a Technical Bulletin published by the ISO in November 2016.[1] A stakeholder conference call was held on January 11, 2017 and the ISO invited stakeholders to submit written comments in response to the bulletin and call.

The topic of imbalance conforming was also discussed at the Market Surveillance Committee (MSC) meeting and in Market Performance and Planning Forum (MPPF) discussions. The MSC completed analysis on the effect of imbalance conformance on real-time revenues for flexible capacity. There was

1 The technical bulletin, presentation, and stakeholder written comments can be referenced at: https://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=e1c05272-e1bd-498f-b6a0-c8a4bcca83a9

general consensus between the MSC, ISO, stakeholders, and the Department of Market Monitoring (DMM) that the ISO should complete a review of the conformance limiter.[2] This initiative builds on the framework form the 2016 technical bulletin and MSC meeting to enhance the conformance limiter and ensure it yields valid results.

2.3. Conforming

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 result in frequency deviations.

Per NERC reliability standard BAL-001-2, it is the responsibility of the balancing authority to ensure the balancing authority area does not exceed the Balancing Authority ACE Limit (BAAL) for more than 30 consecutive minutes. [3] This standard ensures frequency is maintained throughout the interconnection.

In order 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 are following 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.

The grid operator updates the amount of conformance throughout the day based on an informed estimate deduced from observations of numerous factors including but not limited to: forecast deviation, variable energy resource (VER) deviation, real-time contingencies, pump schedule deviation from the day-ahead market run, generator testing, and acute knowledge of the system. Additionally, because the market does not directly recognize ACE deviation, the operator will conform so the market dispatch will help control ACE and ensure BAAL is not exceeded for more than 30 minutes.

The grid operator may conform the load forecast independently for each market run: the 5-minute real time dispatch (RTD), the 15-minute real time pre-dispatch (RTPD), and the 4-hour short term unit

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[2] Reference page 2-3 of the ISO Board of Governors memo submitted by MSC chair, Benjamin Hobbs, on July 24, 2017: http://www.caiso.com/Documents/MarketSurveillanceCommitteeUpdate-Memo-Jul2017.pdf

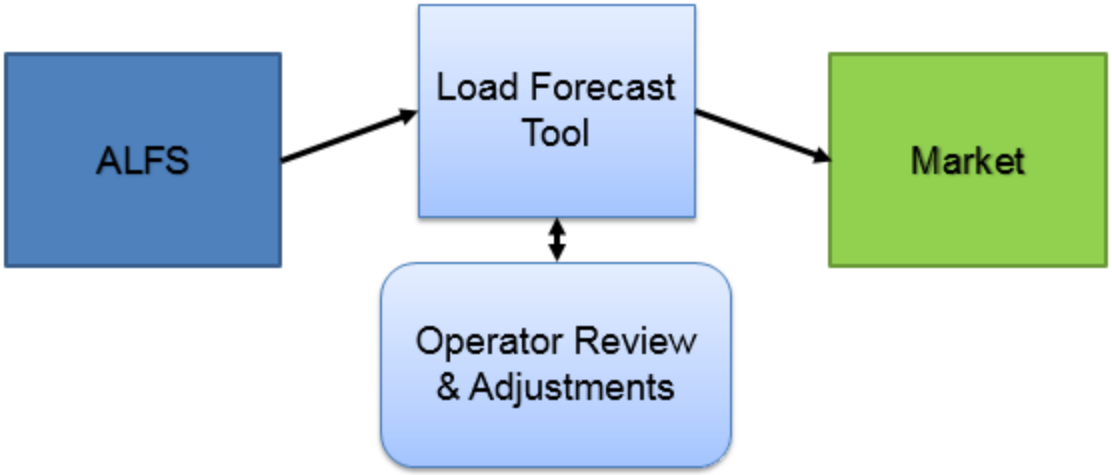
[3] See NERC Standard BAL-001-2 Requirement R1: http://www.nerc.com/_layouts/PrintStandard.aspx?standardnumber=BAL-001-2&title=Real%20Power%20Balancing%20Control%20Performance&jurisdiction=United%20States

commitment (STUC).[4] This may be done for various reasons. Typically, RTD conformance is used for minor corrections including VER deviation and unit testing. RTD will only use generation that is currently online. RTPD and STUC are used to conform for forecast error and ramp uncertainty. These market runs have the ability to bring a unit online/offline or procure more import energy. In most situations the same conformance value is used in RTPD and STUC because STUC has the ability to bring longer start units online (e.g. a generator with a 2 hour start time).

The process of 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 deviation. 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 load forecast tool allows the operator to use an aggregated value and correct for various system changes in an expedited manner.

The load forecast tool receives the forecast from the automated load forecast system (ALFS). The grid operator then has the opportunity to review and update the forecast, if necessary, before the data is used by the market. The forecast value used by the market directly influences the amount of generation that will be dispatched.

Figure 1: Data stream of the load forecast value into the market including operator review.



Another critically important aspect of conforming the load forecast is that the conformance value is distributed across the entire balancing authority area as opposed to a specific generator. Since conformance occurs in order to maintain system reliability, this correctly results in conformance across the system as opposed to a specific region. Because the market solves as a whole, this allows for a feasible market dispatch that does not result in congestion. If an individual generator's deviation is

[4] "Real time pre dispatch" (RTPD) and "real time unit commitment" (RTUC) are used synonymously.

causing problems such as congestion or a reliability concern, the generator will be contacted directly (via their Scheduling Coordinator) and asked to follow their market dispatch.

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.

2.4. Conformance Limiter

Conforming is done solely for reliability reasons. The grid operator's primary objective is to ensure grid reliability with disregard to how this may or may not 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.

In some cases, when the load forecast is conformed to address a loss of a unit, the conformance will reflect the scarcity of supply in a given interval and will appropriately reflect prices. However, in some instances, the conformance does not specifically reflect scarce conditions. When the conformance input value exceeds the ramping capability in the interval, even though there is not true scarcity, the market will be infeasible and pricing will spike to the $1000 MWh price cap.

For example, imagine the following scenario: It is late afternoon and the balancing authority is entering the typical afternoon load pull. The grid operator recognizes the forecast is short by approximately 200 MW. Additionally, the wind has suddenly dropped off in Southern California resulting in an estimated VER shortage of 300 MW based on the forecasted amount. The grid operator knows the sun will be setting soon bringing solar resources offline, yet load will increase as people get home from work. In order to ensure enough generation is online to meet the demand, the operator inputs a conformance into the load forecast tool. The conformance includes +300 MW in the RTD market to compensate for the VER deviation, +200 MW in the RTPD to compensate for the forecast error, and +200 MW in STUC to compensate for the inevitable load increase.

The conformance value input into RTPD and STUC will ensure more generators are brought online, if necessary, to meet the increased demand. However, the conformance value input into RTD will only result in increases and decreases to the output of generators that are already online; it does not bring additional generators online. Based on the bids submitted, the 5-minute market does not have enough ramping capability to meet the +300 MW conformance. RTD is only able to supply +250 MW. Because the conformance (what the market thinks it needs) is greater than the ramping capability (what is available), the market run results in an infeasible solution and sets a +$1000 MWh price.

In reality, the physical system only needs an additional 200 MW within the 5-minute timeframe to compensate for the VER deviation. A scarcity condition does not exist. The operator has no way to know the current ramping capability and over-estimated the RTD conformance requirement. Consequently, the RTD market result is infeasible causing the power balance constraint relax. This results in pricing based on the $1000/MWh bid cap.

The ISO developed the conformance limiter to correct for an action that would otherwise cause a spurious price spike that coincides with the artificial infeasible solution. The conformance limiter only applies in the real-time markets. Explained generally, the limiter allows for the operator to estimate the amount of conformance needed and quickly input the value into the load forecast without triggering artificial price spikes. The operator cannot observe the precise capacity needs at any specific point in time. To avoid infeasibilities, the operator would need to determine exactly how much ramp capability exists and know the system needs. These values would need to be known prior to the moment the market clears. Because this is not possible, the limiter will procure the ramping capability that is available on the system without spiking prices.

The conformance limiter uses simple logic to identify scenarios in which the conformance value is greater than the ramping capacity for the corresponding interval. A dispatch requirement greater than the ramping capability is known as an infeasibility. When the limiter is triggered, the market will use the maximum ramping capability available without exceeding that amount. This results in a feasible market solution and pricing that is not skewed by an estimated input. The limiter allows for consistent pricing when conforming is used to maintain reliability.

The current logic used to trigger the limiter is simple and is only used in the real time markets. The limiter will trigger when the following conditions exist for the applicable market interval:

- The conformance requirement is greater than the magnitude of the infeasibility (positive or negative), and
- The infeasibility is in the same direction as the conformance.

Because the logic is over-simplified, situations exist in which the limiter can falsely trigger or not trigger at all. For example, the limiter may trigger if the conformance exists from a previous interval or has changed direction (negative to positive or vice versa).

This initiative will explore enhancements to ensure the limiter triggers correctly. Proposed limiter logic will have the following characteristics:

- Will recognize conformance from previous intervals,
- Is not limited to rely on information from the current interval,
- Will recognize direction changes for infeasibility and conformance, and
- Will build a memory of the change in load from a previous solution.

The proposed logic and detailed examples are explained in Section 4.3: Proposed Functionality for the Imbalance Limiter.

3. Issue and Proposal

The intent of this policy initiative is to:

- Clarify the ISO's authority to conform for imbalance in the real-time market,
- Clarify the ISO's authority to conform for imbalance in the day ahead market through the residual unit commitment (RUC) net short process, and
- Implement enhancements to improve the imbalance conformance limiter that is used in the real-time markets.

The following subsections will explain current issues and present solutions to clarify authority for the ISO to conform and improve functionality of the limiter. For additional information, reference the Technical Bulletin the CAISO previously published.[5]

3.1. Grid Operators Authority to Conform for Imbalance in the Real Time Market

A conformance for imbalance is an adjustment (positive or negative) to the overall automated load forecast system (ALFS) requirement that is input to the ISO market software. This adjustment is reflected in the load forecast used in clearing the real time market. Grid operators may induce a market dispatch solution, when necessary, through the process of conforming in order to maintain grid reliability.

Although the ISO Tariff does not currently explicitly specify the authority of the ISO to conform in the real time market, the tariff gives the ISO discretion to create a load forecast it deems appropriate to maintain grid reliability. The action of conforming is also a common practice of all balancing authority areas throughout North America. Nevertheless, the ISO believes it would be beneficial to explicitly specify the authority of the ISO to make imbalance conformances and the reasons for taking such actions. For example, the tariff could specify that the ISO and EIM balancing area authorities may make imbalance conformances in response to various factors affecting reliability but may not make them to influence pricing.

[5] The technical bulletin, presentation, and stakeholder written comments can be referenced at: https://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=e1c05272-e1bd-498f-b6a0-c8a4bcca83a9

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 inflections
- Pumping schedule changes
- Averages that do not reflect dramatic load increase or decrease

Existing policies, the process of conforming, and the tools that are used to conform will not be changed with this initiative.

Examples 1 – 2 explain scenarios when the ISO needs to conform to maintain grid reliability.

Example 1:

A generator has unexpectedly tripped offline resulting in a 500 MW shortage. The moment the contingency occurs, the grid operator must use all the tools at his/her disposal to ensure the bulk electric grid remains stable and balanced. This balance is critical in the current market run and must also be maintained in subsequent market runs. The market system is unaware of the generator outage until the generator's scheduling coordinator submits the outage to the ISO's outage reporting system. This process can take up to 30 minutes and is out of the control of the ISO grid operator. However, the market continues to dispatch assuming the generator is online during this time. The grid operator is still responsible for maintaining a balanced system. The most effective tool to maintain balance is to input a 500 MW conformance into the load forecast, which will induce a market result to help mitigate for the contingency. The operator can then remove the conformance when the outage card is correctly submitted and processed.

Example 2:

Every afternoon load increases as people return home from work, turn on lights, and start using appliances. This load increase is even more dramatic in the month of December due to holiday lights – many of these turn on with an automatic timer at 5 pm resulting in up to a 100 MW per minute load increase.

The real time unit commitment (RTUC) market run occurs every 15 minutes and will bring capacity online to meet the forecasted demand. However, the RTUC uses the load forecast average of three 5-minute intervals (as received from ALFS) to determine the capacity requirement.

For example, if it is possible that load may increase from 23,000 MW up to 24,500 MW in a 15-minute interval. This correlates to a 1,500 MW increase in generation output. For the 15-minute interval ending at 5:15 pm, forecasts for 5-minute intervals ending at 5:10, 5:15, and 5:20 pm are used. If the load forecast for the corresponding RTD intervals is 23,700 MW, 24,500 MW and 24,700 MW, the average of the three intervals will be 24,300 MW. This is the requirement that will be used for RTUC, which results in a 1,300 MW increase. The grid operator will therefore input a conformance of 200 MW to offset the difference between the anticipated 1,500 MW increase and the 1,300 MW increase that is predicted by ALFS.

Based on his knowledge of the system and anticipation of the load increase, the grid operator will input a 200 MW conformance into the load forecast tool to ensure 1,500 MW of capacity is online (1,300 MW dispatch + 200 MW conformance). This will ensure there is enough generation to serve the load at the end of the 15-minute interval.[6] This can occur for both load increases and load decreases.

3.2. Grid Operators Authority to Conform for Imbalance in the Day Ahead Market

Similar to conforming in the real time markets, a version of conforming occurs in the day ahead market through the residual unit commitment (RUC) net short process. This section discusses that process, which is only applicable to the ISO and not EIM balancing authority areas as they do not participate in the day-ahead market.

The residual unit commitment process runs after the integrated forward market (IFM) to ensure enough capacity will be online for the following trade date to meet the CAISO forecast of CAISO demand

[6] The real time unit commitment (RTUC) is responsible for bringing generating units on and offline. This process occurs every 15 minutes. The real time dispatch (RTD) will increase/decrease the dispatch operating target (DOT) for units that are already online. Therefore, the grid operator must ensure there is enough capacity online for the duration of the 15 minute interval because the market is not capable of bringing an additional unit online until the subsequent RTUC run.

(CFCD).[7] The ISO forecasts demand using the automated load forecast system (ALFS). ALFS uses a complex algorithm and considers weather, historical trends, current load trends, and other measures. The CFCD is first created by the ALFS and is the best estimate of what load will be for a given timeframe (next day, next hour, or the next market interval). RUC will "ensure sufficient physical capacity is available and committed at least cost to meet the adjusted CFDF for each hour of the next Trading Day, subject to transmission and resource operating constraints" (ISO BPM for Market Operations, Section 2.3.1.3).

The operator may recognize that based on the IFM results, 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, if necessary, to better reflect overall system conditions. This adjustment to the forecast is a form of conformance for the day ahead market. Similar to conformance in real time, the load forecast is the only tool available to induce the necessary market results; the use of RUC net short is not isolated to anticipated changes in load.

The ISO has the authority to set the CFCD 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 reasons for conforming RUC 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

The RUC net short process does not occur on a frequent basis and occurs only when the grid operators determine the demand forecast, which drives the RUC procurement target, does not reflect the amount of capacity needed to meet system needs for the next trade date. Existing policies, the process of conforming, and the tools that are used to conform will not be changed with this initiative.

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[7] For additional information on the day ahead market processes, reference the Business Practice Manual (BPM) for Market Operations, Section 2.3.1: Day-Ahead Market Processes. The BPM is located here: https://bpmcm.caiso.com/BPM%20Document%20Library/Market%20Operations/BPM_for_Market%20Operations_V54_clean.doc

Example 3 explains a scenario when the ISO needs to use the RUC net short process in the day-ahead market.

Example 3:

It is August and California is in the middle of a heat wave. The state is on day five of triple-digit temperatures that are being felt from San Francisco to Los Angeles. It is currently Sunday and the day-ahead market is running for the following trade day, a Monday. As is typical with heat waves, end-use customers are beginning to feel the heat wave exhaustion and the statewide Flex Alert is not anticipated to assist as much as it had in previous days; customers are hot, tired, and will inevitably use their air conditioning systems more.

Load is already high on Sunday, and the grid operator anticipates it will be significantly higher the next day. Based on acute system knowledge, engineering analysis, and discussion with the Reliability Coordinator, it is determined that additional capacity needs to be brought online. The grid operator increases the CFCD by 700 MW using RUC net short for the operating timeframe of 4 to 10 pm the next day. This will allow the RUC to bring additional capacity online putting the grid operator in a better position to maintain reliability during the heat wave.

3.3. Current Functionality of the Imbalance Limiter

As described in Section 3.2, the conformance limiter is used to avoid artificial price spikes in the real-time markets.[8] The operator roughly estimates the conformance requirement and this value may result in an infeasible market solution. When this occurs, the power balance constraint is relaxed and scarcity pricing may be incorrectly triggered.

Currently, the conformance limiter only uses information from the current binding interval. This prevents the limiter from recognizing changes between intervals. The change between intervals is important because the conformance value may be left over from a previous interval. Additionally, the limiter only addresses infeasibilities when the infeasibility and the conformance adjustment are in the same direction. The intent of the conformance limiter is that when the load conformance entered by the operator exceeds and is in the same direction as the infeasibility, the limiter will set the market requirement to a value that is still feasible. This effectively relaxes the power balance constraint and allows the market to clear at the last submitted supply bid rather than setting the price at the administrative price for relaxing the power balance constraint.

[8] The limiter is only used in the real-time markets and is not applicable in the day-ahead market.

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

$$C_i = (PBC_{inf} - Conf_i) \quad (1)$$

If $C_i < 0$, limiter is triggered.

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

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

$$C_i = (PBC_{inf} - Conf_i) \quad (2)$$

If $C_i > 0$, limiter is triggered.

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

Where:

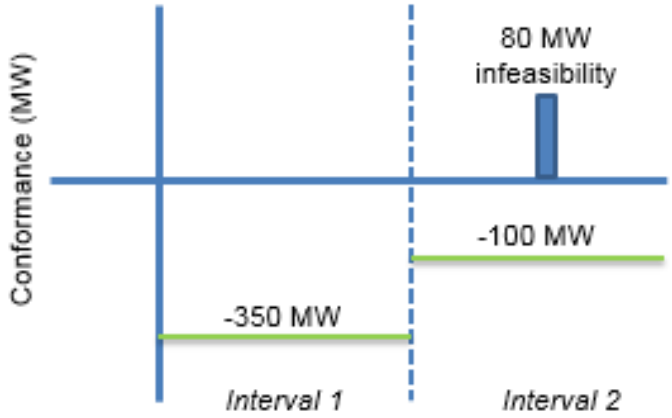
i	is the index for current interval
C_i	is the remaining available capability to absorb power balance constraint infeasibilities in the current interval
PBC_{inf}	is the power balance constraint infeasibility for the current interval
$Conf_i$	is the load conformance for the current interval

Examples 4 – 6 explain the current limiter logic and functionality.[9]

[9] These examples are based on the *Load Conformance Limiter Enhancement* Technical Bulletin. More examples and additional explanation can be referenced in the bulletin located here: https://www.caiso.com/Documents/TechnicalBulletin_LoadConformanceLimiterEnhancement.pdf

Example 4 – Current Functionality:

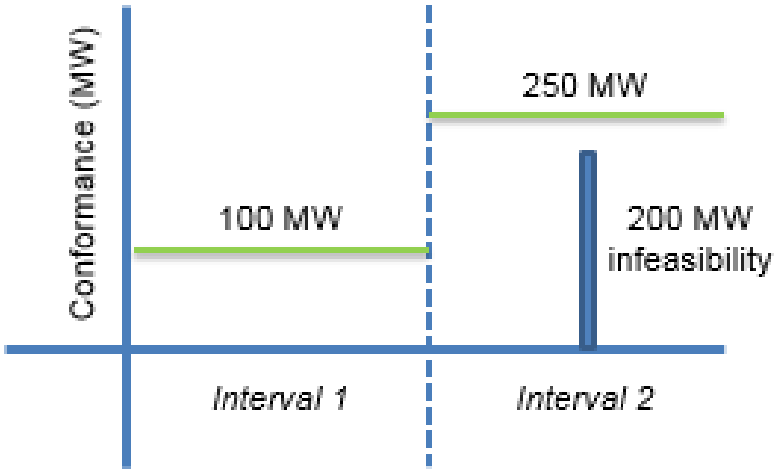
In this example, the limiter should be triggered, but is not triggered based on the current functionality. A grid operator inputs the conformance value of negative 350 MW for Interval 1. The market calculates no infeasibility for Interval 1. In the current interval, Interval 2, the operator inputs a conformance value of negative 100 MW. The market calculates an infeasibility of +80 MW (under supply) for the Interval 2.



Based on current logic, the limiter would not apply because the conformance is negative and the infeasibility is positive. By looking at only one interval, the limiter assumes a negative conformance cannot result in a positive infeasibility. In reality, the difference between the conformance in Interval 1 and Interval 2 is an increase of 250 MW (conformance delta = -100 – (-350)). This is greater than the market infeasibility of 80 MW. The limiter should apply.

Example 5 – Current Functionality:

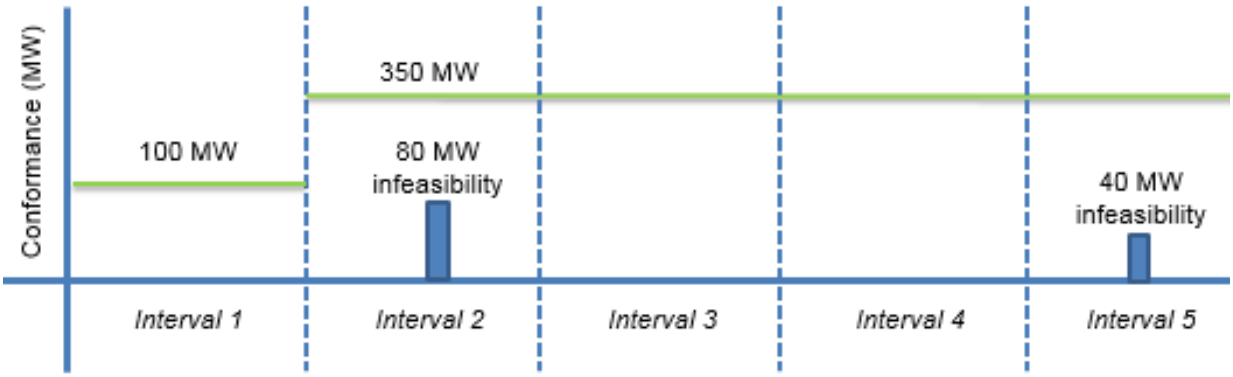
In this example, the limiter should not be triggered, but is triggered based on the current functionality. A grid operator inputs the conformance value of positive 100 MW for Interval 1. The market calculates no infeasibility for Interval 1. In the current interval, Interval 2, the operator inputs a conformance value of positive 250 MW. The market calculates an infeasibility of +200 MW (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 reality, 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.

Example 6 – Current Functionality:

In this example, the limiter should not be triggered for all intervals, but is triggered based on the current functionality. A grid operator inputs a conformance of 100 MW in Interval 1 and a conformance of 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.



Based on the logic described above the limiter would correctly trigger for the infeasibility in Interval 2; the conformance is positive, the infeasibility is positive, and the conformance value is greater than the infeasibility. In the following intervals there is no infeasibility indicating there is adequate ramping capacity on the system for the 350 MW conformance requirement. In interval 5, the limiter is triggered because the 40 MW infeasibility is less than the 350 MW conformance. Because there were no infeasibilities in Intervals 3 and 4, yet the conformance requirement did not change, the reason for the infeasibility must be related to something occurring or a change in the system. The limiter has triggered for Interval 5 because the conformance is greater than the infeasibility. In reality, the conformance requirement has not increased from the previous interval (350 MW – 350 MW = 0). The change in conformance, 0 MW, is less than the infeasibility. The limiter should not apply.

3.4. Proposed Functionality for the Imbalance Limiter

The current logic of the limiter can be enhanced to ensure it triggers (or does not trigger) more accurately. The limiter only applies in the real time markets. The proposed logic is as follows:

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

The following equations explain the logic of the enhanced limiter.

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:

$$C_i = \left(PBC\_inf_i - PBC\_inf_{i-1}\right) - \left(Conf_i - Conf_{i-1}\right) + \max(0, C_{i-1}) \quad (3)$$

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:

$$C_i = \left(PBC\_inf_i - PBC\_inf_{i-1}\right) - \left(Conf_i - Conf_{i-1}\right) + \min(0, C_{i-1}) \quad (4)$$

If $C_i > 0$, limiter is triggered.

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

Where:

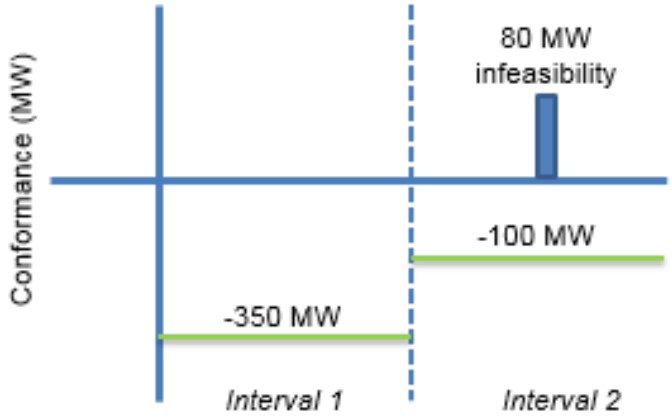
i	is the index for current interval
$(i-1)$	is the previous interval
C_i	is the remaining available capability to absorb power balance constraint infeasibilities in the current interval
$(PBC\_inf_i - PBC\_inf_{i-1})$	is the change of power balance constraint infeasibility between current and previous 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 given interval the power balance constraint infeasibility results in a value of 0, C_i is reset to 0.

Examples 7 – 9 describe the proposed limiter logic and functionality.

Example 7 – Proposed Functionality:

This example is the same as Example 4 but uses the enhanced limiter logic.



Based on the enhanced logic for under supply and starting with $C_0 = 0$, C_1 is calculated as follows:

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

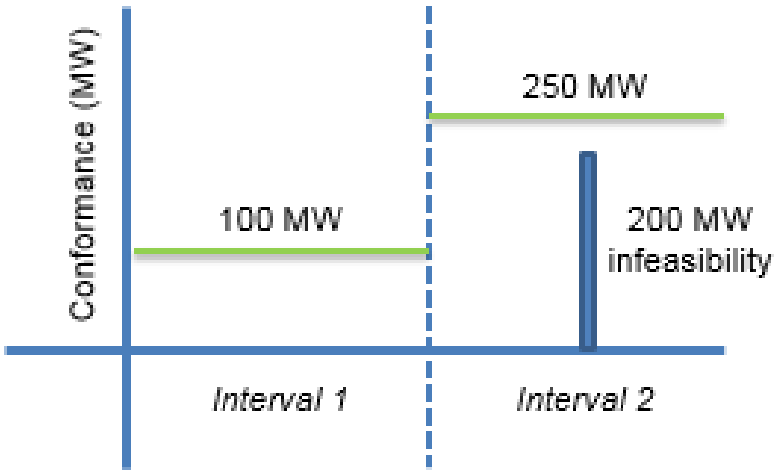
$$C_1 = (80 - 0) - (-100 - -350) + \max(0,0) = -170$$

$C_1 = -170 < 0$? Yes, therefore the limiter applies.

Since C_1 is less than 0, the conformance limiter applies. This is the expected outcome because the conformance difference between intervals is greater than the infeasibility and therefore the limiter should be triggered. With the new logic, the limiter is correctly triggered even though the conformance and the infeasibility are in different directions.

Example 8 – Proposed Functionality:

This example is the same as Example 5 but uses the enhanced limiter logic.



Based on the enhanced logic for under supply and starting with $C_0 = 0$, C_1 is calculated as follows:

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

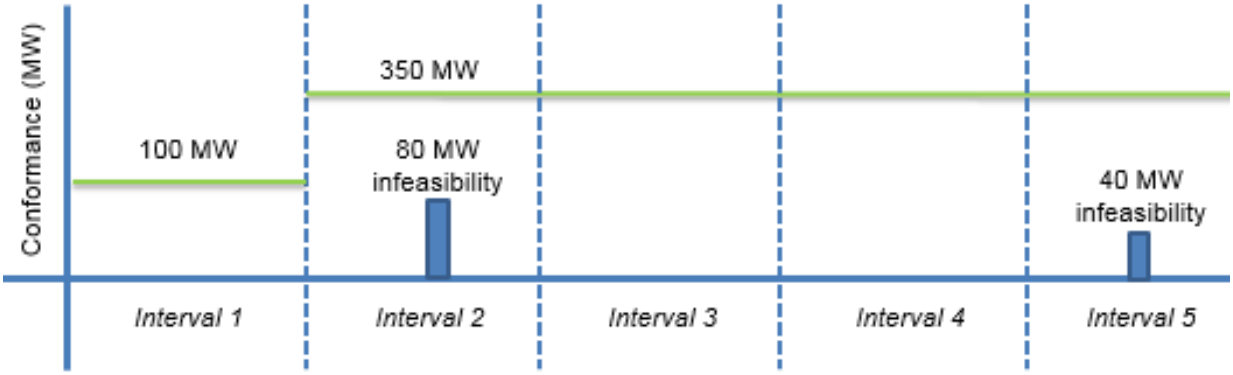
$$C_1 = (200 - 0) - (250 - 100) + \max(0,0) = 50$$

$C_1 = 50 < 0$? No, therefore the limiter does not apply.

Since C_1 is less **not** less than 0, the conformance limiter does not apply. This is the expected outcome because the conformance difference between intervals is less than the infeasibility and therefore the limiter should not be triggered. The limiter is correctly **not** triggered even though the conformance is greater than the infeasibility for the current interval.

Example 9:

This example is the same as Example 6 but uses the enhanced limiter logic.



Based on the enhanced logic for under supply and starting with $C_0 = 0$, C_1 is calculated as follows:

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

$$C_1 = (80 - 0) - (350 - 100) + \max(0,0) = -170$$

$C_1 = -170 < 0$? Yes, therefore the limiter applies.

There is now power balance constraint infeasibility in intervals 3 and 4 therefore setting corresponding C_2 and C_3 to 0.

$$C_4 = (40 - 0) - (350 - 350) + \max(0,0) = 40$$

$C_4 = 40 < 0$? No, therefore the limiter does not apply.

These are the expected results based on the enhanced limiter logic. The limiter should be triggered for Interval 2 because the change in conformance from the previous interval is greater than the power balance constraint infeasibility. The limiter should not be triggered for Interval 5 because there is no change in conformance from previous intervals.

As shown in Examples 7 – 9, the enhanced logic of the conformance limiter ensures the change in conformance and infeasibility values between intervals is known. It also recognizes change in direction (negative to positive, or positive to negative) and does not require that the conformance and infeasibility are in the same direction. Finally, it builds a memory from previous intervals to determine if the limiter should be applied.

These straightforward enhancements improve the accuracy of the limiter and do not have any adverse effects. 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.

4. Stakeholder Engagement and EIM Governing Body Role

The Imbalance Conformance Enhancements initiative has a combined Issue Paper and Straw Proposal. Combining the Issue Paper and Straw Proposal for this initiative allows proposed solutions, which were been previously presented in the Technical Bulletin, to be discussed earlier in the policy initiative stakeholder process. A Draft Final Proposal will follow the combined Issue Paper/Straw Proposal.

4.1. Schedule

Table 1 lists the planned 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 6, 2017
Stakeholder Comments Due	December 20, 2017
Post Draft Final Proposal	January 24, 2018
Stakeholder Conference Call	January 31, 2018
Stakeholder Comments Due	February 14, 2018
EIM Governing Body Meeting	March 8, 2018 (preliminary)
ISO Board of Governors Meeting	March 21, 2018 (preliminary)

This is a preliminary schedule and the ISO will extend the stakeholder process if more time is needed to develop the approach. The EIM Governing Body Meeting and ISO Board of Governor meeting dates will be finalized at a later date. Assuming the stakeholder process results in proposed tariff changes, 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 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.

4.2. EIM Governing Body Role

The Imbalance Conformance Enhancements initiative proposes changes to market rules and if necessary the development of new market rules that are generally applicable to the ISO markets. The process of conforming, which is handled manually by ISO and EIM Entity operations personnel, is necessary for system reliability to maintain balance between supply and demand. The Imbalance Conformance Enhancements initiative will likely add or revise tariff provisions to govern conformance and propose enhancements for the conformance limiter, which is part of the ISO's market software. The new or revised rules that the ISO expects to develop will apply generally to the conformance process used in all markets, including the real-time market, without rules that are specific to EIM balancing authority areas. As such, this initiative is being classified as E2 – the policy initiative falls entirely within the EIM Governing Body's advisory role.

As explained in the Guidance for Handing Policy Initiatives document[10], "To the extent a policy initiative proposes modification of generally applicable rules of the ISO's real-time market or rules that govern all ISO markets, the EIM Governing Body has an advisory and consultative role. It has the right to submit to the Board its advice on any such issue, which the Board will consider when deciding on the amendment."

Stakeholders are encouraged to submit a response to the EIM categorization in their written comments following the conference call for the Issue Paper/Straw Proposal, particularly if they have concerns or questions. The ISO requests stakeholders to submit written comments to: InitiativeComments@caiso.com.

[10] 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

5. Next Steps

The ISO will discuss the Issue Paper/Straw Proposal during the stakeholder conference call on December 6, 2017. The ISO requests stakeholders submit written comments in response to the Imbalance Conformance Enhancements Issue Paper/Straw Proposal paper and conference call by December 20, 2017 to InitiativeComments@caiso.com.