Stepped Constraint Parameters

Straw Proposal

February 28, 2017

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1. Background

The security constrained unit commitment (SCUC) and economic dispatch (SCED) optimization software for the CAISO markets utilize a set of configurable scheduling and pricing parameters that specify the criteria for the software to relax market constraints when necessary to reach a feasible solution. The pricing parameters also specify the criteria for establishing market prices in instances where one or more non-priced quantities are adjusted by the market clearing software.

This initiative will consider the appropriate configurations for market scheduling and pricing parameters and related design decisions. These market parameters are associated with optimization constraints and govern conditions that may set market prices and/or relax constraints. The magnitude of such market parameter values reflect the hierarchical priority order in which the associated constraint may be relaxed in that market by the market software.

2. Changes from issue paper

Transmission constraint parameter

Previously the CAISO proposed to relax the transmission constraints based upon the magnitude of the violation and voltage level. The CAISO originally proposed to have a relaxation tier priced below the bid cap for both high voltage and low voltage.

Stakeholders did not support having transmission relaxation parameters below the bid cap. However with the new FERC Order No. 831 the bid cap will rise to $2000 / MWh. In light of the new cap the CAISO proposes to relax only the transmission constraint for low voltage violations (115kV and lower) at $1500 / MWh scheduling parameter in the event the original limit is exceeded by 2% or more. For high voltage and remaining low voltage the relaxation parameter will be $2500 / MWh, which is a $1000 / MWh increase to reflect the increase in the bid cap.

Shift factor effectiveness

The CAISO proposed to reduce the threshold from 2% to 1% or 0.1%. The intent was if the threshold is reduced then there are more potential economic bids and thus, more ways to resolve congestion. The CAISO proposes to defer consideration of lowering the effectiveness threshold until after the CAISO has experience with performance of the real-time market, under the planned redesign, because of concerns over execution time. These concerns arise because this redesign will increase the functions performed in the real-time dispatch. In addition, proposed enhancements to the EIM GHG accounting design will require the real-time dispatch to be performed twice.

Power balance constraint

The CAISO is proposing a two-step relaxation parameter for upward power balance constraint violations. The first step will release up to 10% of regulation up capacity procured at a price of $155 / MWh. The percentage of regulation up capacity the CAISO will be using will be posted in

the Business Practice Manual (BPM). Based on current analysis, which is reviewed below, the CAISO is proposing to start with 5% of regulation up in the CAISO balancing area and 5% of available upward balancing capacity in EIM balancing areas. The second step will be set at the bid cap in the pricing run as is done today.

EIM resources sufficiency evaluation

Currently, when an EIM entity or the CAISO fails the upward or downward resource sufficiency evaluation for an operating hour, the EIM transfer limit is set zero to restrict additional transfers into or out of, respectively, the failing EIM balancing authority area. In the issue paper, the CAISO discussed implementing a penalty structure similar to the load under-scheduling penalties and over-scheduling penalties as an alternative to freezing transfers. However there was limited stakeholder support for moving to a penalty approach.

Under the CAISO's planned redesign of the real-time market, the 15-minute interval real-time unit commitment process (RTUC) currently used for the 15-minute market (FMM), including its resource sufficiency evaluation, will be eliminated. These functions would then be performed in the 5-minute interval real-time dispatch. During the planned real-time market redesign initiative, the CAISO will consider if the transfers should be frozen for a given operating hour or only in the intervals in which the EIM entity or the CAISO has insufficient economic bids to meet its imbalances independently of the other EIM balancing authority areas.

Lowering the energy bid floor

The bid floor was addressed separately in the CAISO's Self-Schedules Bid Cost Recovery Allocation and Bid Floor[1] initiative, which was focused on design changes to address over supply concerns. At the conclusion of this initiative the decision was made to not change the bid floor at this time.

FERC Order No. 831

This order requires the CAISO to allow energy bids to be submitted up to $2000 / MWh. Since many of the relaxation parameters are set relative to the bid cap and bid floor, the CAISO is reviewing appropriate changes in penalty prices necessary to comply with Order No. 831 as part of this stakeholder initiative. Also, to comply with Order No. 831, the CAISO will need to develop a process to validate the cost basis of bids above $1000 / MWh. This process will be developed as part of the CAISO's Commitment Costs and Default Energy Bid Enhancements[2] stakeholder initiative currently underway.

[1] Additional information is available at http://www.caiso.com/informed/Pages/StakeholderProcesses/SelfSchedulesBidCostRecoveryAllocation_BidFloor.aspx

[2] Additional information is available at http://www.caiso.com/informed/Pages/StakeholderProcesses/CommitmentCosts_DefaultEnergyBidEnhancements.aspx

3. Plan for Stakeholder Engagement

The CAISO plans to present its proposal developed through this initiative for approval at the May 2017 Board of Governors meeting. As this initiative addresses market rules generally applicable to the real-time market, it falls under the EIM Governing Body's advisory role. The current schedule for the policy stakeholder process leading up to this Board of Governors meeting is below.

Item	Date
Publish Straw Proposal	February 28, 2017
Stakeholder meeting	March 8, 2017
Stakeholder comments due	March 14, 2017
Publish Draft Final Proposal	March 28, 2017
Stakeholder call	April 4, 2017
Stakeholder comments due	April 11, 2017
EIM Governing Body Meeting	April 19, 2017
Board of Governors Meeting	May 1-2, 2017

4. Transmission constraint relaxation parameter

The transmission constraint relaxation parameter establishes the cost threshold at which the market software will relax an internal transmission constraint to avoid expensive and ineffective market solutions. In the pricing run, the pricing parameter is set to the lesser of the energy bid cap or the penalty price used by the scheduling run to relax the constraint.

Previously, the CAISO proposed to relax both constraints for 115 kV and 230kV transmission. These constraints would be relaxed based upon both the magnitude of the violation and the voltage level of the transmission path. The intent of setting the relaxation parameter's first tier at $1500 / MWh for 115kV and lower voltages and at $2500 / MWh for 230kV and higher voltages was to further promote efficient Real-Time Market (RTM) dispatch for small amounts of limit violation in the market outcome. The length of the segment at 2% of the limit for the first tier considers the operational margin, which is normally set to 3 to 5% below the actual limit by the system operators.

However, the CAISO is no longer proposing to have a relaxation tier priced below the bid cap for both high voltage and low voltage transmission constraints because stakeholders did not support having transmission relaxation parameters below the energy bid cap.

Nevertheless, in light of the increased energy bid cap under FERC Order No. 831, the CAISO now proposes to relax only the transmission constraint for low voltage violations (115kV and lower) at $1500 / MWh scheduling parameter in the event the original limit is exceeded by 2% or more. This is because exceeding low voltage constraints is less of a potential reliability impact than exceeding high voltage constraints and consequently should have a lower parameter relaxation penalty price. For high voltage and remaining low voltage the relaxation parameter will be $2500 / MWh, which is a $1000 / MWh increase to reflect the increase in the bid cap.

5. Power balance constraint

The CAISO is proposing a two-step relaxation parameter for upward power balance constraint violations for the 5-minute real-time dispatch. This will be done in the 5-minute real-time dispatch to prevent short transient price intervals of small infeasibilities when not in true scarcity. This reflects that there may be instances in which load should be met through regulation up resources Automatic Generation Control (AGC) instruction versus higher priced dispatch instructions to other resources or triggering penalty prices tied to the bid.

The first step will be set at up to 10% of regulation up capacity procured at a price of $155 / MWh. The percentage of regulation up capacity the CAISO will be using will be posted in the BPM. The second step will be set at the bid cap in the as is done today. The CAISO is proposing no change to the 15-minute market which will retain a single step set at the bid cap. The CAISO is also proposing to maintain the existing downward power balance constraint single step in both the 15-minute market and real-time dispatch which is set at ($155) / MWh.

For EIM balancing authority areas, the CAISO is also proposing a two-step relaxation parameter only for the upward power balance constraint in the 5-minute real-time dispatch. The first step will be set at up to 10% of the upward available balancing capacity submitted for the operating hour at a price of $155 / MWh. The percentage of regulation up capacity the CAISO will be using will be posted in the BPM. The second step will be set at the bid cap as is done today after all available balancing capacity has been exhausted.

Background

After the implementation of the Energy Imbalance Market, the CAISO observed instances in which the power balance limit had to be relaxed because of insufficient economic bids which resulted in prices being set at the power balance constraint relaxation parameters[3]. However, since the EIM entity maintains balancing authority responsibilities, the EIM entity had available resources to meet its load. The market optimization was not able to recognize that this available capacity that is manually dispatched to maintain system balance within the balancing authority area. If the market optimization could recognize this capacity and include it in the

[3] The relaxation parameters are a function of the bid cap and the bid floor. The upward power balance constraint is relaxed at $1000/MWh and the downward power balance constraint relaxation is ($155)/MWh.

economic dispatch, prices would be set based upon the last economic energy bid[4] instead of the relaxation parameter.

In March 2015, the CAISO implemented its "available balancing capacity" design which allows the market to recognize the additional resources the EIM entity uses to meet its balancing authority responsibilities. The design ensures that this capacity is only included in the bid stack in the event that the balancing authority area's individual power balance constraint is being violated because of insufficient economic bids from participating resources within its balancing authority area. When the available balancing capacity is deployed, these resources are included in the bid stack, which allows the LMP within the balancing authority area to be set by the marginal economic bid and not the power balance constraint relaxation parameter.

When developing the available balancing capacity design, the CAISO reviewed approaches developed by other ISO/RTOs. Potential power balance constraint infeasibilities between half of a percent to 1 percent of intervals are not unusual for ISO/RTOs that do not relax regulation or reserve constraints. To mitigate instances of small power balance constraint infeasibilities triggering extreme prices, other ISOs have recognized that for small infeasibilities of a transient nature, the ISO was not in true scarcity because it had sufficient operating reserves that could be utilized without negatively impacting reliability. Other ISOs rationally relate prices in these intervals to the practices which resolve the imbalance. In the NYISO for instance, a system of penalty prices allows the operator to balance the system, which includes releasing up to 25 MW at a penalty price of $25 / MWh and 55MW at $400 / MWh. Over the years, they have evolved the amount of regulating capacity made available in the dispatch and the penalty price at which it is made available based on operator experience with the value of retaining the incremental regulating capacity[5].

Determining the MW quantity of first step

The CAISO analyzed its 4-second regulation activation data to calculate the percentage of regulation up capacity that is used by automated generation control to meet reliability standards to manage area control error (ACE). Assuming the load forecast is perfect in the real-time dispatch, when the power balance constraint is relaxed the shortfall must be made up through AGC signals to resources providing regulation up. If there is sufficient AGC headroom within regulation up capacity to balance load and generation within the interval, then the inability to balance load and generation within the dispatch does not result in balance supply and demand within that 5-minute interval. If however, there is insufficient AGC headroom on regulation up

[4] If a resource bid $1000/MWh and was not mitigated, the last economic bid would equal the current $1000/MWh relaxation parameter. Under the available balancing capacity design, if the transfer limit into the balancing authority area is binding, local market power mitigation rules will be in effect and since all bids within that balancing authority area are effective address the transfer limit congestion, all internal resources' bids will be mitigated.

[5] The actions of other ISO/RTO was discussed at the April 17, 2015 Market Surveillance Commitment meeting by Dr. Scott Harvey. The presentation is available at http://www.caiso.com/Documents/Discussion_EnergyImbalanceMarketPotentialPricingSolutions-MSC_Presentation-April2015.pdf

capacity, the market should set the scarcity price at the bid cap because the system is unable to balancing supply and demand within that 5-minute interval.

The MW quantity of the first step must be determined prior to the market optimization starting to run. The CAISO also procures different amounts of regulation up capacity by operational hour. To determine the MW quantity of regulation capacity that will be released at the $155 penalty price, the CAISO reviewed historical AGC usage of resources that were awarded regulation up capacity. The historical usage is calculated as the percentage of the 4-second AGC signal to the awarded regulation up capacity. The percentage can then be applied to the hourly procurement target for regulation up.

Figure 1 below uses the average AGC signal over a 5-minute dispatch interval in a given operating hour necessary to bring ACE to zero divided by the amount of regulation capacity procured for that 5-minute interval. The data below does not measure actual regulation instructions because it does not account for physical limitations that might be present in the system or on units providing regulation (such as ramp rate limitations).

The CAISO then calculated the 95th percentile for each hour of the average 5-minute AGC signal observed in 2016. As seen, by the blue line in Figure 1, there is at least 5% of regulation capacity that provides available AGC headroom to cover the regulation capacity used to relax the upward power balance violation.

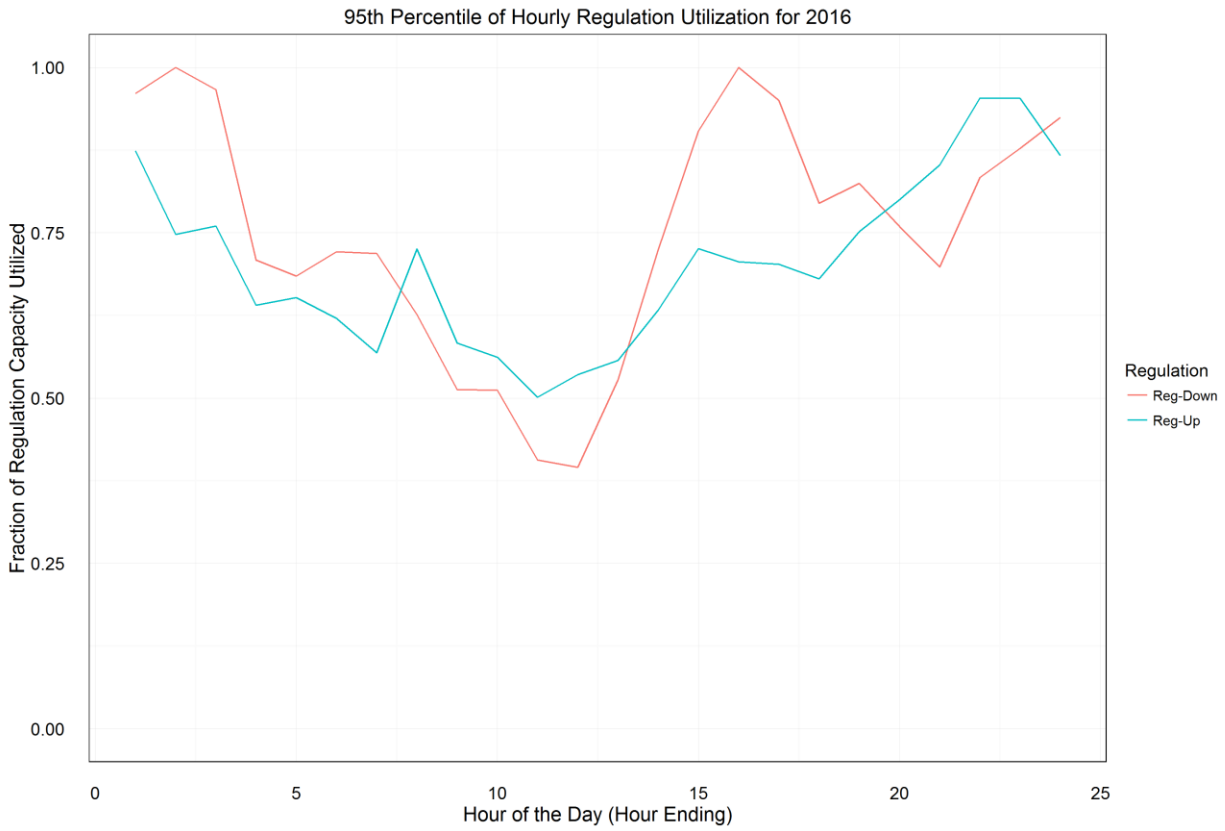

Figure 1: Regulation Capacity for 2016

Therefore the CAISO is proposing to initially set the MW quantity of the first step at 5% of the regulation up capacity procured, because the AGC headroom form regulation up is routinely available. The CAISO will also allow operators to eliminate the first step entirely during intervals where the risk to relying on AGC headroom is high.

The CAISO procures 100% of its forecasted regulation up capacity in the day-ahead market. The CAISO can also procure incremental regulation up capacity in the 15-minute market. The final awarded regulation from both the day-ahead and 15-minute market will be used to set the MW quantity step to be used in the three relevant 5-minute intervals.

For EIM balancing authority areas, the CAISO does not receive the MW quantity of resource that are providing 4-second AGC to maintain ACE within the 5-minute interval. However, the EIM entity does communicate the upward available balancing capacity on an hourly basis. The available balancing capacity includes resource that are only available to the market in the event of a power balancing constraint violation within its balancing authority area. So, this capacity includes resources that are meeting other reliability requirements beyond 4-second AGC to maintain ACE within the 5-minute interval. Therefore, the CAISO believes that 5% of available balancing capacity can be used to set the first step MW quantity on an hourly basis.

As discussed more below, the CAISO will enforce a constraint that the use of the first step to relax the power balance constraint can only be used to meet an individual balancing authority areas shortfall and will not be used to meet load in other balancing authority areas in the EIM, including the CAISO.

Determining the price of the first step

To determine the price of the first step the CAISO looked at historical system marginal energy cost data for 2015 and 2016. The CAISO then sorted the 5-minute data from lowest SMEC to highest SMEC. The CAISO wanted to set the price such that the power balance constraint is being routinely relaxed before accepting available economic bids. As shown in the figures below, once prices exceed $150 / MWh they quickly rise to the bid cap. In Figure 1 below all of the SMEC points can be seen on one graph, while Figure 2 takes a closer look at the chosen price range. Other studies were completed based off different seasons throughout the year and all the graphs had the same shape and results.

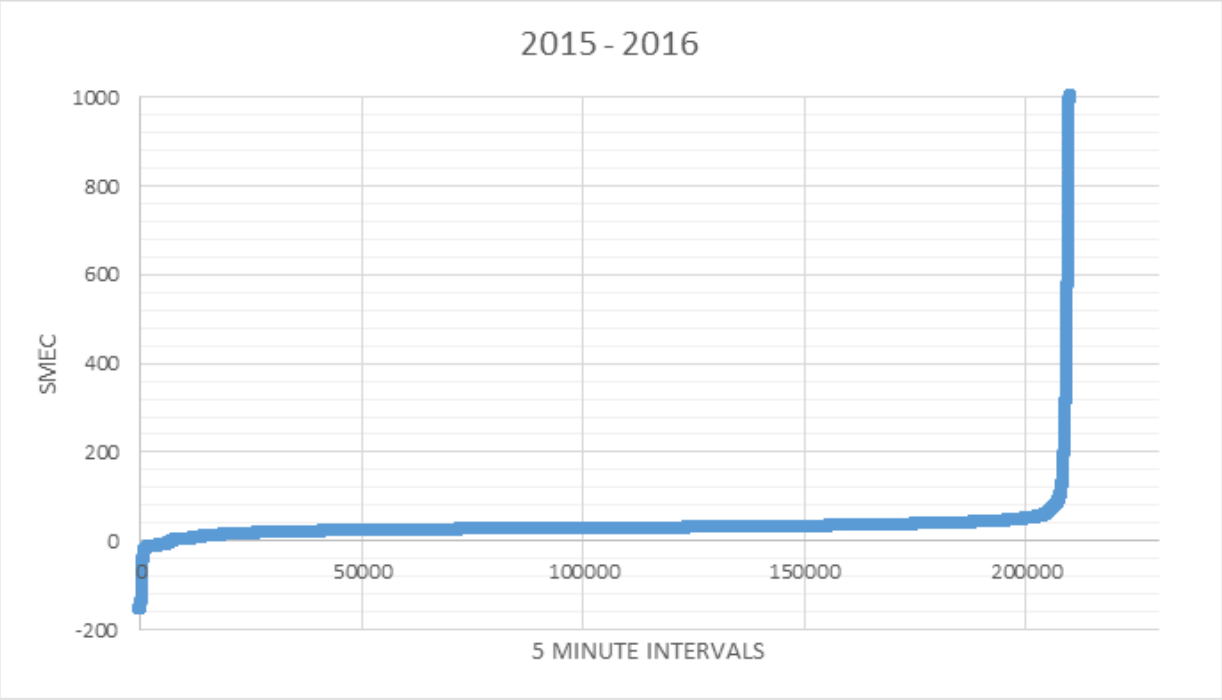

Figure 2: All SMEC data over two years

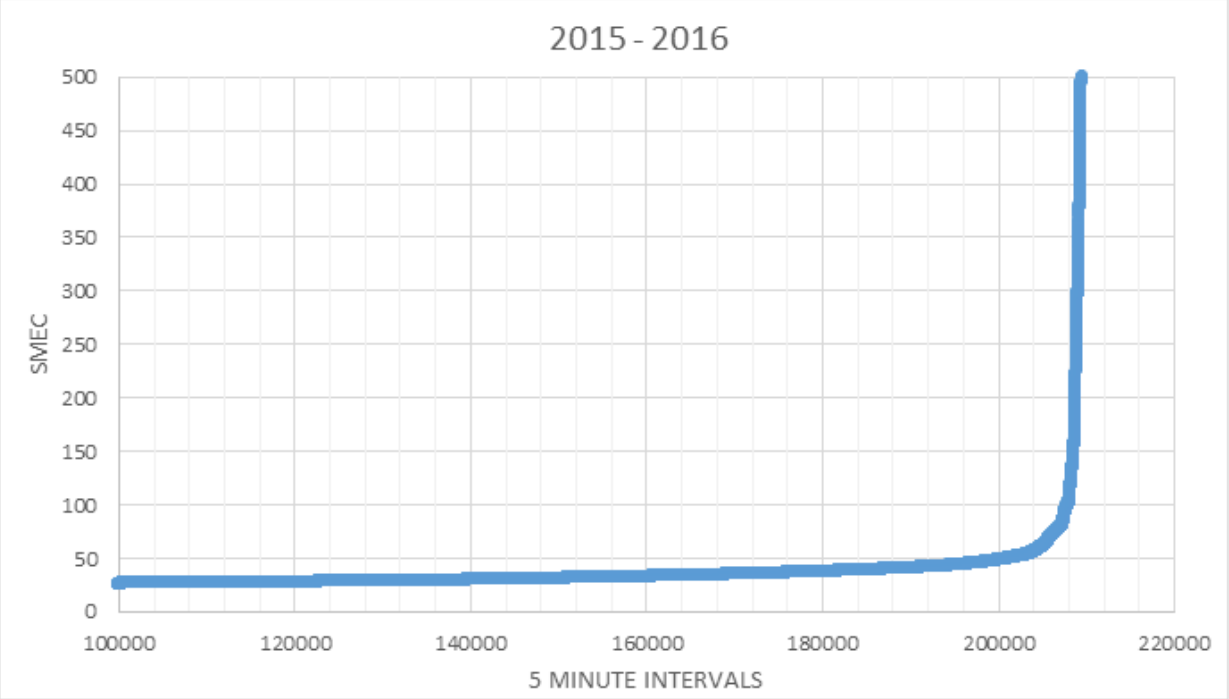

Figure 3: Zoomed into SMEC curve

Since the single downward power balance constraint relaxation tier is set at ($155) / MWh the CAISO believes that symmetry between first step of the upward power balance constraint can improve price convergence between day-ahead, 15-minute market, and real-time dispatch. Therefore the CAISO is proposing a step price of $155 / MWh.

Interaction with load conformance limiter

A load conformance is an adjustment –positive or negative– to the overall automated forecasted load requirement used in clearing the real-time market. How much the load requirement is conformed is the result of the operators' best judgement of current system operational and reliability needs that were not factored into the load forecast or the available supply expected by the market dispatch application. Because the load adjustments are manual, these adjustments are, by nature, coarse adjustments made to respond quickly to rapidly changing system conditions and tend not to be finely tuned or gradually applied.

The CAISO uses a load conformance limiter[6] in the CAISO and in each of the EIM balancing authority areas to prevent artificial infeasibilities from occurring because of manually driven over-adjustments when using load conformance. "Artificial" refers to infeasibilities that do not reflect actual scarcity conditions. The load conformance will be limited before the first step of the upward power balance constraint can be relaxed. For example, assume the first step of the power balance constraint is 15 MW and a load conformance was entered for 500 MW; however, there are only 200 MW of ramp feasible economic bids. The load conformance will be reduced to 200 MW. The 15 MW from the first step of the power balance constraint will be used before feasible bids that are above $155 / MWh.

Power balance constraint formulation in the EIM

In the EIM, there is a power balance constraint for each EIM balancing authority, as well as a system power balance constraint that that contains all EIM balancing authority areas and the CAISO.

The set of power balance constraints does not need a CAISO specific power balance constraint. This would be a redundant constraint, given that CAISO is part of the system constraint and there are individual constraints for all other balancing authority areas included in the system power balance constraint. When all EIM balancing authority areas are balanced, but the system power balance constraint is still not satisfied and must be relaxed, this must mean that there is a shortage in the CAISO balancing authority area.

When available balancing capacity was implemented in March 2015, two constraints for each EIM balancing authority area, including the CAISO, were introduced – one for the upward direction and the other for the downward direction. These constraints ensure that the available

[6] Additional information is available at http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=E1C05272-E1BD-498F-B6A0-C8A4BCCA83A9

balancing capacity is used only to support local infeasibilities. The upward direction constraint will include the slack variable "under-Gen slack" of the power balance constraint:

(UPWARD_ABC + under-Gen slack) * (T – Tbase) <= 0,

where T is EIM Transfer and

Tbase is base EIM Transfer

This is to guarantee that both upward available balancing capacity and power balance constraint relaxation will not be dispatched for supporting other BAAs. In other words, both can only be used locally.

Interaction with EIM available balancing capacity

In the scheduling run, available balancing capacity[7] is released between $1000.00 / MWh and $1100 / MWh. This ensures that all available bids, which are mitigated, up to the bid cap are scheduled prior to releasing available balancing capacity into the bid stack used in the pricing run. Since the first step of the upward power balance constraint is released at $155 / MWh, it will be used before releasing available balancing capacity. If the power balance constraint violation exceeds the first step, then the full quantity of available balance capacity will be released. This could result in a power balancing constraint shortfall that is greater than available balancing capacity in a given interval before triggering the penalty price at the bid cap. For example, assume there is 100 MW of upward available balancing capacity. This results in 5 MW for the first tier of the power balance constraint relaxation. If the shortfall is between 100 MW and 105 MW, the bid cap price will not be triggered. This assumes that the 5 MW used to relax the power balance constraint is being met by other resources available to the EIM balancing authority area that are not submitting economic bids or have not been identified as providing available balancing capacity.

It is important to note, that the available balancing capacity design does dispatch resources providing available balancing capacity based upon telemetry. In the event, that the power balancing constraint was relaxed in the previous market interval and these resources received AGC instructions to meet load, this will reduce the available balancing capacity in the current market interval.

Interaction with Flexible Ramping Product

Currently, the flexible ramping product procures additional upward ramping capability through a demand curve. This demand curve is calculated based upon the probability of an upward power balance constraint and as such setting energy prices at the bid cap. The demand curve represents the avoided cost of the power constraint violation so that the market only procures additional ramping capability if the cost of doing so is less that the avoided costs of a potential

[7] Additional information on the available balancing capacity design is available in FERC docket number ER15-861-003.

violation. The demand curve is also capped at $247 / MWh in order to relax procurement of ramping capability to meet uncertainty before relaxing ancillary services procurement.

As discussed above, the CAISO is proposing to relax the upward power balance constraint at $155 / MWh. The CAISO is not proposing to modify the upward flexible ramping product demand curve. This could result in the market relaxing the power balance constraint in the current interval while still holding ramping capability to meet energy needs in a future interval. When relaxing the power balance constraint, the market is relying on meeting its current interval load through AGC signals to available regulation capacity versus dispatch instructions higher cost resources.

6. Changes needed to comply with FERC Order No. 831

This order requires the CAISO to allow economic bids to be submitted up to $2000 / MWh. Since many of the relaxation parameters are set relative to the bid cap and bid floor, the CAISO is reviewing as part of this stakeholder initiative review appropriate changes in penalty prices necessary to comply with Order No. 831.

In the Appendix below includes tables from the Market Operations business practice manual that document the parameter valuates used in the various markets. The parameter values are organized into three sections: the Integrated Forward Market (IFM), the Residual Unit Commitment (RUC), and the Real Time Market (RTM). The parameters in these tables are penalty factors, which are associated with constraints on the optimization and which govern the conditions under which constraints may be relaxed and the setting of market prices when any constraints are relaxed. Importantly, the magnitude of the penalty factor values in the tables for each market reflect the hierarchical priority order in which the associated constraint may be relaxed in that market by the market software.

Currently the CAISO has simply increased each relevant penalty parameter by $1000 / MWh to scale to the new bid cap of $2000 / MWh. This approach maintains the currently priority order among the penalty prices. The CAISO is assessing if additional changes are needed since the relative priority is also important. The CAISO is planning to update this appendix in the draft final proposal if changes are needed.

7. Next Steps

The CAISO plans to discuss this straw proposal with stakeholders during a stakeholder conference call to be held on March 8th. The CAISO requests comments from stakeholders on the proposed scope of this initiative to review the stepped constraint parameters. Stakeholders should submit written comments by March 14th to intitiativecomments@caiso.com.

8. Appendix

Integrated Forward Market (IFM) Parameter Values

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
Market energy balance	Market energy balance is the requirement that total supply equal the sum of total demand plus losses for the entire system. In the IFM energy balance reflects the clearing of bid-in supply and demand; in the MPM component of the DAM it reflects the scheduling of bid-in supply against the ISO demand forecast.	6500	1000	7500	2000	Increase by $1000 to align with $2000 bid cap
Transmission constraints: Intertie scheduling	Intertie scheduling constraints limit the total amount of energy and ancillary service capacity that can be scheduled at each scheduling point.	5000	1000	6000	2000	Increase by $1000 to align with $2000 bid cap
Reliability Must-Run (RMR) pre-dispatch curtailment (supply)	The ISO considers transmission constraints when determining RMR scheduling requirements. After the ISO has determined the RMR scheduling requirements, the	-6000	-150	-6000	-150	

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	market optimization ensures that the designated capacity is scheduled in the market.					
Pseudo-tie layoff energy	Pseudo-tie layoff energy is scheduled under contractual arrangements with the Balancing Authority in whose area a pseudo-tie generator is located.	-4000	-150	-4000	-150	
Transmission constraints: branch, corridor, nomogram (base case and contingency analysis)	In the scheduling run, the market optimization enforces transmission constraints up to a point where the cost of enforcement (the "shadow price" of the constraint) reaches the parameter value, at which point the constraint is relaxed.	5000	1000	6000	2000	Increase by $1000 to align with $2000 bid cap
Transmission Ownership Right (TOR) self schedule	A TOR Self-Schedule will be honored in the market scheduling in preference to enforcing transmission constraints.	5900, -5900	1000, -150	6900, -5900	2000, -150	Increase by $1000 to align with $2000 bid cap
Existing Transmission Contract (ETC) self schedule	An ETC Self-Schedule will be honored in the market scheduling in preference to	5100 to 5900, -5100 to -5900	1000, -150	6100 to 6900, -5100 to -5900	2000, -150	Increase by $1000 to align

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	enforcing transmission constraints. The typical value is set at $5500, but different values from $5100 to $5900 are possible if the instructions to the ISO establish differential priorities among ETC rights. For some ETC rights the ISO may use values below the stated scheduling run range if that is required for consistency with the instructions provided to the ISO by the PTO.					with $2000 bid cap
Converted Right (CVR) self schedule	A CVR Self-Schedule is assigned the same priority as the typical value for ETC Self-Schedules.	5500, -5500	1000, -150	6500, -5500	2000, -150	Increase by $1000 to align with $2000 bid cap
Ancillary Service Region Regulation-up and Regulation-down Minimum Requirements	In the event of bid insufficiency, AS minimum requirements will be met in preference to serving generic Self-Scheduled demand, but not at the cost of overloading transmission into AS regions.	2500	250	3500	1250	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
Ancillary Service Region Spin Minimum Requirements	Spinning reserve minimum requirement is enforced with priority lower than regulation up minimum requirement in scheduling run.	2250	250	3250	1250	Increase by $1000 to align with $2000 bid cap
Ancillary Service Region Non-Spin Minimum Requirements	Non-spin reserve minimum requirement is enforced with priority lower than spin minimum requirement in scheduling run.	2000	250	3000	1250	Increase by $1000 to align with $2000 bid cap
Ancillary Service Region Maximum Limit on Upward Services	In the event of multiple AS regional requirements having bid insufficiency, it is undesirable to have multiple constraints produce AS prices equaling multiples of the AS bid cap. An alternative way to enforce sub-regional AS requirements is to enforce a maximum AS requirement on other AS regions, thereby reducing the AS prices in the other regions without causing excessive AS prices in the sub-region with bid insufficiency.	1500	250	2500	1250	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
Self-scheduled CAISO demand and self-scheduled exports using identified non-RA supply resource	Pursuant to section 31.4, the uneconomic bid price for self-scheduled demand in the scheduling run exceeds the uneconomic bid price for self-scheduled supply and self-scheduled exports not using identified non-RA supply resources.	1800	1000	2800	2000	Increase by $1000 to align with $2000 bid cap
Self-scheduled exports not using identified non-RA supply resource	The scheduling parameter for self-scheduled exports not using identified non-RA capacity is set below the parameter for generic self-schedules for demand.	1150	1000	2150	2000	Increase by $1000 to align with $2000 bid cap
Regulatory Must-Run and Must Take supply curtailment	Regulatory must-run and must-take supply receive priority over generic self-schedules for supply resources.	-1350	-150	-1350	-150	
Price-taker supply bids	Generic self-schedules for supply receive higher priority than Economic Bids at the bid floor.	-400	-150	-400	-150	
Conditionally qualified Regulation Up	Conversion of AS self-schedules to Energy pursuant to section 31.3.1.3	-405	NA	-405	NA	

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
or Down self-provision	received higher priority to maintaining the availability of regulation, over spinning and non-spinning reserve.					
Conditionally qualified Spin self-provision	Conversion of AS self-schedules to Energy pursuant to section 31.3.1.3 receives higher priority to maintaining the availability of spinning reserve, over non-spinning reserve.	-400	NA	-400	NA	
Conditionally qualified Non-Spin self-provision	This penalty price for conversion of self-provided non-spinning reserves balances the maintenance of AS self-schedules with ensuring that the conversion to energy occurs before transmission constraints are relaxed.	-395	NA	-395	NA	

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
Conditionally unqualified Reg Up or Down self-provision	In instances where AS self-provision is not qualified pursuant to the MRTU tariff, the capacity can still be considered as an AS bid, along with regular AS bids. The price used for considering unqualified AS self-provision is lower than the AS bid cap, to allow it to be considered as an Economic Bid.	-195	NA	-195	NA	
Conditionally unqualified Spin self-provision	Same as above.	-170	NA	-170	NA	
Conditionally unqualified Non-Spin self-provision	Same as above.	-155	NA	-155	NA	

Residual Unit Commitment (RUC) Parameter Values

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
Transmission constraints: Intertie scheduling	The Intertie scheduling constraint retains higher relative	2000	250	3000	1250	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	priority than other RUC constraints.					
Market energy balance -under procurement	The RUC procurement may be less than the Demand forecast if the CAISO has committed all available generation and accepted intertie bids up to the intertie capacity.	1600	0	2600	1000	Increase by $1000 to align with $2000 bid cap
Transmission constraints: branch, corridor, nomogram (base case and contingency analysis)	These constraints affect the final dispatch in the Real-Time Market, when conditions may differ from Day-Ahead.	1250	250	2250	1250	Increase by $1000 to align with $2000 bid cap
Maximum energy limit in RUC schedule	Limits the extent to which RUC can procure energy rather than unloaded capacity to meet the RUC target. For MRTU launch the limit will be set so that the total energy scheduled in the IFM and RUC will be no greater than 99% of the RUC target unless this limit is relaxed in the RUC scheduling run.	1500	250	2500	1250	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
Limit on quick-start capacity scheduled in RUC	Limits the amount of quick-start capacity (resources that can be started up and on-line within 5 hours) that can be scheduled in RUC. For MRTU launch the limit will be set to 75%.	250	0	1250	1000	Increase by $1000 to align with $2000 bid cap
Day-Ahead energy schedules resulting from the IFM run	These values preserve schedules established in IFM in both the RUC scheduling run and pricing run.	250	0	1250	1000	Increase by $1000 to align with $2000 bid cap
Market energy balance -over procurement	Market energy balance when the RUC procurement may be more than the Demand forecast.	200	0	1200	1000	

Real Time Market Parameters

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
Energy balance/Load curtailment and Self-Scheduled exports utilizing non-RA capacity	Scheduling run penalty price is set high to achieve high priority in serving forecast load and exports that utilize non-RA capacity. Energy bid cap as pricing run parameter	1450	1000	2450	2000	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	reflects energy supply shortage.					
Transmission constraints: Intertie scheduling	The highest among all constraints in scheduling run, penalty price reflects its priority over load serving. Energy bid cap as pricing run parameter reflects energy supply shortage.	1500	1000	2500	2000	Increase by $1000 to align with $2000 bid cap
Reliability Must-Run (RMR) pre-dispatch curtailment (supply), and Exceptional Dispatch Supply	RMR scheduling requirement is protected with higher priority over enforcement of internal transmission constraint in scheduling run. Energy bid floor is used as the pricing run parameter for any type of energy self-schedule.	-6000	-150	-6000	-150	
Pseudo-tie layoff energy	Same priority of protection as RMR schedule in scheduling run. Energy bid floor is used as the pricing run parameter for any type of energy self-schedule.	-1500	-150	-1500	-150	
Transmission constraints: branch, corridor,	Scheduling run penalty price will enforce internal transmission	1500	1000	2500	2000	Increase by $1000 to align with

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
nomogram (base case and contingency analysis)	constraints up to a re-dispatch cost of $ of congestion relief in $1500 per MWh. Energy bid cap as pricing run parameter consistent with the value for energy balance relaxation under a global energy supply shortage.					$2000 bid cap
Real Time TOR Supply Self Schedule	In RTM, TOR self-schedule scheduling run penalty price is much higher in magnitude than generic self-schedule but lower than transmission constraint. Energy bid floor is used as the pricing run parameter as any type of energy self-schedule.	-5900	-150	-5900	-150	
Real Time ETC Supply Self Schedule	In RTM the range of penalty prices for different ETCs supply self-schedules are much higher in magnitude than generic supply self-schedules but lower than TOR. Energy bid floor is the pricing	-5100 to -5900	-150	-5100 to -5900	-150	

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	parameter for all energy supply self-schedules.					
Ancillary Service Region Reg-Up and Reg-Down Minimum Requirements	Scheduling run penalty price is below the one for transmission constraint. Pricing run parameter is set to the AS market bid cap to reflect AS supply shortage.	1450	250	2450	1250	Increase by $1000 to align with $2000 bid cap
Ancillary Service Region Spin Minimum Requirements	Scheduling run penalty price is lower than the one for regulation-up minimum requirement. Pricing run parameter is set to the AS market bid cap to reflect AS supply shortage.	1400	250	2400	1250	Increase by $1000 to align with $2000 bid cap
Ancillary Service Region Non-Spin Minimum Requirements	Scheduling run penalty price is lower than the one for spin minimum requirement. Pricing parameter is set to the AS market bid cap to reflect AS supply shortage.	1350	250	2350	1250	Increase by $1000 to align with $2000 bid cap
Ancillary Service Region Maximum Limit on Upward Services	Scheduling run penalty price is lower than those for minimum requirements to avoid otherwise	1200	250	2200	1250	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	system-wide shortage by allowing sub-regional relaxation of the maximum requirement. AS market bid cap as pricing run to reflect the otherwise system-wide shortage.					
Self-scheduled exports not using identified non-RA supply resource	Scheduling run penalty price reflects relatively low priority in protection as compared to other demand categories. Energy bid cap as pricing run parameter to reflect energy supply shortage.	1150	1000	2150	2000	Increase by $1000 to align with $2000 bid cap
Final IFM Supply Schedule	Scheduling run penalty price is much higher in magnitude than supply generic self-schedule but lower than ETCs. Energy bid floor is the pricing parameter for all energy supply self-schedules.	-750	-150	-750	-150	
Regulatory Must-Run and Must Take supply curtailment	Scheduling run penalty price reflects the higher priority of regulatory must-run	-1400	-150	-1400	-150	

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	and must-take supply received over generic self-schedules for supply resources. Energy bid floor is the pricing parameter for all energy supply self-schedules.					
Price-taker supply bids	Energy bid floor is the pricing parameter for all energy supply self-schedules.	-400	-150	-400	-150	
Qualified Load Following self-provision Up or Down	Scheduling run penalty price reflects the highest priority among all categories of AS self-provision. AS bid floor is used as the pricing parameter for any type of AS self-provision.	-8500	0	-8500	0	
Day ahead conditionally qualified Reg Up or Down Award	Scheduling run penalty price is higher than the penalty price for energy balance constraint to reflect higher in priority over energy. AS bid floor is pricing parameter for any type of AS self-provision.	-7750	0	-7750	0	
Day ahead conditionally	Scheduling run penalty price is	-7700	0	-7700	0	

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
qualified Spin Award	lower than the one for Reg-up. AS bid floor is pricing parameter for any type of AS self-provision.					
Day ahead conditionally qualified Non-spin Award	Scheduling run penalty price is lower than the one for Spin. AS bid floor is pricing parameter for any type of AS self-provision.	-7650	0	-7650	0	
Conditionally qualified Reg Up or Down Real Time self-provision (RTUC only)	Scheduling run penalty price allows the conversion of AS self-schedules to Energy to prevent LMP of local area from rising so high as to trigger transmission constraint relaxation. AS bid floor is pricing parameter for any type of AS self-provision.	-405	0	-405	0	
Conditionally qualified Real Time Spin self-provision (RTUC only)	Scheduling run penalty price is below the one for regulating-up. AS bid floor is pricing parameter for any type of AS self-provision.	-400	0	-400	0	
Conditionally qualified Real Time Non-Spin	Scheduling run penalty price is below the one for	-395	0	-395	0	

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
self-provision (RTUC only)	spin. AS bid floor is pricing parameter for any type of AS self-provision.					
Conditionally unqualified Reg Up or Down Real Time self-provision (RTUC only)	In scheduling run, AS self-provision not qualified in pre-processing can still be considered as an AS bid with higher priority in the Energy/AS co-optimization along with regular AS bids. AS bid floor is pricing parameter for any type of AS self-provision.	-195	0	-195	0	
Conditionally unqualified Spin Real Time self-provision (RTUC only)	Same as above.	-170	0	-170	0	
Conditionally unqualified Non-Spin Real Time self-provision (RTUC only)	Same as above.	-155	0	-155	0	
System power balance constraint	To reflect the role regulation plays in balancing the system when economic bids are exhausted, the ISO allows the system power balance constraint to relax by as much as the seasonal regulation	1100, -155	1000, -155	2100, -155	2000, -155	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	requirement. The prices are selected to allow for coordinated dispatch of bids that may exist at or near the bid cap, or at or near the bid floor.					
Power Balance constraint for individual PACE and PACW areas.	Subject to the FERC order granting waiver of tariff sections 27.4.3.2.and 27.4.3.4, and consistent with Section 10.1.6 of the BPM for Energy Imbalance Market, which implement the price discovery mechanism overriding the pricing parameters and yielding the last economic signal under constraint relaxation. The scheduling run parameter is set to -750 for the individual EIM areas to coordinate the relaxation of the EIM power balance constraint during over-generation conditions relative to congestion on	1100, -750	1000, -150	2100, -750	2000, -150	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	non-EIM constraints.					
EIM Upward Available Balancing Capacity Range	The Penalty Price Range used for the Available Capacity Range prices to maintain the economic merit order reflected in the energy bid prices of the allocated energy bid portions	1200 through 1100	Bid in Prices Range for EIM Participating resource and DEB for EIM Non-Participating	2200 through 2100	Bid in Prices Range for EIM Participating resource and DEB for EIM Non-Participating	Increase by $1000 to align with $2000 bid cap
EIM Downward Available Balancing Capacity	The Penalty Price Range used for the Available Capacity Range prices to maintain the economic merit order reflected in the energy bid prices of the allocated energy bid portions	-250 through -350	Bid in Prices Range for EIM Participating resource and DEB for EIM Non-Participating	-250 through -350	Bid in Prices Range for EIM Participating resource and DEB for EIM Non-Participating	
EIM Transfer Constraint	Penalty price and pricing parameter consistent with the transmission constraint;	1500	1000	2500	2000	Increase by $1000 to align with $2000 bid cap
EIM Entitlement Rate of Change Constraint (RTD Only)	Penalty price aligned with EIM transfer constraint is currently applicable to RTD 5	1500	0	2500	1000	Increase by $1000 to align with $2000 bid cap

Penalty Price Description	Penalty Price Comment	Scheduling Run Value OLD	Pricing Run Value OLD	Scheduling Run Value NEW	Pricing Run Value NEW	Comment on Proposed Change
	minute rate of change.					
Flexible Ramping Constraint for ISO	The penalty price used to reflect the price at which the ISO will relax the constraint and procure flexible ramping capacity.	60	60	1060	1060	Increase by $1000 to align with $2000 bid cap
Flexible Ramping Constraint for individual PACE and PACW areas	Set to implement the FERC order granting waiver of tariff sections 27.4.3.2.and 27.4.3.4, and consistent with Section 10.1.6 of the BPM for Energy Imbalance Market, which implement the price discovery mechanism overriding the pricing parameters and yielding the last economic signal under constraint relaxation.	60	0 or near 0	1060	1000 or near 1000	Increase by $1000 to align with $2000 bid cap