California ISO
Your Link to Power

California Independent
System Operator Corporation

March 8, 2013

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

Re: California Independent System Operator Corporation
Docket No. ER13-____- 000-

Revision of Real-Time Scheduling Transmission Constraint Relaxation Parameter

Dear Secretary Bose:

The California Independent System Operator Corporation ("ISO") hereby submits for filing the attached amendment to its Fifth Replacement FERC Electric Tariff.[1] The proposed tariff amendment reduces the real-time transmission congestion relaxation parameter, *i.e.,* the point at which the ISO will relax a transmission constraint rather than rely on increasingly expensive and ineffective supply bids to resolve congestion, from $5,000 per megawatt-hour to $1,500 per megawatt-hour.

This change is necessary to arrive at a more effective and efficient market solution that reliably resolves congestion at a reasonable cost. A sudden increase in the cost of managing real-time congestion in July and August of 2012 caused the ISO to look more closely into drivers of such costs. The ISO's analysis revealed that in highly constrained conditions the current parameter setting leads to the use of less effective energy bids to relieve system congestion that come at a higher cost. Use of such ineffective bids provide *de minimus* incremental congestion relief compared to the result from lower parameter settings and can significantly and unnecessarily increase real-time congestion offset costs. The ISO's studies show that the lower real-time scheduling transmission constraint relaxation parameter will produce a reliable market solution at a more reasonable cost than the current parameter.

The ISO proposes an effective date for the amendment proposed in this filing of May 10, 2013.

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1 The ISO makes this filing pursuant to section 205 of the Federal Power Act, 16 U.S.C. § 825d (2006) and 18 C.F.R. Part 35.

I. SUMMARY

The ISO proposes to revise the real-time transmission constraint relaxation parameter in response to the dramatic increase in real-time congestion offset costs observed late last summer and into the fall of 2012. These costs remain relatively high compared to historic levels and, in light of the existing transmission constraints, the ISO expects them to remain so for the foreseeable future. The real-time congestion offset cost is an account that records the difference between the ISO's real-time congestion payments to generators and its real-time congestion charges to load. In the real-time market, this is primarily caused by transmission constraints that appear in real-time to be more limiting than those the ISO anticipated and reflected in the day-ahead market. In order to address these new constraints by relieving the congestion they create, the ISO must redispatch generation, *i.e.*, it must send incremental dispatch instructions to certain resources and decremental dispatch instructions to others, which generally results in a greater net payment of congestion costs to generators versus what is collected from demand.

The increase in real-time congestion offset costs that the ISO observed in the later part of the 2012 was the result of an increase in real-time constraints caused by a number of operational factors. Some were specific events, such as the outage of the San Onofre Nuclear Station and the California wildfires of last summer. Many of the increased constraints result from system operational changes and are not the direct result of a specific event. Rather, they are attributable to the change in operational practices resulting from the need for greater regional coordination with neighboring balancing authority areas, *e.g.,* new constraints resulting from lessons learned from the system outage events experienced on September 8, 2011. These practices have created a more constrained real-time environment overall. While the ISO has adopted other measures to better anticipate and address known real-time constraints in the day-ahead market, the ISO expects these system constraints to continue into the foreseeable future.

The transmission constraint relaxation parameter establishes the cost threshold at which the market software will relax an internal transmission constraint in order to avoid ineffective but costly market solutions. As a general matter, if the software identifies congestion on a particular constraint, it will try to relieve the congestion using economic bids to redispatch supply resources in the least-cost manner. Because the output of any particular resource is typically much less than 100 percent effective in resolving a given constraint, the ISO must often dispatch several megawatt-hours of incremental and decremental energy from different resources to obtain just one megawatt-hour of congestion relief on the constraint. When the cost of the next one-megawatt reduction reaches the predetermined transmission constraint relaxation parameter (currently $5000 per megawatt-hour), the software will relax the transmission limit so that it can produce a less costly solution.

Prior to submitting this filing, the ISO performed a series of analyses of the effect of a lower real-time transmission constraint relaxation parameter. The analyses showed that a reduction in the parameter to $1500 would produce significant savings (up to 36 percent) and with only a marginal reduction in effectiveness of resources bid into the market to relieve congestion (at most 5 to 6 percent reduction under acceptable redispatches). The fact that the reduction in effectiveness is *de minimis* also means that the reduction to $1500 would not negatively affect reliability. For these reasons, the ISO proposes in this amendment to set the real-time transmission constraint relaxation parameter at $1500 per megawatt hour. The ISO initially considered lowering the parameter to $2,500. However, upon further investigation it determined that lowering the parameter to $2,500 essentially provided the same congestion relief as the $1,500 setting. In contrast, the lower setting provided a significantly higher reduction in the cost of real-time congestion. The ISO also concluded that further lowering the real-time transmission constraint parameter to $1,000 would be counterproductive because it could prevent the dispatch of economic bids at the $1,000 bid cap and would interfere with the ISO's ability to establish schedule priorities. The ISO also does not propose to change the day-ahead transmission constraint relaxation parameter, currently set at $5,000, in order to ensure the full utilization of economic bids in the day-ahead market.

The ISO stresses that the transmission constraint relaxation parameter does not act as a price cap. As a result of the interaction of this constraint with other constraints in the market, the prices may still exceed the $1,500 setting. While the ISO anticipates there will be an impact on prices, the ISO also anticipates that the change will continue to appropriately compensate resources that are providing effective congestion relief. It does not deny generators any inherent value of their generation because any effective resource that is dispatch to relieve a constraint will be priced at least at its bid or better. The ISO also notes that because reducing the transmission constraint relaxation parameter will not have a significant effect on flow relief, the ISO does not expect any material increase in exceptional dispatches of resources that have effective economic bids available.

The ISO recognizes that it must evaluate measures to address other drivers of increased congestion offset, including accounting for expected congestion when running the day-ahead market and the ISO is undertaking such evaluations. The ISO does not believe, however, that the pursuit of these additional avenues to address real-time congestion and the real-time congestion offset is a legitimate basis to abandon the instant tariff revision that will provide necessary meaningful and reasonable cost relief while maintaining operationally effective constraint relief, given that the ISO's studies show that there is not legitimate basis for imposing the additional expense under any conditions.

Finally, a recent dip in the amount of the real-time congestion offset costs has led to questions as to whether the reduction of the parameter is still necessary. It does not. This reduction reflects a seasonal trend and the costs remain at an all-time high for the winter months. Most importantly, however, even if there were evidence that the reduction would persist, the ISO studies support the conclusion that there is no justification for the higher parameter setting when the constraint is binding. Equivalent congestion relief can be obtained through use of a lower parameter setting, which will greatly benefit ratepayers by reducing the costs they appear to be bearing unnecessarily. The ISO respectfully requests Commission approval of the proposed tariff amendment to avoid these unnecessary costs.

II. BACKGROUND

A. The Transmission Constraint Relaxation Parameter and the Real-Time Congestion Offset

1. Scheduling and Pricing Parameters

As the Commission is aware, the ISO operates day-ahead and real-time integrated markets for energy, ancillary services, and residual unit capacity. Absent operational constraints such as congestion (where scheduled flow would exceed transmission line limitations), the need to honor self-schedules, and reliability requirements, the ISO would match demand and supply based solely on price. Because those constraints exist, however, the ISO operates these markets using a software program that performs a mathematical algorithm known as constrained optimization. The two types of constrained optimization used in the ISO's markets are "security constrained unit commitment" and "security constrained economic dispatch." The goal of the constrained optimization algorithm is to produce a least-cost dispatch based on submitted economic bids by clearing the optimal amounts of the effective "economic bids" submitted by scheduling coordinators, subject to a set of identified constraints that limit the available choices. The economic bids submitted by market participants contain prices paired with quantities. The constraints are "non-priced" quantitative values in the software, which the software typically cannot adjust in the optimization process and which include the flow limits on transmission facilities, performance characteristics of generators (ramp rates, minimum run and minimum down times), procurement requirements for ancillary services, and self-schedules submitted by scheduling coordinators, which contain bid supply and demand quantities without associated prices. The market optimization technology contains configurable parameters through which the market operator establishes the manner in which the software will manage the various constraints in each market run. Mr. Mark A. Rothleder explains the operation of the ISO's markets in greater detail.[2]

The software seeks a feasible solution by accepting effective economic bids taking into consideration all these factors. A feasible solution means that (a) energy supply plus losses equals energy demand, (b) procured quantities of ancillary services

[2] *See* Exh. ISO-1, Testimony of Mark A. Rothleder, included as Attachment C, at 3-5. (Rothleder Testimony)

meet reliability requirements, and (c) the solution respects all physical operating limits – both transmission limits and generator performance limits. To achieve the feasible solutions, the software will "redispatch" the system as necessary, *i.e.,* will adjust the dispatch of generation and dispatchable load from that which would have resulted from a purely economic dispatch. The additional cost incurred as a result of this adjustment is the cost of congestion.[3]

The software does not use all bids in attempting to reach a feasible solution. Rather, it uses only "effective" bids. Certain combinations of system conditions and bidding patterns, usually involving high volumes of self-schedules relative to the volume of economic bids, create a situation where the only available economic bids are geographically distant from the congested constraint. These bids are not very effective in relieving such constraint. In very simple terms, a bid's effectiveness is measured according to the change in flow on the constraint that a given volume of energy from the resource achieves relative to a reference bus. For example, if the dispatch of 10 megawatt-hours from the resource reduces flow on the constraint by one megawatt-hour, the bid is 10 percent effective. The ISO has established a minimum effectiveness threshold of 2 percent.

In some circumstances, however, the available effective economic bids will not be sufficient to achieve a feasible solution. The ISO cannot simply rely upon the effectiveness of the available bids to determine when such circumstances arise, because the effectiveness threshold does not limit combinations of ineffective movement at different locations that are individually within the effectiveness threshold. Ultimately, considering all supply resources on the system, the optimization software considers the relative effectiveness of all resources on the system as it seeks to meet all demand and honor identified constraints. In considering all the bids submitted on the system as a whole, the market software selects the set of resources that provide the most effective relief of all constraints on the system as a whole. For example, in considering the effectiveness of a resource in relieving a particular constraint, the optimization takes into account any change in its effectiveness attributable to another resource that the software may have dispatched in order to relieve another constraint. Thus, even if a resource would have been effective in one market run, it may not be effective in another market run under different system conditions even if it is submitted at the same location with the same economic price.

Rather than relying upon bid effectiveness, the market software has specific rules for adjustment of non-priced quantities to address situations in which the available effective economic bids will not be sufficient to achieve a feasible solution. The software implements the rules through scheduling and pricing parameters. These parameters are numerical values in the form of prices that the ISO sets in the software for each constraint. They compensate for the fact that the non-priced quantities do not

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3 *Id.* at 6-7

have associated bid prices. The parameters play a role analogous to economic bid prices by guiding the software to prioritize certain schedules and to selectively relax constraints in a manner that minimizes total bid costs as it finds the feasible solution.[4]

2. The Transmission Constraint Relaxation Parameter

One of the current scheduling run parameters is the parameter for relaxation of an internal transmission constraint. As mentioned above, if the software identifies congestion on a particular constraint, it will try to relieve the congestion using economic bids to redispatch supply resources in the least-cost manner. Typically this requires increasing the output of higher-priced resources while lowering the output of less expensive resources to maintain system energy balance. There is therefore a net cost of such redispatch, which, as noted above, is the cost of congestion. Because the output of any particular resource is typically much less than 100 percent effective on any given constraint, it will often require several megawatt-hours of incremental and decremental dispatches of different resources to obtain just one megawatt-hour of congestion relief on the constraint. When the cost of the next one-megawatt reduction reaches the established transmission constraint relaxation parameter (currently set at $5000 per megawatt-hour), the software will relax the transmission limit. Until that point, the ISO relies upon the redispatch of resources based on their submitted bids or adjustment of highly effective resources with self-schedules but no bids to manage congestion. In some cases use of the $5,000 relaxation parameter results in the solution to resorting to adjustment of schedules that are not associated with economic bids.

The ISO is able to relax the transmission limit in the market run without jeopardizing reliability because in practice the ISO does not operate the market to clear exactly at the physical transmission limits. Instead, the ISO establishes margins within which to manage the system reliably. The ISO sets the transmission constraints and other limits representing the physical characteristics of the transmission grid through the full network model, which is incorporated into the ISO market model. In doing so, the ISO incorporates an operational margin between the actual hard physical limit and what it considers in the market, taking into consideration NERC/WECC requirements for operating the system reliably within the rated limits. If this operational margin is too high, the system is overly and unnecessarily constrained. If it is too low, the market dispatch may produce a set of dispatches that forces the ISO to intervene manually to ensure it does not operate the system outside of NERC/WECC criteria. Under current practices, when actual flows approach the actual limit, operators introduce on average a 5 percent margin to the real-time market limit to accommodate the actual flow variability and to avoid having the actual flows drift over the limit.[5]

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[4] *Id.* at 8-9. In his testimony, Mr. Rothleder explains how the ISO determines whether an economic bid is effective. *Id.* at 7-8.

[5] *Id.* at 5-6.

The ISO established the current transmission constraint relaxation parameter based on two different empirical analyses. First, the ISO used the value in the market simulation software for a six-month period prior to the implementation of the market software. The simulation showed that the current parameter provided a reasonable balance between the objectives of avoiding overuse of constraint relaxation and avoiding extremely large redispatch quantities to relieve a small amount of congestion. Second, the ISO ran several test cases assuming extreme grid conditions such as multiple transmission line derates in an area where there are high-priority self-schedules under existing transmission rights. The ISO found that the $5000 limit appropriately protected self-schedules and relaxed the binding constraints. In proposing the tariff language to implement that parameter, however, the ISO noted that it would need to continue to monitor the performance of the constraint and to make additional adjustments as necessary.[6]

3. Real-Time Congestion Offset Costs

The cost of using the transmission grid is the marginal cost of congestion component at a particular node. The marginal cost of congestion is the difference in the cost of delivering energy to a reference location and to a particular location on the grid, or node.[7] The marginal cost of congestion at a particular location relative to the reference bus determines the shadow price of a particular constraint. The market software determines the marginal cost of congestion at each of the nodes on the system. The locational marginal price paid to a generator at a specific location includes a marginal cost of congestion at the supply nodes, as does the locational marginal price paid by demand at locations on the ISO system.[8]

In the day-ahead market, the ISO attempts to manage all of its system congestion based on submitted bids for energy supply and demand. To the extent that the system conditions in real-time are the same as assumed in the day-ahead market, there should be no additional real-time congestion costs incurred. However, if new constraints arise in the real-time that were not addressed in the day-ahead market, the ISO may be unable to use the lowest-cost resources to deliver the energy according to the day-ahead schedules and the real-time market will need to redispatch resources in the real-time to account for the additional constraints. Mr. Rothleder discusses such constraints in his attached testimony. Some examples would be modeling or visibility limitations that cause an inability to capture actual loop flows on the system in the day-

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6 *See* November 24, 2008 filing in Docket Nos. ER09-240 at 9 and Exh. ISO-1, Testimony of Dr. Lorenzo Kristov at 20-22.

7 The reference location, or reference bus, is determined by weighting the various system nodes according to an established algorithm. ISO Tariff § 27.1.1.

8 The other elements are the system cost of energy and the cost of marginal losses. ISO Tariff § 27.1.1.1 and 27.1.1.2.

ahead or a transmission outage that was not contemplated in the day-ahead. This real-time redispatch will cause the ISO to incur additional congestion costs.

Some circumstances may cause the ISO's total real-time congestion payments to differ from total real-time congestion charges. Real-time constraints that cause a change in transfer capability are the primary drivers of such differences.[9] As explained above, a real-time constraint will require the ISO to redispatch generation and to pay generators, on net, additional amounts. Because real-time constraints do not affect demand, however, there is no concomitant increase in demand to which the ISO can allocate the additional payments.[10] The real-time congestion offset is an accounting tool that captures the cost of this real-time difference between congestion revenues and payments for purposes of allocating the costs to the ISO's internal metered load and real-time export schedules. Mr. Rothleder provides a simple example of this.[11]

As Mr. Rothleder explains, differences between congestion revenues and payments can occur also occur in the day-ahead market.[12] The ISO addresses day-ahead differences through the congestion revenue rights balancing account. The congestion revenue rights balancing account is normally positive, because the ISO usually collects more from load than it pays out to generation. The ISO allocates the surpluses to holders of congestion revenue rights for particular paths. The ISO allocates and auctions congestion revenue rights on a year- and month-ahead basis. In the real-time, however, the ISO does not manage a similar system of rights and accounts. Instead, the ISO must account for the difference in congestion payments and revenues which may be positive or negative, through the real-time congestion offset account. The ISO allocates the surplus or shortages in the real-time congestion offset account to load serving entities, based on their measured demand, and to real-time exports.[13]

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[9] Among other causes are certain schedules, such as those on transmission ownership rights, that are provided a "perfect hedge," *i.e.*, they are exempt from congestion charges. In addition, while the ISO pays suppliers the locational marginal price for energy at the node where the resource is located, *i.e.,* where it injects energy into the grid, load pays for energy at load aggregation points and not at the specific location from which it actually withdraws power. The ISO calculates the price at load aggregation points based on weighted averages of the prices for the constituent pricing nodes of the load aggregation point. This also causes a difference between collections and payments.

[10] If there is no change in transfer capability between the day-ahead and real-time, but there is an increase in demand in the real-time, the real-time market will redispatch resources to meet the new demand. The redispatch of resources for this purpose does not produce the same phenomenon as does the reduction of transfer capability between the two markets because the new load will pay for any new costs of congestion.

[11] Exh. ISO-1at 22-24.

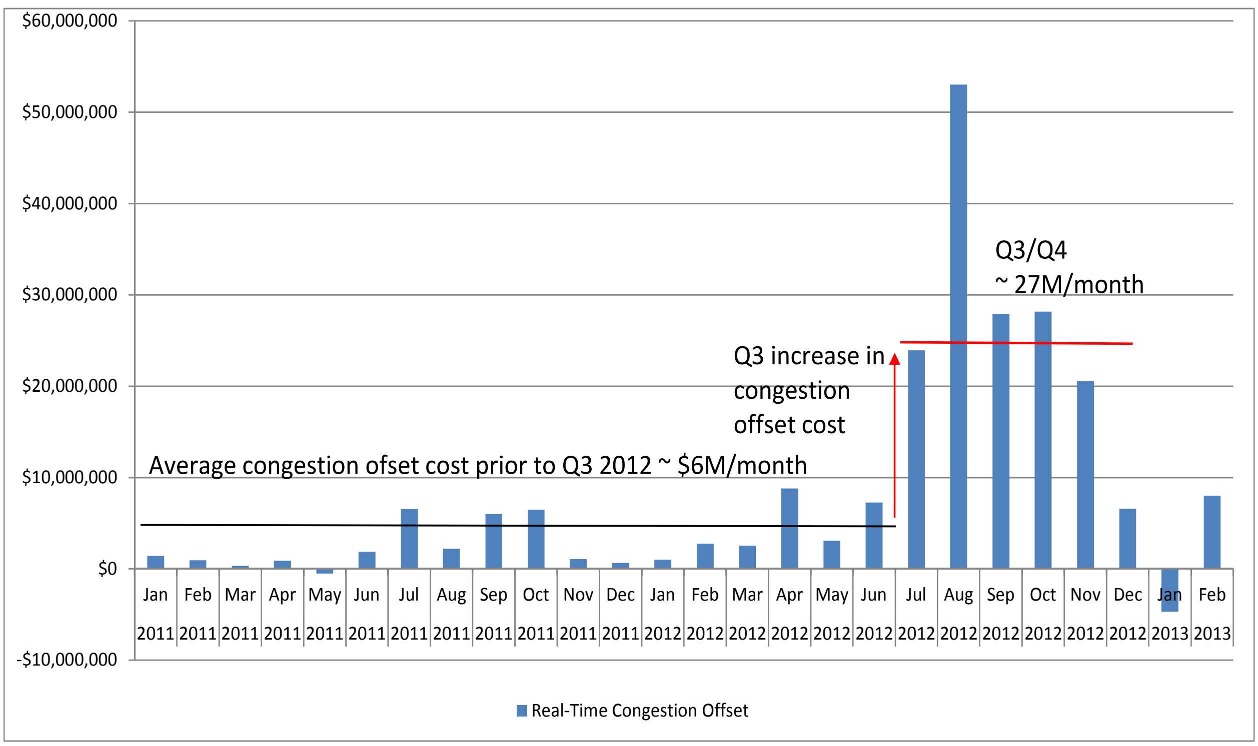
[12] *Id.,* at 21-22.

[13] *See* Exh. ISO-1 at 20-21; *see also* ISO Tariff § 11.5.4.2.

4. Changes in Real-Time Congestion Offset Costs

From the commencement of the ISO's new markets on March 31, 2009, until last June, the real-time congestion offset has remained relatively stable. As illustrated in Figure 1, the average real-time congestion offset cost for each month was approximately $5 million, and the cost never exceeded $10 million. In July 2012, however, it jumped to $25 million and in August it peaked at almost $55 million. It remained close to or above $20 million until November and dipped slightly below $10 million December 2012.[14] The average real-time congestion offset costs were negative in January, 2013, but as Mr. Rothleder explains, this was due to a large amount of real-time wind generation deviation from the day-ahead schedules coupled with real-time congestion.[15] In February we saw the costs increase again. However, even though the December and February costs were more tempered than those observed in July and August 2012, those costs were much higher that historical December and February costs.

Figure 1 – Real-Time Congestion Offset



Mr. Rothleder explains that the greater part of the increase in real-time congestion offset is attributable to convergence bids. This does not, however, mean

[14] *Id.* at 27-28.

[15] *Id.* at 35.

that convergence bidding causes the increased real-time congestion offset. Rather, the greater the difference between day-ahead and real-time prices, the greater the incentive for market participants to submit virtual bids to take advantage of that spread. Thus, the increase in the real-time congestion offset causes the increased contribution of convergence bids, rather than vice-versa.[16]

The ISO has concluded that the cause of the increase in real-time congestion offset was the increase in the number of constraints requiring management in real-time. As discussed above, such constraints are the primary source of the real-time congestion offset. The increased number of constraints observed in real-time is a result of several changes in operational conditions. For example, two events this summer contributed to the increase: the outage of the San Onofre Nuclear Generating Station and the inability to dispatch generation in the Feather River system during the extensive wildfires occurring in August 2012.[17]

Much of the increase, however, derives from system operations changes that are not the direct result of a specific event, but rather are attributable to a real-time environment that is more constrained overall. In response to the September 8, 2011, transmission outages in southern California, the WECC has increased its focus on regional coordination and evaluation of actual conditions, including the use of a real-time contingency analysis to identify critical constraints. As a result, the WECC and neighboring balancing authority areas have identified additional contingency constraints that ISO must manage, but which derive from flows external to the ISO balancing authority area. In some cases flow conditions that are external to the ISO balancing authority area and are not easy to predict, or for which information is not available, in the day-ahead market. These conditions create real-time constraints that increase real-time congestion costs.[18] The ISO expects the constraints that arise from these system operations changes to persist for the foreseeable future. In addition, there is no established timeline for the return to operation of the San Onofre Nuclear Generating Station, if ever.

In addition, ISO has also encountered increased unscheduled flows on its own system in real-time. For example, the hours of unscheduled flow events in 2012 have increased to more than twice the number of hours in the highest previous year since 2007, from slightly more than 700 in 2008 to almost 1800 in 2012. All of these matters are explained in greater detail in Mr. Rothleder's testimony.[19] The ISO is keenly interested in calibrating the transmission constraint relaxation parameter at this time not

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16 *Id.* at 25-26.

17 *Id.* at 29-34.

18 *Id.*

19 *Id.*

only because the changes in its operational practices described above make the system more sensitive to system conditions on the system in any given time.

Moreover, the fact that these additional constraints occur in real-time magnifies their impact because the ISO has fewer options to address such constraints in real-time than in the day-ahead market. In the day-ahead market, and even in the hour-ahead scheduling process, the ISO has the option of intertie adjustments or additional resource commitments, which may be the most effective remedy for congestion relief. In contrast, in real-time, the ISO has no ability to commit additional resources or to redispatch interties schedules based on economic bids. In addition, the only generation dispatchable in real-time is generation that can be dispatched in 5 minutes, while in the day-ahead market the ISO can dispatch units with much longer ramp rates and at lower cost. As a result, if there are changes in the operating limits due to unscheduled flow or operating margin, the ability to respond to such limit changes is more significantly limited in real-time than in day-ahead.[20]

5. Relationship between the Real-Time Congestion Offset and the Transmission Constraint Relaxation Parameter.

As explained below, the cost of relieving congestion depends on the relative effectiveness, or shift factor, of the resources that the ISO must redispatch up or down in order to relieve the constraint. If the relative effectiveness is zero, increasing the output of one resource and decreasing the output of the other resource will result in no relief. On the other hand if the shift factor difference is 1.0 then an increase of one megawatt at the source and a decrease of one megawatt at the sink results in one megawatt of relief in the flow on the constraint. Mr. Rothleder explains in detail how as the relative effectiveness of a resource increases, the bid price difference necessary to achieve the same change in congestion cost decreases. The transmission relaxation parameter limits the permissible increase in congestion cost associated with the use of ineffective bids and overall congestion cost.[21] Figure 8 in Mr. Rothleder's testimony illustrates this effect.

As Mr. Rothleder explains, the $5,000 per megawatt-hour scheduling transmission constraint relaxation parameter, in combination with the additional tools available, has functioned well in controlling congestion costs in the day-ahead market. In contrast, however, the current $5,000 per megawatt-hour real-time scheduling transmission constraint relaxation parameter is exacerbating the cost of the increase in real-time constraints. Because the system has recently been more constrained, the modeled constraints are likely to bind more frequently, thereby causing the prices to increase frequently in the real-time. The system is likely to be exposed to these constraints again in part due to the seasonal variations and in part due to the ISO's

[20] *Id.* at 17.

[21] *Id.* at 38-43.

need to consider the impact of regional flows more closely as explained above and in Mr. Rothleder's testimony. As a result, the ISO has had to more frequently rely upon bids approaching the $5,000 threshold and expects that it will be required to continue to do so in the future. A lower threshold, such as the $1,500 threshold that the ISO proposes in this filing, would allow the ISO to avoid these costly market solutions without compromising congestion relief. Figure 9 in Mr. Rothleder's testimony shows how a $1,500 threshold would limit the use of ineffective, but costly, redispatch solutions to relieve the constraint.[22] Essentially, Figure 8 and 9 illustrate the principle that at some point allowing the system to dispatch more expensive resources provides little if any congestion relief. One has to ask, then, what is the reason for allowing the market to produce a more expensive congestion management solution that is just as readily available at the lower cost. The studies conducted by the ISO, discussed in further detail below, confirm that there is none.

B. Stakeholder Process and Board Consideration

In light of in the increasing cost of the real-time congestion offset and the ISO's conclusion that the $5,000 transmission constraint relaxation parameter was exacerbating that increase, the ISO initiated a stakeholder process to consider revision of the transmission constraint relaxation parameter. On October 19, 2012, the ISO posted a straw proposal[23] and, on October 25, conducted a web conference regarding the proposal. On October 31, the ISO posted the results of an analysis of the impact on the real-time congestion offset costs for three sample constraints of different values for the transmission constraint relaxation parameter.[24] The ISO received 11 sets of comments on the straw proposal.[25]

After considering the comments and the analysis, the ISO posted a draft final proposal on November 14, 2012.[26] The ISO held a web conference on the final draft proposal on November 16. The ISO received and reviewed nine sets of comments on the draft final proposal.

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22 *Id.*

23 The straw proposal is available at http://www.caiso.com/Documents/StrawProposal-TransmissionConstraintRelaxationParameterChange.pdf.

24 The analysis is available at http://www.caiso.com/Documents/TranmissionConstraintRelaxationParameterChange-AnalysisResults.pdf.

25 The comments are available at http://www.caiso.com/Documents/Transmission%20constraint%20relaxation%20parameter%20change%20-%20stakeholder%20comments%7CComments%20on%20straw%20proposal.

26 The draft final proposal is available at http://www.caiso.com/Documents/DraftFinalProposal-TransmissionConstraintRelaxationParameterChange.pdf.

The ISO presented the proposed amendment to the ISO Board of Governors on December 14, 2012.[27] The Board approved the ISO's proposal. In response to concerns by certain participants that the change would have the impact of unjustly depressing prices or would result in a significant reduction in generator revenues, the Board also asked ISO staff to continue evaluating the performance of this parameter and report back to the Board. The ISO staff agreed to do so noting that it may be necessary to consider changes that more finely tune the parameter as discussed below. The ISO shared the results of this additional round of analysis with stakeholders on February 7, 2013, and discussed the results at its Market Performance and Planning meeting on February 13, 2013. The results of the additional studies, in addition to the original studies, are discussed at greater length in Mr. Rothleder's testimony and summarized below.

III. DESCRIPTION OF TARIFF AMENDMENT

The ISO proposes to revise section 27.4.3.1 of the ISO Tariff to set the real-time transmission constraint relaxation parameter at $1,500 per megawatt-hour. The ISO's proposal is based on extensive analyses that demonstrate the current $5,000 per megawatt hour provides few benefits that are not also achievable at a lower threshold and a considerably lower cost.

A. Factors and Analyses the ISO Considered in Developing this Proposal

The ISO performed a series of sensitivity analyses to evaluate the performance of the ISO market to produce market solutions that adequately address congestion in the real-time through the ISO market. The ISO looked at a total of 97 cases through three rounds of analysis. Mr. Rothleder provides a detailed description of the studies and their results in his testimony. The study confirms the principle that because of the way in which the software measures the effectiveness of a bid in relieving congestion, at a certain point there is a diminishing return to the effectiveness of bids in relieving a particular constraint. Beyond that point, it is not justifiable to force the market to incur such a dispatch solution that comes at an unnecessarily high cost. In the first round of analysis, the ISO immediately determined that reducing the constraint to lower levels did not force the ISO to forgo the dispatch solution that provided significantly better congestion relief than those produced with the lower parameter. In contrast, lowering the parameter provided significant savings to the market.

In that first round of analysis the ISO was also able to establish that when the parameter was lowered to $1,500, there were 91 constraints that bound in 2,400 real-time market intervals. The ISO's analysis in this round focused on the 18 most binding

[27] The memorandum to the Board from ISO management, the PowerPoint presentation to the Board, and a matrix of stakeholder comments presented to the Board are included as Attachments D, E, and F, respectively.

constraints out of the 91. Immediately, the ISO was able to determine that the higher parameter was not producing a dispatch solution that was significantly better at relieving system congestion than could be achieved at the lower parameter. The ISO then expanded its sample set and looked at an additional 14 cases. Finally, the third set of analyses expanded the study set to include 97 cases representing 74 of the 91 constraints during the 2,400 intervals identified as binding the study period.[28]

The ISO's first two rounds of analysis confirmed that the lower transmission constraint relaxation parameter resulted in only minimal amounts of reduced congestion relief, generally ranging from zero percent to one percent. These are well within the operations margin used in real-time operations. These analyses also guided the ISO's choice of the $1,500 per megawatt-hour threshold. The ISO considered, and analyzed the impacts of, a $2,500 threshold. The analyses showed that a $2,500 threshold produced an 18 percent reduction in congestion offset cost, and provided a reduction of congestion relief, *i.e.,* increased flows, between zero percent and six-tenths of a percent. On the other hand, the $1,500 threshold provided twice the reduction in congestion offset costs (36 percent), as noted above, still with only a minimal reduction in congestion relief (zero percent to one percent).[29] The clear conclusion from these extensive analyses is that significant further savings could be made at the lower parameter setting of $1,500 instead of $2,500, while setting the parameter at $2,500 would achieve no additional congestion relief benefits. Accordingly, the ISO concluded that reducing the parameter to $1,500 is the better approach.

As discussed above, the ISO conducted the third round of analysis at the request of the ISO Board of Governors in part because of stakeholders' requests for additional assurances that there were no unintended consequences associated with the constraints that the ISO had not studied, and comments that in some cases the higher-priced bids could have provided congestion relief that would be overlooked with the lower parameter. The third round of results confirmed the ISO's prior findings that lowering the parameter to $1,500 would produce significant savings without a significant reduction in congestion relief.

The complete set of results from all three of the analyses comparing the impact of reducing the parameter to $1,500 are provided in Table 1 of Mr. Rothleder's testimony. There are eight outlier intervals where the reduction in congestion relief was greater than five percent, suggesting that the $5,000 parameter might possibly yield a more reliable and effective market solution in that limited number of circumstances. However, upon further examination, the ISO found that the greater congestion relief was not the result of the higher parameter setting. At the higher level, the greater congestion relief was achieved either by adjusting inter-tie schedules or through the power balance constraint. In reality, however, any intertie schedule curtailments are

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[28] Exh. ISO-1 at 46-47.

[29] *Id.*, at 53-55.

rare and manually implemented by operators, not by automated software dispatch, and it is likely that the ISO would never have implemented that dispatch result unless it was also implementing load curtailments. With the lower parameter, some of the intertie export schedules were not adjusted because relaxing the transmission constraint was more economic than curtailing the intertie schedules. Thus, the improvement in congestion management resulting from the market solution was not what was actually implemented given that exports schedules were not actually adjusted and the ISO would have had to rely on manual dispatch to achieve that solution. These analyses are explained in greater detail in Mr. Rothleder's testimony.

Although some stakeholders advocated reducing the parameter to $1,000 per megawatt-hour, the ISO believes that reducing the parameter to that level would be counter-productive. Lowering the transmission constraint parameter to $1,000 could potentially prevent the dispatch of resources with effective economic bids at the $1,000 bid cap.[30] A gap between the transmission constraint parameter value and the bid cap is also needed to establish the priorities of other uneconomic adjustments, such as reducing certain self-schedules (other than on the capacity of existing transmission contracts or transmission ownership rights) before relaxing a constraint.

B. The ISO's Consideration of Other Issues Raised by Stakeholders

One stakeholder objected to the reduction of the transmission constraint relaxation parameter on the basis that it amounted to a price cap that would strip millions of dollars from suppliers. This is not correct. As Mr. Rothleder explains in his testimony, locational marginal prices can exceed the transmission constraint relaxation parameter.[31] The results of the sensitivity analysis also show that the while there may have been extra dollars paid to generators during certain intervals at the higher parameter, essentially no value was provided to the ISO given that little enhancement in congestion relief effectiveness was provided at that increased cost. There is no basis for such generators to expect to continue receiving and relying on such unjustifiable and unnecessary payments. Also, high price events resulting from the scheduling transmission constraint relaxation parameter are usually fleeting, typically lasting one to three intervals. Thus, there is no legitimate basis to rely on them as a steady revenue stream. Further, in such cases, resources may have insufficient time to respond to the fleeting events and could find themselves falling behind dispatch instructions, thereby exposing themselves to negative real-time deviations.[32] Therefore, it is not clear -- and there is no definitive evidence -- that in the aggregate generators benefited from these pricing events.

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[30] *Id*. at 56.

[31] *Id.* at 15.

[32] *Id.* at 58.

Moreover, physical generators are not the entities most likely to lose revenues from the lower parameter setting. While the relaxation of the transmission constraint does affect locational marginal prices, the bulk of the real-time congestion offset revenue is driven by liquidation of convergence bids, rather than actual redispatch of physical resources in real-time.[33] Furthermore, there is no justification for allowing this stream of revenue to convergence bidders based on the transfer of capacity from the day-ahead to the real-time given that the higher parameter does not seem to be yielding a more effective congestion management solution at the higher real-time prices.

To the extent that the reduced transmission constraint relaxation parameter may occasionally reduce locational marginal prices in some constrained locations and reduce revenues, this impact cannot properly be viewed as unfairly penalizing generators. The current $5,000 threshold does not reflect some absolute value that derives from the inherent effectiveness of particular resources. Stated differently, the parameter not related to a particular resource's effectiveness. Rather, it reflects a balance that the ISO proposed, and the Commission accepted, between cost and operational considerations based on circumstances at the time of that tariff amendment. Those circumstances – namely system conditions -- have changed significantly since that time. If the circumstances had been different at that time, the ISO would have proposed a different balance, and suppliers would have had no cause to complain. It is now apparent, however, that conditions have changed, and the previously established balance is no longer reasonable. The possibility that the revised threshold may, in certain circumstances, reduce revenues does not make it unjust or unreasonable.

One stakeholder recommended raising the resource effectiveness factor (currently 2 percent) as an alternative to revising the transmission constraint relaxation parameter. The ISO agrees that raising the resource specific effectiveness threshold can be effective in some instances. As Mr. Rothleder explains in his testimony, however, the effectiveness of a redispatch to resolve congestion ultimately depends on the effectiveness of combinations of resource movements. A combination of effective bids might produce a significantly less effective solution, causing the ISO to incur potentially high costs. The ISO thus concluded that lowering the transmission constraint relaxation parameter is a more direct and effective approach than raising the resource effectiveness factor threshold.[34]

Some stakeholders expressed concern that revising the transmission constraint relaxation parameter will increase the frequency of exceptional dispatch. The ISO does not expect any material increase in exceptional dispatches of resources that have effective economic bids available because the ISO's analyses discussed above demonstrated that reducing the transmission constraint relaxation parameter will not have a significant effect on flow relief. In some cases, where the most effective

[33] *Id*.

[34] *Id.* at 59.

resource to adjust is a firm intertie schedule, the reduction of the transmission constraint parameter may slightly increase the need to curtail a firm intertie schedule in cases where the operators find they are not able to maintain the actual flows below an actual constraint limit. This will be infrequent because, as noted previously, the amount of change in constraint relief expected using the $1,500 parameter, rather than the $5,000 parameter, falls within the amount of operational margin of approximately five percent applied in the real-time market.

Some stakeholders suggested that the proposed threshold is too low because it limits the use of effective bids to relieve congestion. Again, the ISO's analysis clearly demonstrated that there is little material change in constraint relief from using the $1,500 parameter; thus the ISO is confident that lowering the transmission constraint parameter will not result in forgoing effective combinations of economic bids. Further, the ISO only proposes to use the lower parameter in the real-time, where available options for economic redispatch are subject to a significant limitation: the only usable bids are those with available five-minute ramping capability on previously committed internal generation resources. In order to avoid forgoing legitimate economic commitment or effective redispatch of interties based on economic bids, the ISO does not propose to reduce the transmission constraint relaxation parameter of $5,000 used in the day-ahead market, the hour ahead scheduling process, or the real-time unit commitment processes.

Other stakeholders urged the ISO to take steps to address uplifts driven by convergence bidding. The ISO decided, however, not to address convergence bidding in this proposal and it was not within the initial scope of this stakeholder initiative. In any event, as discussed above, increased convergence bidding is a side effect, not a cause, of the increase in real-time congestion offset costs. Suspending or limiting convergence bidding would reduce the real-time congestion offset costs, but it would not eliminate the upward trend and it would not address the root of the problem, *i.e.,* the increased constraints on the system and the inability of prices to actually converge due to differences in constraints between the day-ahead and the real-time markets.[35]

The ISO notes that it has previously considered allocating some of the costs of the real-time congestion offset to virtual bids, but at the time of its assessment the ISO determined that there are significant difficulties in finding an allocation method that equitably identified the causal effects. This does not mean that the ISO will not revisit this issue in the future after more evaluation or changes that necessitate it. The ISO has made a commitment to take a closer look at all of its cost allocation methodologies over time with the intent of identifying whether there is a need to modify the current cost

[35] *Id.* at 62-63.

allocation methods to better align them with a number of cost allocation principles that the ISO recently adopted for determining proper cost allocation.[36]

Finally, some stakeholders contend that the ISO, rather than revising the transmission constraint relaxation parameter, should instead address the root causes of the problems with addressing real-time congestion. They are concerned that the revision of the transmission constraint relaxation parameter will reduce the ISO's incentive to do so. The ISO is already evaluating the means to address other drivers of an increased congestion offset, including accounting for expected congestion when running the day-ahead market, and will continue to do so. The ISO has already taken the following measures to address these issues which have already affected the real-time congestion offset: (1) Use of Transmission Reliability Margin (TRM), (2) adjustment of day-ahead conditions to better reflect real-time observed difference, (3) accounting for available ramping capability when making real-time conforming and margin adjustments to limits. The ISO also plans to take the following actions which will require additional time: (1) physical upgrades to reduce constraints and (2) consideration of the congestion costs when performing outage coordination.

The ISO does not believe, however, that the need to pursue additional avenues for addressing real-time congestion and the real-time congestion offset provide a basis at this time for abandoning a tariff revision that will provide immediate, meaningful and reasonable cost relief while maintaining operationally effective constraint relief. The ISO is committed to continuing analysis evaluating the impact and appropriateness of the proposed transmission constraint relaxation parameter, including consideration of a tiered parameter that depends on the level of constraint relaxation, voltage level of constraint, or the system impact of the constraint. Indeed, the ISO's Board of Governors has requested a report on the effectiveness of the revision one year after implementation. Based on the current available information, however, the ISO has concluded that the proposed amendment is the most effective means for reducing the sharp increase in the real-time congestion offset.

IV. EFFECTIVE DATE AND REQUEST FOR WAIVERS

The ISO requests an effective date of May 10, 2013. The ISO believes that the information submitted with this filing substantially complies with the requirements of Part 35 of the Commission's regulations applicable to filings of this type.[37]

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[36] *Id.* at 63-64.

[37] 18 C.F.R. Part 35 (2012).

V. COMMUNICATIONS

The ISO requests that the Commission address communications regarding this filing to the following individuals and place their names on the official service list established by the Secretary with respect to this submittal:

Michael E. Ward
Alston & Bird LLP
The Atlantic Building
950 F Street, NW
Washington, DC 20004
Tel: (202) 239-3300
Fax: (202) 654-4875
michael.ward@alston.com

Anna McKenna
Assistant General Counsel
California Independent System
Operator Corporation
250 Out Cropping Way
Folsom, CA 95630
Tel: (916) 608-7287
Fax: (916) 608-7296
amckenna@caiso.com

VI. SERVICE

The ISO has served copies of this transmittal letter, and all attachments, on the CPUC, the California Energy Commission, and all parties with effective Scheduling Coordinator Service Agreements under the ISO tariff. In addition, the ISO is posting this transmittal letter and all attachments on the ISO website.

VII. ATTACHMENTS

The following documents, in addition to this transmittal letter, support the instant filing:

Attachment A	Revised ISO Tariff Sheets – Clean
Attachment B	Revised ISO Tariff Sheets – Marked
Attachment C	Exh. ISO-1, Testimony of Mark A Rothleder
Attachment D	December 6, 2012, Memorandum from Mark A. Rothleder to the ISO Board of Governors
Attachment E	December 14, 2012, Presentation to the ISO Board of Governors on the Decision on Transmission Constraint Relaxation Parameter Modification
Attachment F	Matrix of Stakeholder Comments Presented to the ISO Board of Governors Regarding the Decision on

Transmission Constraint Relaxation Parameter Modification

VIII. CONCLUSION

For the reasons set forth above, the ISO respectfully requests that the Commission approve the tariff modifications in Attachments A and B, effective as of May 10, 2013.

Respectfully submitted,

By: *<u>/s/Anna McKenna</u>*

Nancy Saracino
General Counsel
Anthony J. Ivancovich
Deputy General Counsel
Anna McKenna
Assistant General Counsel
California Independent System Operator Corporation
250 Out Cropping Way
Folsom, CA 95630
Tel: (916) 608-7135
Fax: (916) 608-7296
Counsel for the
California Independent System Operator Corporation

Michael E. Ward
Alston & Bird LLP
The Atlantic Building
950 F Street, NW
Washington, DC 20004
Tel: (202) 239-3300
Fax: (202) 654-4875

Dated: March 8, 2013.

Attachment A – Clean Tariff

Tariff Revisions – Transmission Constraint Relaxation Parameter

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

March 8, 2013

* * *

27.4.3.1 Scheduling Parameters for Transmission Constraint Relaxation

In the IFM, the internal Transmission Constraint scheduling parameter is set to $5000 per MWh for the purpose of determining when the SCUC and SCED software in the IFM and the HASP will relax an internal Transmission Constraint rather than adjust Supply or Demand bids or Non-priced Quantities as specified in Sections 31.3.1.3, 31.4 and 34.10 to relieve Congestion on the constrained facility. This scheduling parameter is set to $1,500 per MWh for the Real-Time Dispatch. The effect of this scheduling parameter value is that if the optimization can re-dispatch resources to relieve Congestion on a Transmission Constraint at a cost of $5000 per MWh or less for the IFM and HASP (or $1,500 per MWh or less for the Real-Time Dispatch), the Market Clearing software will utilize such re-dispatch, but if the cost exceeds $5000 per MWh in the IFM and HASP (or $1,500 per MWh or less for the Real-time Dispatch) the market software will relax the Transmission Constraint. The corresponding scheduling parameter in RUC is set to $1250 per MWh.

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Attachment B – Marked Tariff

Tariff Revisions – Transmission Constraint Relaxation Parameter

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

March 8, 2013

* * *

27.4.3.1 Scheduling Parameters for Transmission Constraint Relaxation

In the IFM, tThe internal Transmission Constraint scheduling parameter is set to $5000 per MWh for the purpose of determining when the SCUC and SCED software in the IFM and the HASPRTM will relax an internal Transmission Constraint rather than adjust Supply or Demand bids or Non-priced Quantities as specified in Sections 31.3.1.3, 31.4 and 34.10 to relieve Congestion on the constrained facility. This scheduling parameter is set to $1,500 per MWh for the Real-Time Dispatch. The effect of this scheduling parameter value is that if the optimization can re-dispatch resources to relieve Congestion on a Transmission Constraint at a cost of $5000 per MWh or less for the IFM and HASP (or $1,500 per MWh or less for the Real-Time Dispatch), the Market Clearing software will utilize such re-dispatch, but if the cost exceeds $5000 per MWh in the IFM and HASP (or $1,500 per MWh or less for the Real-time Dispatch) the market software will relax the Transmission Constraint. The corresponding scheduling parameter in RUC is set to $1250 per MWh.

* * *

Attachment C – Exh. ISO-1, Testimony of Mark A Rothleder

Tariff Revisions – Transmission Constraint Relaxation Parameter

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

March 8, 2013

Exhibit No. ISO-1

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation	**)** **)**	**Docket No. ER13-____-000**

DIRECT TESTIMONY OF
MARK ROTHLEDER
ON BEHALF OF THE
CALIFORNIA INDEPENDENT SYSTEM
OPERATOR CORPORATION

Q. Please state your name, title, and business address.

A. My name is Mark A. Rothleder. I am employed as Vice-President of Market Quality and Renewable Integration Division for the California Independent System Operator Corporation ("ISO"). My business address is 250 Outcropping Way, Folsom, CA 95630.

Q. Please describe your educational and professional background.

A. I have been employed at the ISO in various positions since July 1997. I hold a B.S. degree in Electrical Engineering from the California State University, Sacramento. I have taken post-graduate coursework in Power System Engineering from Santa Clara University and earned an M.S. in Information Systems from the University of Phoenix. Prior to my current position, I was the Executive Director, and before that Director, of Market Analysis and Development for the California ISO. Prior to that, as Principle Market Developer for the ISO, I played a lead role in designing many of the aspects of the ISO's revised market design, implemented on March 31, 2009. Since joining the ISO, I have worked extensively on implementing and integrating the market rules for California's competitive energy and ancillary services markets and the rules for congestion management, real-time economic dispatch, and real-time market mitigation of the operations of the ISO balancing authority area. I have also held the position of Director of Market Operations.

Q. What are your duties and responsibilities at the ISO?

A. As Vice-President of Market Quality, I am responsible for overseeing the design and implementation of ISO market rules and operating procedures, and the evaluation of the market's performance.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to describe the analysis performed to support the proposed change to transmission constraint relaxation parameter. The analysis demonstrates it is appropriate to change the real-time market transmission constraint parameter from $5,000 to $1,500 to better align the operational congestion relief value gained and impacts on the real-time congestion offset costs. In addition, I provide a description of the interplay between the transmission constraint relaxation parameter and the relative effectiveness and cost of resources capable of providing congestion relief. I also provide a description of the real-time congestion offset and how the transmission constraint parameter impacts the real-time congestion offset costs. Lastly, I describe how the proposed change is one element of a set of elements intended to improve the real-time congestion model and increase consistency of conditions modeled in the day-ahead market and the real-time market.

I. GENERAL DESCRIPTION OF THE ISO MARKETS

Q. Please provide a high-level description of the ISO market.

A. The ISO operates a day-ahead and a real-time market. The day-ahead market is conducted one day prior to the operating day. Parties can submit bids for energy, residual unit commitment capacity, and ancillary services capacity up to seven days in advance of the actual trading day and up until 1000 of the day in which the applicable day-ahead market is conducted. Between 1000 and 1300 a day before the trading day, the ISO uses security constrained economic dispatch and unit commitment to clear supply (generation and imports) and demand (load and exports) for each hour of the next operating day, with the objective of minimizing the cost of meeting bid-in demand and ancillary services, subject to transmission and resource constraints. In the day-ahead market, the ISO's network model takes into account thermal and voltage limits on the transfer capacity of the transmission lines that make up the ISO controlled grid as well as data on planned outages and limits on flow based on those outages. In addition, a resource's schedule is constrained from one hour to the next based on the speed at which the resource can increase or decrease output, *i.e.,* ramp up or down in 60 minutes.

The real-time market consists of three processes: (1) an hour-ahead scheduling process, used for awarding hourly interties, which is run once an hour at approximately an hour before the operating hour; (2) a real-time pre-dispatch process used for awarding ancillary services and committing resources, also known as real-time unit commitment, which is run every 15 minutes; and (3) a real-time dispatch process used to economically dispatch energy from online resources providing economic bids to balance the system, which is run every 5 minutes. Scheduling coordinators have an opportunity to submit bids for the real-time market in order to adjust their day-ahead schedules. If they submit no bids in the real-time market, their day-ahead schedules are protected from adjustment, unless the ISO is not able to achieve a feasible market solution using effective economic bids, as I discuss below. In addition to day-ahead schedules, real-time self-schedules and self-schedules under pre-existing grandfathered contracts are protected to avoid their adjustment. The ISO tariff assigns each type of schedule a relative priority that is applicable if adjustment becomes necessary.

To facilitate the prioritization of self-schedules, the ISO conducts a scheduling run prior to a separate pricing run. The scheduling run ensures the use of economic bids to resolve constraints before any adjustment of self-schedules. As I discuss further below, in order to avoid ineffective and overly expensive solutions, the scheduling run also uses a parameter for transmission constraint relief to limit the extent to which economic bids are used to manage congestion. After the scheduling run, the ISO conducts a pricing run to establish prices based on the submitted economic bids, using parameters that reflect the bid floor and cap instead of high-priced parameters used in the scheduling run to protect certain schedules and for transmission constraint relaxation. The real-time market is informed by the Energy Management System state estimator, which reflects the actual operational conditions including the effects of unscheduled flow through the system.

Q. How does the ISO reflect transmission constraints on the system in clearing its markets?

A. As I noted, the ISO operates its markets based on a security constrained economic dispatch. In simple terms, this means that the ISO does not simply clear economic bids and offers, but rather the ISO market systems minimize the cost of serving demand subject to physical constraints of both supply resources and the transmission infrastructure on the ISO grid. The ISO's full network model incorporates the physical limits of the elements in the system, *i.e.,* the transmission line limits and the capacity of the various transmission elements that together make up the ISO controlled grid. The supply resource's physical limitations are taken into account through the Master File registrations of the resources' physical characteristics and through updates to the ISO's Scheduling and Logging System if submitted by the scheduling coordinator. The full network model is further translated into the base market model for use in clearing the ISO markets. The base market model incorporates contingencies and nomograms used to limit the simultaneous flows on combinations of transmission elements based on known outages and other system conditions. The ISO may further adjust the limits, contingencies, and nomograms to account for operational conditions that the software cannot directly model. In the real-time market, the ISO does not clear the market at the exact physical transmission limits, but uses adjusted limits that provide margins that protect the ISO's ability to manage the system's variability. When actual flows approach the limit, operators use a limit 3%-5% below the actual real-time market limit in order to accommodate the actual flow variability and to avoid having the actual flows drift over the limit.

Q. How does security constraint economic dispatch address these transmission constraints?

A. Security constraint economic dispatch addresses these transmission constraints through the congestion management process. Congestion management relieves constraints by increasing the injection of energy at one location and reducing the injection of energy at another location, *i.e,* by "redispatching" generation. Through the use of the network model, the security constrained economic dispatch determines the effectiveness of a change (which can be incremental or decremental) in the injection or withdrawal of energy at each location in changing flows on a transmission constraint relative to change in the opposite direction in the injection of energy at an established reference location (*i.e.*, the reference bus location). This determination produces a value known as the shift factor or power transfer distribution factor. Although the shift factor is determined using an opposite change in injection or withdrawal at the reference bus, there is no actual economic bid to adjust the reference bus. Therefore, the shift factor alone does not represent the effectiveness of a particular redispatch. Rather, the difference in the shift-factor of the location being increased and that of the location being decreased, each of which do have bids, determines the effectiveness of the change in reducing flow on a constraint.

Q. How does the security constrained economic dispatch account for bids?

A. As I explained, a constraint is binding if the flows would exceed the modeled transfer limit but for the redispatch by the security constrained economic dispatch system. The redispatch consists of combinations of incremental supply bids or decremental demand bids on one side of the constraint and an equal quantity of decremental supply bids or incremental demand bids up on the opposite side of the constraint. The marginal cost of relieving a constraint, its “shadow price,” will in such cases reflect the bid of the resource that was marginal in relieving the constraint. If there is no congestion, the marginal cost of congestion will be zero and the locational marginal price of any location will reflect only the system marginal cost of energy and the marginal cost of losses at the respective location.

Q. Does the ISO use all bids in clearing the market?

A. No. Certain combinations of system conditions and bidding patterns that involve unusually high volumes of self-schedules relative to the volume of economic bids create a situation where the only available economic bids are electrically distant from the congested constraint and have very low effectiveness in relieving the constraint. Without a minimum effectiveness threshold, the market optimization technology could accept extremely ineffective resource adjustments to relieve a constraint, which could result in the redispatch of significant quantities on energy in order to achieve a small amount of congestion relief on a particular constraint. The ISO therefore uses only available "effective" economic bids in relieving the constraints.

Q. What happens if there are insufficient effective bids?

A. If there are insufficient effective bids, the security constrained economic dispatch is designed to relax the transmission constraints in order to clear the market. Relaxing the transmission constraint means increasing the modeled transfer capability so that the market clears based on the available effective economic bids. Without such action, the market optimization would not be able to arrive to a solution without using ineffective bids because it would be faced with an insolvable mathematical problem.

Q. How does the ISO evaluate which bids are effective bids for determining whether such bids will be used before relaxation of the transmission constraint?

A. Prior to the start of its nodal market, the ISO established, through specific provisions of the ISO tariff, a configurable setting, or parameter, in the ISO's software that sets forth the minimum degree of effectiveness in relieving a constraint that is required for use of a bid in congestion management. This parameter is needed in order to avoid unnecessarily incurring significantly high shadow prices and congestion costs, and also to avoid a dispatch solution that is not consistent with good utility practice. This setting reduces slightly the set of allowable redispatch solutions for relieving congestion on a given constraint in order to eliminate those solutions that would be operationally unreasonable because they use highly ineffective resource adjustments. This parameter is currently set at 2.0 percent effectiveness.

Q. Is this effectiveness threshold sufficient in itself to ensure results consistent with good operation practice?

A. No. The effectiveness threshold only establishes the limit of effectiveness of adjustment of a *single* location relative to the *distributed reference bus*. As I previously discussed, however, it is the relative effectiveness of two or more resources with economic bids to each other and not the effectiveness relative to the reference bus that determines the effectiveness of redispatching the resources to resolve congestion.

Because the effectiveness threshold thus does not in itself limit ineffective combinations of dispatches at different locations that are individually within the effectiveness threshold. The ISO software contains other configurable parameters that enable the ISO to manage the constraints and priorities rather than relying solely on this individual resource effectiveness threshold.

Q. How are these parameters incorporated into the ISO systems?

A. Prior to the start of the ISO's nodal market, on November 8, 2008, the ISO submitted the initial parameters to govern over the scheduling and pricing of resources through its optimization software in FERC Docket No. ER09-240. Dr. Lorenzo Kristov provided a thorough explanation of the tools the ISO uses to inform the optimization software how it should manage the various constraints. I will not repeat all the details in my testimony here, but will focus on the elements that are important for understanding the proposed changes in this proceeding. I recommend a review of Dr. Kristov's testimony for a more complete account of all the parameters used in the ISO scheduling and pricing runs. In the scheduling run, the scheduling parameters instruct the market optimization software regarding the sequence to follow in making adjustments to the different categories of non-priced quantities and include such parameters as the transmission constraint limitations and the thresholds for moving from one category of non-priced quantities to the next. The pricing parameters in the pricing run affect how the software will determine prices when one or more non-priced quantities have been adjusted to achieve a solution.

Q. Please describe the role of the scheduling transmission constraints relaxation parameter, which the ISO proposes to modify in this amendment.

A. The scheduling run transmission constraint relaxation parameter works as a strike price above which the software will relax a transmission constraint in order to clear the market and set schedules in the scheduling run. It limits the extent to which the optimization run will use available effective economic bids before it will relax the modeled transmission constraint. At the current $5,000 setting, the software will relax the transmission constraint if it cannot eliminate the overload at a cost of $5,000/MWh or less. There are a number of other such configurable parameters that also act as strike prices, and the numerical hierarchy of these prices represents the relative value of protecting the various constraints modeled in the system. For example, other parameters are associated with adjusting a resource beyond its economic bid range to ensure the economic bids are used before adjustment of price-taker self-schedules or higher priority self-schedules using existing transmission contract rights or transmission ownership rights. The scheduling run parameter for adjusting price-taker self-scheduled supply is -$1,100 and that for existing transmission contract or transmission ownership rights self-scheduled supply is between -$3,200 and -$4,500. Based on the existing transmission constraint parameter of $5,000, it is possible for such self-scheduled supply to be adjusted before a transmission constraint is relaxed only if the self-schedule resource is highly effective in relieving congestion. If the self-scheduled resource is not highly effective, the software will relax the constraint instead before adjusting a self-schedule. Operationally, procedural mechanisms are in place to manually adjust existing transmission contracts or transmission ownership rights schedules if necessary.

Q. How does the operation of the transmission constraint relaxation parameter differ from that of the bid effectiveness threshold?

A. Unlike the bid effectiveness threshold, the transmission constraint relaxation parameter establishes the upper limit on cost of adjustment that will be allowed before the constraint will be relaxed for the individual constraint, taking into account the combined effectiveness of the available bids' effective bids. Therefore, the transmission constraint parameter can limit combinations of ineffective and thus highly expensive adjustments that the minimum effectiveness threshold cannot limit. A simplified example would be a single resource relative to a distributed reference bus that is 10 percent effective. One can think of the $5000 value intuitively as the cost of obtaining one MWh of additional energy from that resource if it is bidding $500. The 10 percent effectiveness means that it takes 10 MWh of energy from the resource to change the flow on the constraint by one MW for the hour; thus the cost of one MWh of congestion relief is the cost of 10 MWh of energy or $5000. The software therefore could also accept a $200 bid from a resource that is only five percent effective, accepting 20 MWh at a cost of $4000 to obtain one MWh of congestion relief. Alternatively the software could accept a self-schedule adjustment that has a scheduling parameter of $1000 and is 25 percent effective, accepting four MWh at $4000 to obtain one MWh of congestion relief. This example is highly simplified because it refers to the effectiveness of a single resource adjustment. However, through the actual workings of the many constraints in the market optimization, as I previously discussed, it is the combination of adjustments that determines actual effectiveness.

Q. Please explain how the scheduling transmission constraint relaxation parameter operates to limit redispatch and to relax a constraint.

A. If the software sees congestion on a particular constraint, it will try to relieve the congestion using economic bids to redispatch supply resources in the least-cost manner. Since the output of any particular resource is typically much less than 100 percent effective on any given constraint, it will take several MWh of increase and decrease of different resources to obtain just one MWh of congestion relief on the constraint. Suppose the first and cheapest MWh of congestion relief costs $1200, the next MWh of relief costs $2300, and so on up to $5500. With the relaxation parameter set at $5000, the software will accept the bids for redispatch at costs from $1200 up to $4999, but if the line is still congested and the next MWh of congestion relief costs more than $5000, the software will cease redispatch of additional energy. The software will consider bids above that amount to be ineffective with respect to that constraint, will forego use of these bids, and will adjust the non-priced quantity, *i.e.,* relax the transmission limit. Taking into consideration the entire system as a whole, the market system will consider the combined effects of all bids to relieve a constraint.

Q. How does relaxation of the scheduling run transmission constraint impact schedules and prices?

A. The relaxation of the parameter enables the ISO software to clear the market and to establish a schedule for all resources on the system that are feasible within the constraints as modified through the scheduling run. This enables the ISO to operate the system reliably using effective economic bids. In cases where a transmission constraint or a self-schedule is relaxed using the uneconomic adjustment parameters used in the scheduling run, the scheduling run may also affect the locational marginal price for a given run and at a specific location when running the pricing run. The pricing run uses the schedules, dispatched bids, and constraints relaxed in the scheduling run to establish the actual price. In the pricing run, any constraint relaxed or any self-schedule adjusted in the scheduling run is fixed at the MW level established in the scheduling run plus a small amount of additional movement called “epsilon.” The pricing run parameters used for such uneconomic adjustment are set based on the energy price bid cap. In the pricing run, there are two possibilities for establishing prices associated with a relaxed constraint. If the amount of epsilon movement at the bid cap is partially used, the pricing run parameter itself will establish the marginal or shadow price for a constraint that has been relaxed in the scheduling run. However, if the amount of epsilon movement at the bid cap is fully used, it means that there was an economic solution available between the price level of the parameter used in the pricing run and the level used in the scheduling run. This economic solution will then establish the shadow price of relieving the constraint.

Q. Does the scheduling run transmission constraint relaxation parameter act as a ceiling for locational marginal prices?

A. No. Locational marginal prices can actually exceed the level of the transmission constraints relaxation parameter. In the event there are multiple simultaneous constraints, the locational marginal price at a location will reflect the sum of the product of the shadow price of the constraints and the associated power transfer distribution factor for the respective location. This is expressed in an equation in Appendix C of the ISO tariff for the marginal cost of congestion at any specific location:

$$MCCi = -(\Sigma\ PTDFik * FSPk)$$

k=1ive to each constraint.

II. REAL-TIME CONGESTION OFFSET

Q. Please describe the real-time congestion offset.

A. Before I describe the real-time congestion offset, I must explain that the ISO market settlements must be neutral, *i.e.,* the amount of money collected must equal the money dispersed. Therefore, the ISO has developed several accounting devices to ensure it can allocate any excess revenue or shortages accrued through its markets. One source of such excess revenue or shortage is real-time congestion charges and payments. Part of the locational marginal price paid to suppliers is the value of congestion relief provided by energy injections at a particular location, *i.e.,* the marginal cost of congestion. Specifically, the marginal cost of congestion is the component of the locational marginal price that reflects sensitivity of relieving congestion by increasing supply at the location balanced by an equal increase in demand at the reference bus. The real-time congestion offset is the neutrality accounts designed to specifically account for differences between congestion revenue and congestion credits in the real-time.

Q. What drives real-time congestion costs?

A. The ISO operates its day-ahead and real-time market with the expectation that the bulk of demand bids and supply offers for energy will be cleared and be feasible in the day-ahead market, with only incremental demand and supply cleared in the real-time. Achieving this outcome is dependent on the amount of bids and offers submitted in the day-ahead market, but also on the ISO's ability to capture and model system conditions accurately in the day-ahead market systems. For example, if outages occur that are not known in advance and are only known in the real-time, the day-ahead market will clear based on a higher transmission transfer capability than will exist in real-time. Such schedules may not be feasible in real-time when actual outage conditions result in a lower transfer capability. Similarly, unscheduled flows that appear in real-time and that are not adequately captured in the day-ahead market, the real-time market will have to redispatch other schedules to manage flows. However, in real-time the cost of such redispatch could be significantly higher while the effectiveness of real-time dispatch could be significantly less because there are fewer effective resources available to the ISO in the real-time. In real-time five-minute dispatch the ISO no longer has the ability to start resources, economic adjustment of hourly interties is no longer possible, and the amount of redispatch is limited by the ramping ability of the available resources. As I discuss below, when there are material reductions in transfer capability in real-time, the risk of having large real-time congestion cost offset shortages increases significantly.

Q. Please explain the calculation of the real-time congestion offset.

A. To derive the real-time congestion offset for each hour real-time market, the ISO calculates the difference between the total real-time congestion revenue and congestion payments. The total congestion revenue is calculated as the sum of the revenues the ISO receives, based on the respective real-time locational marginal cost of congestion, from (1) reduction of dispatched energy from supply, (2) the increased imbalance demand energy, and (3) virtual supply liquidated as demand. Imbalance demand energy is the difference between the amount of demand a scheduling coordinator schedules in the day-ahead market and its actual demand based on metered demand. Total real-time congestion payments are calculated as the sum of ISO payments, based on the respective real-time locational marginal cost of congestion, from (1) increased dispatches of imbalance supply energy, (2) reductions of imbalance demand, and (3) virtual demand liquidated in the real-time. The total real-time congestion payments also (1) include the sum of real-time and hour-ahead scheduling process congestion charges that the ISO assesses to intertie ancillary services awards and (2) exclude any congestion credits provided to grandfathered contracts or transmission rights owners in the hour-ahead scheduling process and real-time.

Q. Why are there differences in real-time congestion revenue and payments?

A. Resources are paid the locational marginal price, which includes the marginal cost of congestion, based on the specific location at which they are injecting in the ISO controlled grid. Real-time additional demand pays for withdrawals at different locations than where generation is injected. The cost of redispatching to resolve congestion in real-time is the difference in (1) payments made to supply to increase output above their day-ahead level or payments made to demand to reduce consumption to below their day-ahead level, and (2) charges to supply for reducing output below their day-ahead level or charges made to demand for increasing demand above their day-ahead level. When in the real-time there is reduction of transfer capability from day-ahead level, the amount of payments paid for redispatch in the real-time may exceed the amount of revenue received from resources redispatched from their day-ahead levels. This difference in congestion payments and congestion revenue is accounted for in the real-time congestion offset.

Q. How does the real-time reduction in transfer capability lead to a difference between congestion payments and congestion revenues?

A. The main driver of the real-time congestion offset shortages is the cost of real-time congestion due to a reduction in transfer capability that occurs in real-time from the transfer capability used to determine day-ahead schedules. Real-time congestion costs depend on the volume of redispatch necessary in real-time to accommodate the changes in transfer capability from day-ahead to real-time. Therefore, in cases where there is reduction in transfer capability, the redispatch payments will increase from day-ahead. Congestion revenues, however, may not increase in a matching amount. As I explained, one part of real-time congestion revenue is charges made to demand for increasing demand above their day-ahead level. Because there is no link between reductions in transfer capability and changes in demand, there may be increases in congestion payments without increased demand to provide sufficient revenues. For example, if there were no change in demand from day-ahead, there would be no revenues to compensate for the increased cost of congestion due to a reduction in transfer capability. Thus, as the cost of congestion reflected in the locational marginal price increases at specific locations, the congestion offset shortages may also increase. Conversely, in cases where there is increased use of system but the transfer capability has not reduced from the day-ahead level, there could be a surplus of congestion revenue.

Q. Is this the only cause of the real-time congestion offset costs?

A. No. Other factors can also contribute to the real-time congestion offset. First, the fact that load settles at a load aggregation point at the hourly load aggregation price whereas generation is paid at the specific pricing node. Second, the fact that the ISO provides a "perfect hedge" to existing transmission contracts and transmission ownership rights, also adds to the real-time congestion offset costs. Through the perfect hedge the ISO does not impose a congestion charge to real-time schedule changes from the day-ahead submitted under these rights despite any incurrence of costs to redispatch the system to support these real-time changes. Because there are no revenues to match the redispatch costs to support these real-time schedule changes, such costs contribute to the real-time congestion offset costs. However, both of these contributing factors are relatively small compared to the more significant impact of unbalanced redispatched costs that arise when there is reduction of transfer capability in real-time to levels below those established in the day-ahead.

Q. How does the ISO recover real-time congestion offset costs?

A. The ISO tracks any surplus or shortages in recovering for congestion offset costs through the real-time congestion offset account. The ISO allocates such surpluses or shortages to its load serving entities based on their measured demand, including exports. The details of this accounting device are provided in Section 11.5.4.2 and the definition of the Real-Time Congestion Offset in Appendix A of the ISO tariff. Additional configuration detail is provided in Charge Code 6774, which is part of the Business Practice Manual for Settlements.

Q. Is the difference between real-time congestion revenues and payments a new development?

A. These phenomena existed prior to the start of the ISO's nodal market. In the zonal-based market, these types of redispatch costs were referred to the transmission owner debit costs and were allocated to both demand and the participating transmission owners. Under the new market, these redispatch cost shortages that result from reduction in transfer capability are collected via the real-time congestion offset and are only allocated to measured demand, which includes internal load and exports, even if the amount of day-ahead demand equals the real-time and actual measured demand.

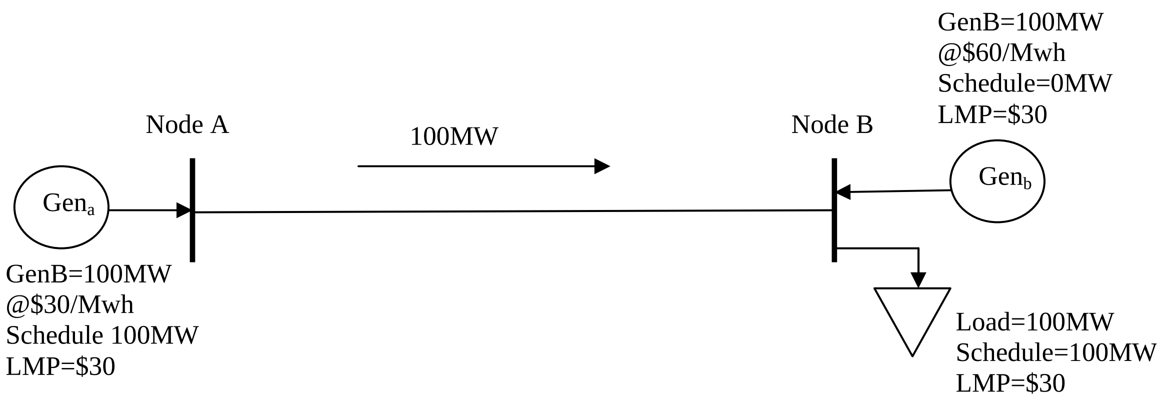
Q. **Can there be differences in congestion revenues and payments in the day-ahead market?**

A. Yes, but these charges and payments are accounted for in the day-ahead market through congestion revenue rights balancing account. Therefore, there is no need for such a congestion offset account in the real-time market. In the day-ahead market, if there is a derate in transfer capability that occurred compared to what was allocated or auctioned in the congestion revenue rights process, there may also be insufficient money collected in the day-ahead congestion revenue balancing account after accounting for the amount of payments that must be made to congestion revenue rights holders. As with the real-time congestion offset, any shortages or surpluses are allocated to measured demand.

Q **Can you provide an example of how this might happen?**

A. Yes. Assume a simple two node system with a 100 MW transfer capability from generation at one node A and 100MW demand at node B. Generation at node A costs \$30/MWh. There is also a generator at node B that costs \$60/MW.

Figure 1: Congestion Revenue and Payments in Day-Ahead Market



As illustrated in Figure 1, in the day-ahead market there is sufficient transmission capacity for the 100 MW demand to be served by the most economic resource at node A at $30. However, in real-time, the transfer capability between node A and node B reduces to 80 MW.

Figure 2: Congestion Revenue and Payments in Real-Time Market Result

Assuming the same bids from the day-ahead market exist, generator at node A has to reduce to 80 MW and generator at node B increases to 20 MW to serve the 100 MW demand at node B at a price of $60/MWh. As illustrated in Figure 2, in this simple example the real-time congestion offset equals the 20 MWh x $60/MWh – 20 MWh x $30/MWh = $600 to compensate the redispatch necessary to address the reduced limit in the real-time market. The only congestion the real-time market is resolving in this example is the 20MW of reduction in transfer capability between node A and node B. However, because the transfer capacity between A and B is reduced versus the limit used in the day-ahead market, the resource at node A has to be redispatched down because the system cannot transfer

100MW to load at node B. The MW reduction in transfer capability causes the need to redispatch generator at B up by 20MW resulting in a price of $60/MWh at node B. The total cost to relieve real-time congestion is $600/MWh calculated as follows: the $1200 (20 MWh x $60) payment to generator at node B minus $600 (-20 MWh x $30) revenue collected from generator at node A. The resultant $600 shortage in this example is ultimately collected via the real-time congestion offset, which is allocated to the ISO's internal load and exports (*i.e.*, measured demand). Despite the fact that 100 MWh cleared in the day-ahead market and did not have any dispatch adjustment in real-time, the demand drives the cost of the real-time dispatch to account for the differences between the day-ahead and real-time.

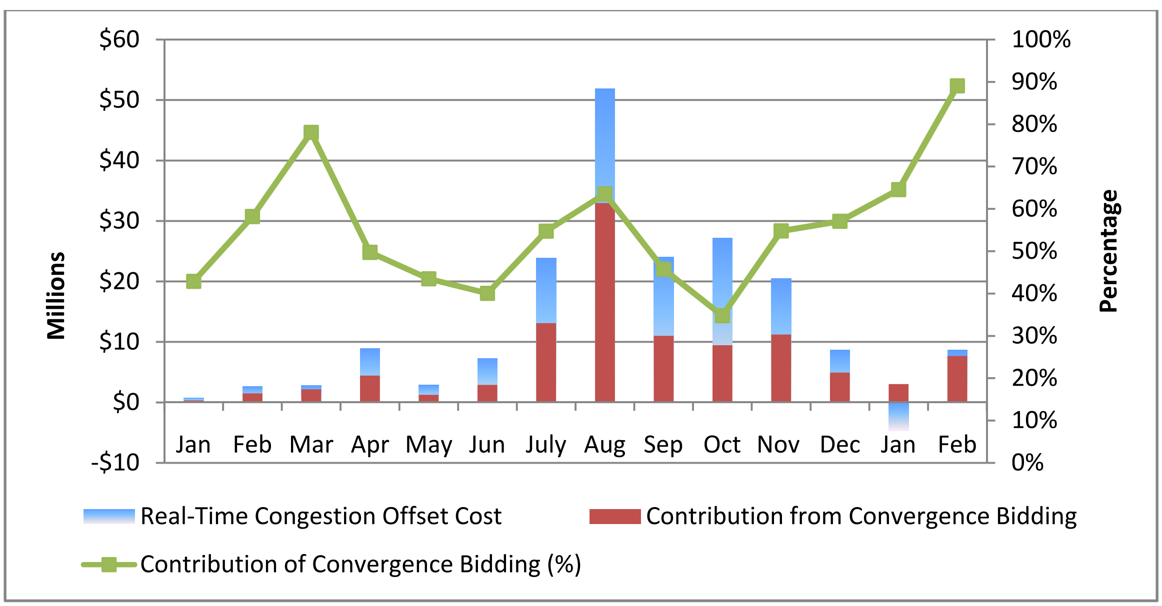
Q. Do convergence bids contribute to the real-time congestion offset, and if so how?

A. Yes, convergence bids contribute to the congestion offset costs. Both physical and virtual bids contribute to the demand to be accounted for in real-time when there is a capability transfer from day-ahead to real-time. However, while physical demand is allocated the congestion costs associated with that transfer in capability, virtual bids are liquidated in real-time and therefore are not allocated any of the real time congestion offset costs. An extension of the prior example demonstrates this phenomenon. Assume that instead of the 100 MW demand clearing in the day-ahead market, only 95 MW of physical demand clears in the day-ahead market and 5 MW of total demand consists of virtual demand cleared at node B. In real-time, the transmission between node A and node B is again reduced to 80 MW. The actual load at node B is 100 MW. In this case, generation at node A is reduced by 20 MW and that at node B is dispatched up by 20 MW. However, 5 MW of virtual demand is liquidated in the real-time market at the node B real-time $60 price for a total real-time congestion credit of $300 (5MW x $60/MWh) paid to virtual demand. Since the physical load increased by 5MW in real-time, physical demand is charged $300 (5MW x 60/MWh). However, the physical measured demand is also allocated the $600 congestion offset that results redispatch cost of generator at node B due to the reduction in transfer capability. Therefore, the virtual position is not exposed to the allocation of the congestion offset costs resulting from the derate in the same way the physical demand is exposed to the congestion offset costs.

Q. Do convergence bids contribute significantly to the real-time congestion offset?

A. Yes. As shown in Figure 3 below, the bulk of the real-time congestion offset is attributed to convergence bids. Even before the notable increase in real-time congestion offset costs over the summer, as reflected by the red portions of each bar in Figure 3, convergence bidding activity usually accounted for the bulk of the real-time congestion offset. As the offset itself grows, so does the convergence bidding contribution and it continues to be the most significant contribution. As noted earlier, liquidation of the convergence bids that cleared the day-ahead market increases real-time congestion offset cost when there are reductions of transfer capability in real-time market. However unlike actual measured demand, convergence bids are not allocated any of the real-time congestion offset costs. Some have suggested that the convergence bids should be allocated a portion of the real-time congestion offset costs. The ISO believes that consideration of allocation of a portion of the real-time congestion offset costs to convergence bids may be warranted as a separate proposal, but would not be sufficient to replace the proposal to modify the real-time transmission constraint relaxation parameter.

Figure 3: Contribution of Convergence Bidding to Real-time Congestion Offset



Q. Does this mean convergence bids "cause" the offset?

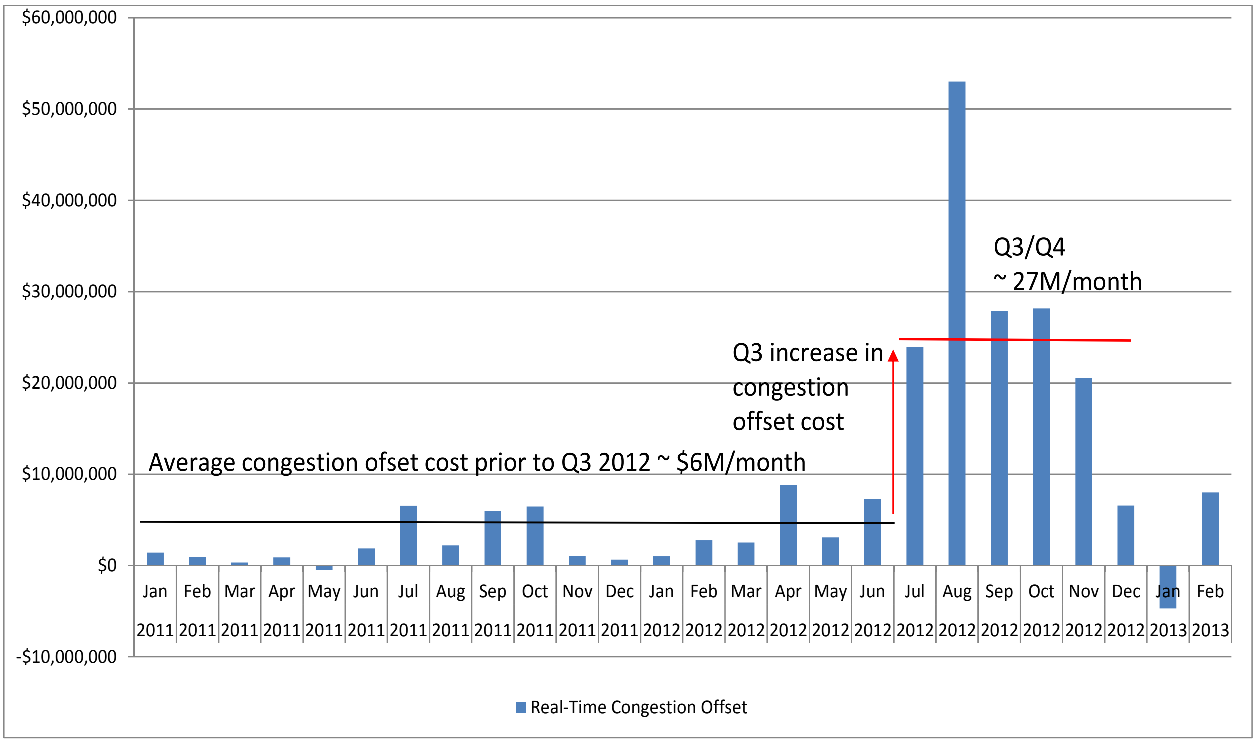
A. No. The spread in pricing between the day-ahead and real-time markets provides an incentive for market participants to submit virtual bids to take advantage of the expected price spread. This is expected convergence bidding behavior. However, the prices between the day-ahead and real-time are not able to converge because the separation is driven by the transfer capability and not economic bidding behavior, as I describe above. This results in an increased volume of convergence bids and a comparable increase in their contribution to the real-time congestion offset.

III. INCREASE IN REAL-TIME CONGESTION COSTS

Q. Please describe the trend of the real-time congestion offset?

A. Until last July, the real-time congestion offset had remained relatively stable since the ISO commenced operating its LMP-based market on February 1, 2009. Figure 4 below shows that the average real-time congestion offset for each month was about $4 million. However, in July 2012, it jumps to a monthly average of $27 million and in August it peaks at almost $55 million. Since August 2012, the real-time congestion offset cost decreased but, with one exception, remained at elevated levels. The exception was the month of January 2013. During one day in January, a large amount of real-time wind generation deviation from the day-ahead schedules coupled with real-time congestion resulted in large negative real-time congestion offset cost. In February the real-time congestion offset increased again, and again it was substantially higher than prior year amounts for February.

Figure 4: Trends in Real-time Congestion Offset.



Q. What drove this increase?

A. The increase in the real-time congestion offset costs over the last seven months arises from a significant increase in the number of constraints the ISO has had to manage in real-time using transfer capability reductions below those used in the day-ahead market to ensure reliable operations. As more constraints to be resolved in the real-time market increases, the costs to resolve such congestion increase because, as I discussed above, the ISO has fewer economic redispatch options to resolve congestion in the real-time dispatch process.

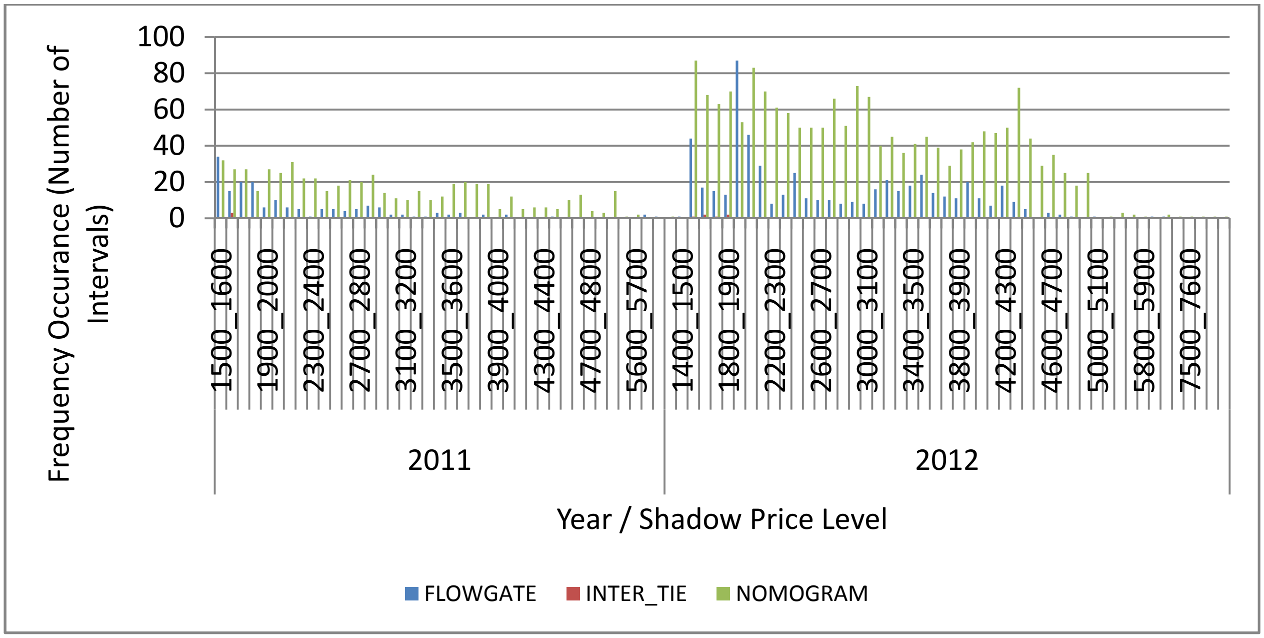
Q. What caused the increased number of constraints in real-time?

A. The increased number of constraint observed in real-time is a result of several changes in actual system operational conditions. Two changes were related to specific events. First, the system became more constrained as a result of the outage of San Onofre Nuclear Generating Station over the summer 2012. This outage is expected to continue for the foreseeable future and there is no established timeline for San Onofre Nuclear Generating Station to return to service, if ever. Second, planned and forced outages increased beyond what is typical in late summer, which increased congestion occurring on the system. For example in August fires exacerbated congestion on the Table Mountain 500/230kV bank due to the inability to dispatch generation in the Feather River system. The other causes reflect more permanent changes and challenges. The ISO has adopted new constraints in the real-time market as a result of increased regional coordination in response to the September 8, 2011 outages. These are expected to remain in place. In addition, significantly more unscheduled flow occurred in real-time, which increases the frequency of congestion requiring reduction of schedules established in day-ahead market. The ISO has no basis to conclude that these unscheduled flows will be subsiding. Finally, some of the new constraints are related to flow conditions that are external to the ISO balancing authority area. The ISO is less able to accurately identify these unscheduled flows in the day-ahead and, therefore, is limited in minimizing the transfer of capability from the day-ahead to the real-time. Going forward, the ISO will maintain its new practice of modeling more constraints to ensure reliable operations through the ISO's market dispatch. A reduction in available capacity combined with constraints due to unforeseen contingencies in the context of its modified practices will result in a more constrained system over time. While these new practices and circumstances are perfectly acceptable and expected, in light of the ISO's finding that there appears to be no improvement in the effectiveness of resources in relieving congestion at the higher parameter setting, which I describe in detail below, there is no justifiable reason for imposing the greater cost to the market. Another way to look at these circumstances is that if the system was less constrained, the higher parameter setting might not have as great a financial impact to the market given that the constraint would bind less frequently. But as the system becomes more constrained, the parameter becomes more active as the constraint binds more, triggering the higher cost of relieving congestion.

Q. How did the frequency of higher cost of real-time congestion contribute to the real-time congestion offset?

A. There are a number of factors that contributed to this increase. As I explained above, the congestion offset is in part driven by high real-time cost of congestion. Figure 5 below provides a comparison of the frequency of the congestion event where the cost of congestion exceeds $1500, and indicates that the frequency of high-priced congestion events has approximately tripled between 2011 and 2012.

Figure 5: Frequency of Congestion Where Shadow Prices exceeded $1,500 MWh in the Real-time.

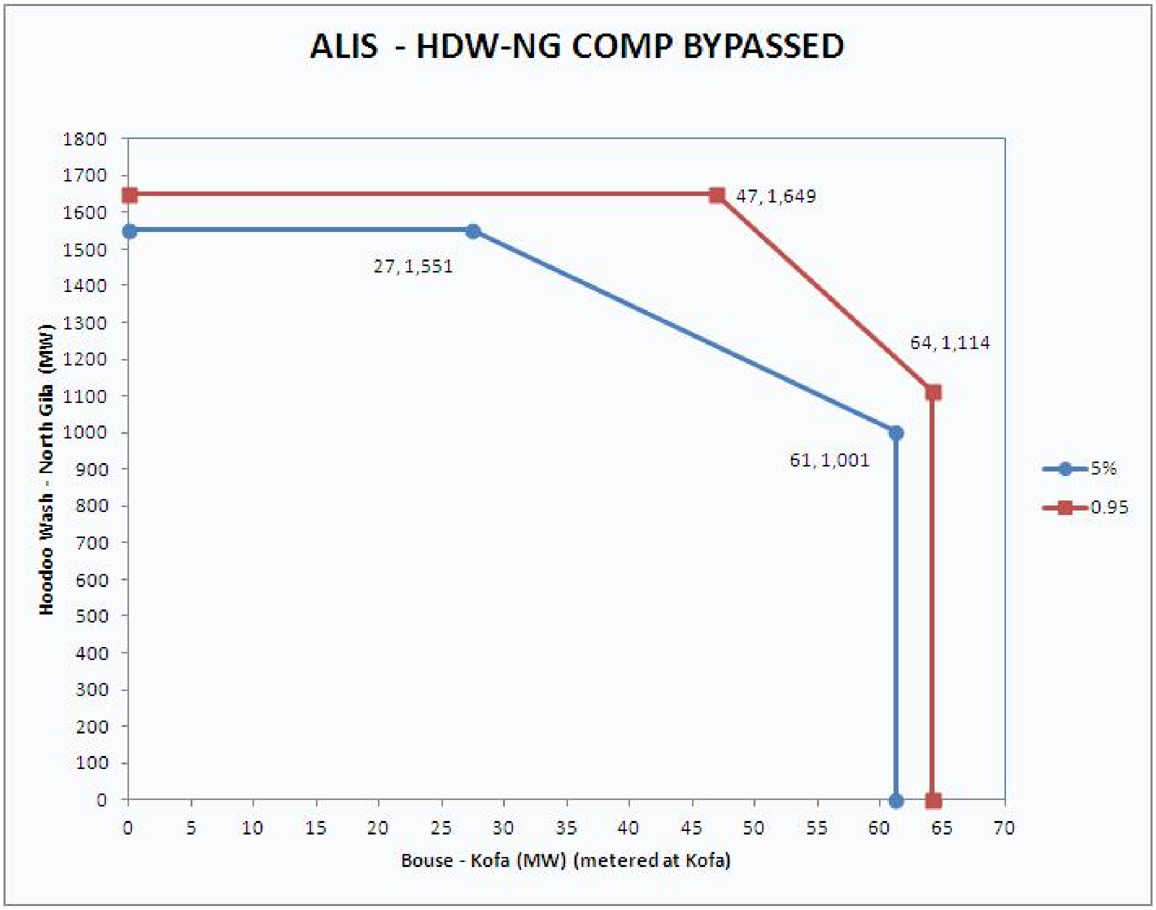


This increased frequency of high priced congestion events explains in part the almost five-fold increase observed in real-time congestion offset cost in the third and fourth quarter of 2012 shown in Figure 5. While, as shown in Figure 4, December 2012 and February 2013 congestion offset costs have moderated to almost $10 million, the costs in these months remain relatively high when compared to the same months in prior years, for example, less than $1million in December 2011 and approximately $3 million in February 2012. This supports the conclusion that there appears to be a fundamental change in system conditions that has led to a recurring increased amount of real-time congestion.

Q. Can you provide an example of the increased challenges in the real-time market using the example of the Hoodoo Wash–North Gila 500kV constraint?

A. The Hoodoo Wash–North Gila constraint is an example of a new constraint that was identified as a result of the coordinated improvement in modeling both in the ISO and neighboring balancing authorities' areas that has occurred as a result of the September 8, 2011 southwest outage. Figure 6 is an illustration of a nomogram representing the simultaneous limit of flows on the ISO's Hoodoo Wash-North Gila 500kV line and Western Area Lower Colorado's Bouse-Kofa line. Since the ISO does not know the flows on the Bouse – Kofa lines in the day-ahead market, the ISO finds itself having to adjust the limit on the Hoodoo Wash – North Gila 500kV line in real-time when simultaneous flows approach the diagonal limit of the nomogram. This causes the transfer capability in real-time to become more limited than that used in day-ahead market. In addition, this makes the redispatch of resources downstream of the constraint inside the ISO ineffective in relieving the constraint and leaves the ISO only the option of adjusting hourly imports at the interties.

Figure 6: Simultaneous Flow limit of Hoodoo Wash – North Gila and Bouse – Kofa 161 kV line flow limit in WALC area.



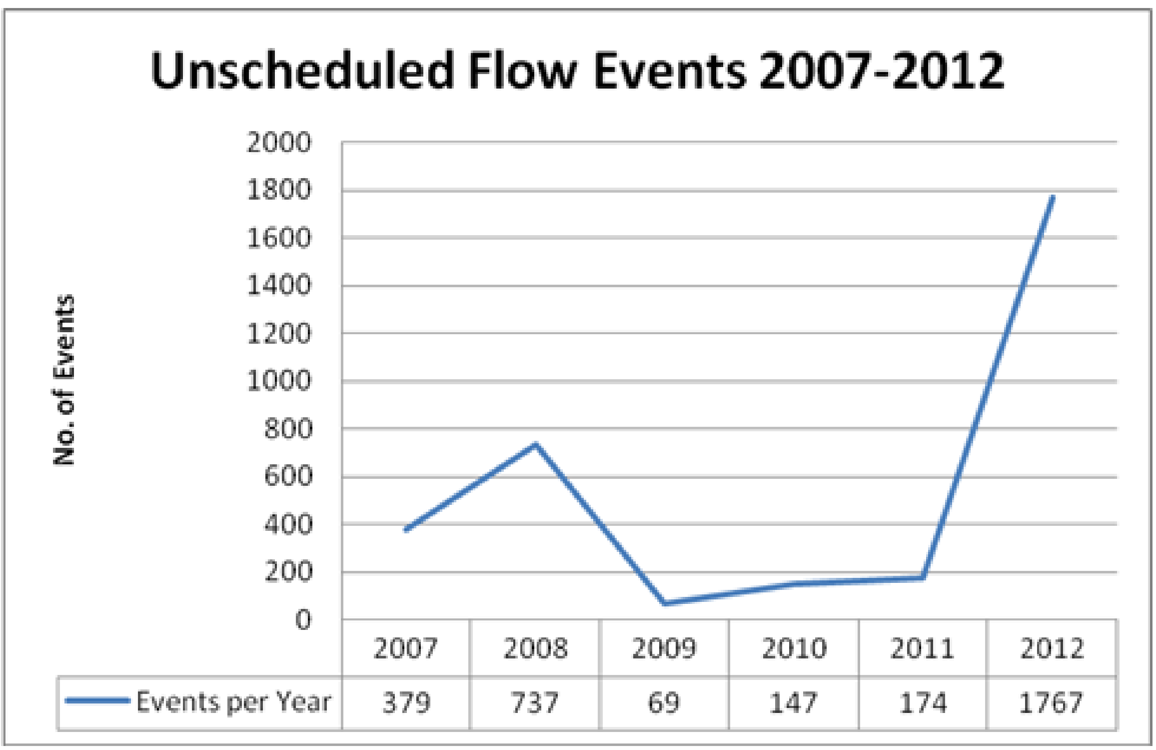
The need to manage the Hoodoo Wash – North Gila constraint is also an example of a constraint impacted by increases of unscheduled flow events in 2012. Other examples include the Table Mountain 500/230kV bank constraint mentioned above that occurred in August of 2012 due to fires in the Feather River area that were also impacted by unscheduled flows.

Q. What are your observations regarding unscheduled flow frequency in 2012?

A. Much of the unscheduled flow that we observed to have increased significantly in 2012 was not accounted for in the day-ahead market.

Rather, the ISO was required to manage much of the congestion associated with the unscheduled flow in the real-time market. Figure 7 reflects the number of unscheduled flow events called since 2007 on the California Oregon Intertie (Path 66). This illustrates that the number of unscheduled flow events in 2012 has increased significantly or doubled as compared to any prior year. While the ISO anticipates that both the ISO and its neighboring balancing authority areas will continue to take measures to minimize unscheduled flow, the increasing trend indicates a need to consider that these will persist for some time.

Figure 7: Unscheduled Flow Events 2007-2012



Source WECC hourly notices.

Q. You mentioned that there was a decrease in the real-time congestion offset cost recently. Please explain that decrease.

A. The downward trend of real-time congestion off-set costs between December 2012 and February 2013 was a result of (1) seasonal limits that relaxed some of the constraints, and (2) reduced flows from imports due to scheduled transmission resulting in derate of import capability. In addition, as I mentioned above, in January 2013, there was a larger than normal negative congestion offset triggered by how real-time deviations from variable resources were being considered by the software resulting in increased transmission use and congestion.

Q. Do you anticipate this downward trend to continue?

A. No. Generally, because the ISO has taken other measures to address the discrepancy between the day-ahead and real-time transfer capability availability, we do not anticipate that the real-time congestion offset will rise quite to the high levels we observed in August. Nonetheless, because the recent down-ward trend is seasonally related, we do anticipate that as we move into the shoulder months in the spring time, when more resources and grid facilities have scheduled outages, the system will again become more constrained. In addition, summer operational conditions can be constrained due to unexpected events such as fires. This will put pressure on the real-time congestion offset again. Combined with the ISO's new practice of modeling more constraints in the real-time as I described above, it is safe to assume that the downward trend is temporary. In fact, we are already observing an upwards swing in February. The ISO is making this filing in time to have the parameter modified in the spring and summer months in order to alleviate these unnecessary costs to load.

IV. SETTING OF THE TRANSMISSION CONSTRAINTS RELAXATION PARAMETER AND ITS RELATIONSHIP TO THE REAL-TIME COST OF CONGESTION

Q. Please explain why the ISO originally set the transmission constraint relaxation parameter at $5,000/MW.

A. In 2008, prior to the start of the new nodal market on February 1, 2009, the ISO conducted a stakeholder process to establish the numerical value for the various parameters. At that time, the ISO had not yet had any experience with operating an actual nodal market. As explained by Dr. Kristov, in setting this parameter, the ISO strove to balance two competing objectives. The first was to set it high enough to avoid overuse of constraint relaxation in the markets. The second objective goal was to set it low enough to avoid accepting the kind of extreme scheduling outcomes, where a large volume of energy from ineffective resources is redispatched to obtain a small amount of congestion relief on a geographically distant constraint. Both these goals were and remain crucial because a guiding principle of the ISO's new nodal market adopted in 2009 has been to produce feasible day-ahead schedules and real-time dispatch instructions so that the ISO does not have to resort to manual dispatches to ensure reliable operation of the system.

Q. How did the ISO determine that the $5,000 setting met these two goals?

A. Prior to actually implementing the nodal market design, the ISO had to rely on market simulations conducted to evaluate the performance of the established levels. The ISO had to rely on market simulation data because it did not have actual market data on which to test the parameters. The ISO tested the $5000 value in market simulations for six months, where it produced a reasonable and appropriate balance between the above objectives. The ISO also created specific test cases simulating extreme grid conditions, such as multiple transmission line derates in an area where the ISO has to honor high-priority self-schedules under existing transmission rights. Through these tests the ISO found that the software, using the parameter, appropriately protected self-schedules and relaxed the binding constraints, based on anticipated conditions at that time. While these market simulations were effective at simulating day-ahead conditions, however, they were not as effective in simulating actual real-time conditions such as unscheduled flow, and the impact of reductions of transfer capability in the real-time market.

Q. Was this setting intended to be permanent?

A. No. The ISO included this parameter setting in the tariff and intended it to govern for as long as actual market conditions supported the findings.

Q. Did the ISO set the pricing run parameter at the same level?

A. No. The two need not be set at the same level. The scheduling run parameter is set at levels above the bid cap to provide sufficient pricing points above the bid cap price, currently $1,000/MWh, to account for the various non-priced parameters the ISO must consider in clearing the market. For example, self-schedules are protected above economic bids such that self-schedules will clear unless there is a need to reduce the available transfer capability for all resources, at which point the ISO follows a hierarchy or priority rules defined in sections 31.4 and 34.10 of the ISO tariff. On the other hand, the pricing parameters are set to the bid caps so that the prices will rise at least as high as the bid caps in cases where a constraint has been resolved using uneconomic adjustment in the scheduling run. In summary, the parameters in the scheduling run are used to enforce the hierarchy of priorities of self-schedules, while the parameters in the pricing run are used to establish prices.

Q. How does the level of the transmission constraint relaxation parameter affect the range of shadow prices that can be achieved with different combinations of relative effectiveness and difference in bid costs?

A. As I previously discussed, the cost of relieving congestion depends on the relative effectiveness of redispatching one resource in one direction versus the effectiveness of redispatching another resource in the opposite direction. The relative effectiveness between two resources is bounded by 0 and 1.0. If the effectiveness is zero then it means that increasing one resource and decreasing the injection of the other resource will result in no relief. On the other hand, if the shift factor difference is 1.0 then an increase of 1MW at the source combined with a decrease of 1MW at the sink results in a 1MW relief in the flow on the constraint. As the relative effectiveness increases, the smaller the bid price difference that is necessary to relieve the congestion at the same cost. Because the transmission relaxation parameter limits the level of shadow price, it limits the level of ineffective and cost of redispatch to resolve congestion. Figures 8 and 9 illustrate, using the range of permissible bids, how the cost of relieving congestion is a function of the relative effectiveness and relative difference in bid costs of two or more resources. As described above, under certain conditions the scheduling transmission constraint relaxation parameter can have an impact on pricing. Depending on system constraints, the parameter may or may not have a notable impact on prices. When the system is overly constrained, the transmission constraint relaxation parameter is likely to bind more frequently, which in turn renders managing congestion more costly. Figure 8 illustrates the range of shadow prices that can be achieved for different combinations of relative effectiveness and difference in bid costs assuming a transmission relaxation parameter of $5000. Figures 8 and 9 reflect a graph of the Shadow Price of a constraint as a function of the relative effectiveness of two resources and the bid price difference:

Shadow Price = $(BP_2 - BP_1)/(SF_2 - SF_1)$

Where;

BP_1 is the Bid Price of resource 1

BP_2 is the Bid Price of resource 2

SF_1 is the Shift Factor of resource 1

SF_2 is the Shift Factor of resource 2

Figure 8: Range of Congestion Shadow Prices Using $5000 Transmission Constraint Relaxation Parameter

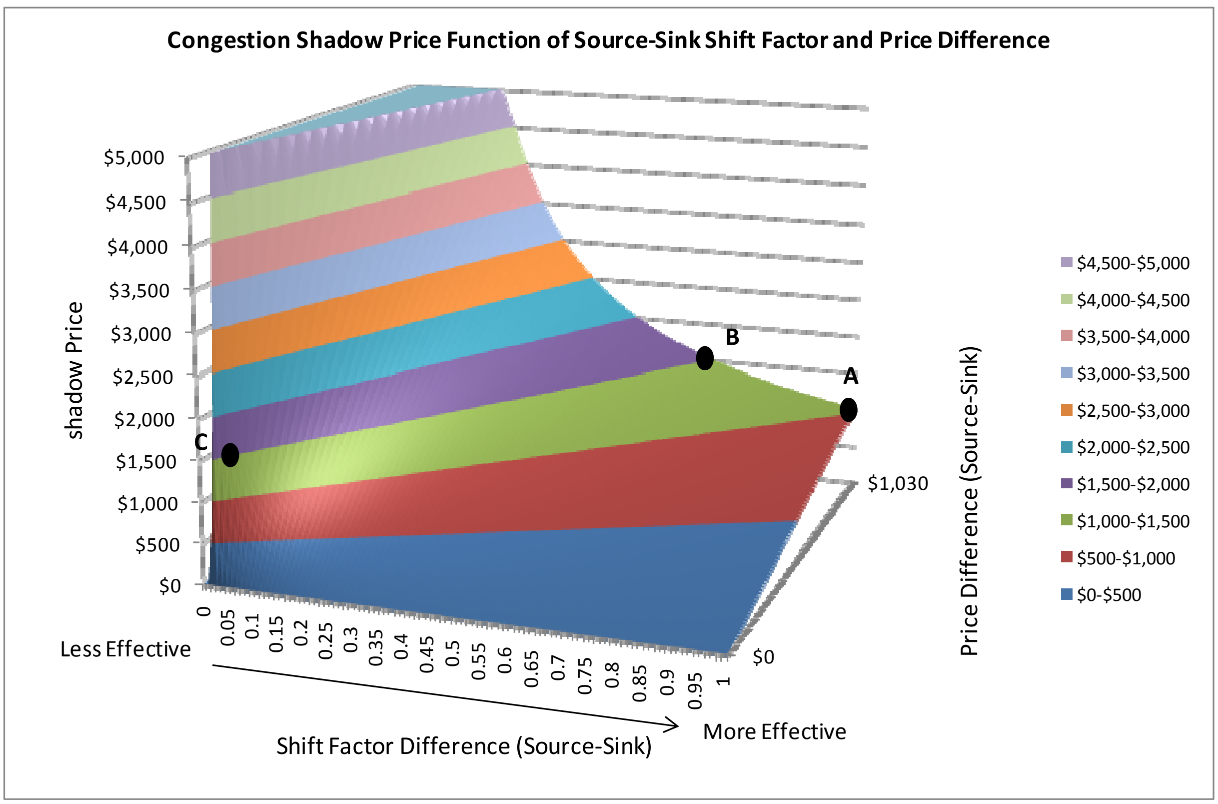
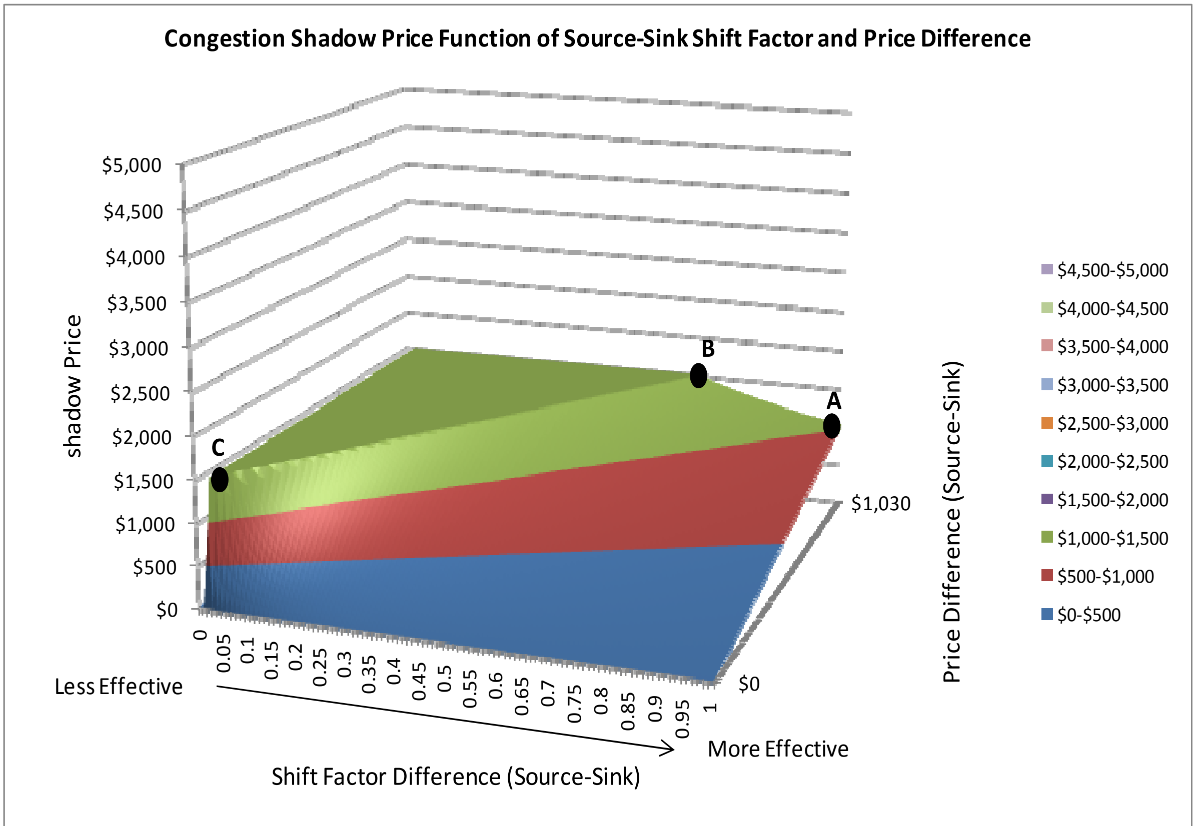


Figure 8 illustrates the range of shadow prices that can be achieved with different combinations of relative effectiveness and difference in bid costs assuming a transmission relaxation parameter of $1500 as proposed by the ISO in this proceeding.

Figure 9: Range of Shadow Prices Using the $1,500 Transmission Constraint Relaxation Parameter



The Southern California Edison import limit definition and management in support of under-frequency load shedding (SCE_PCT_IMP_BG) constraint, a closed interface constraint, is a good example for describing the phenomena described above, in which resources on one side of the constraint will have shift factor difference of 1.0 relative to a resource on the opposite side of the constraint. Assuming no losses, the maximum shadow price that can occur based on the maximum difference in bid cost difference between the source and sink resources is approximately $1030 (the difference between the bid cap of $1000 and the bid floor of $30). This point is illustrated as point A in Figures 8 and 9. Point A is unaffected by the application of $1500 transmission constraint relaxation parameter instead of the $5000 parameter. Point B on Figures 8 illustrates how a resource that has a +9 percent shift factor (+.09) relative to a reference may be redispatched up if there is another resource that has a negative 57 percent shift factor (-0.57) in reducing flow relative to the same reference bus. In this case the relative effective difference is 66 percent (0.09-(-0.57)). A bid of $1000 on the resource that is 9% effective would be dispatched even if the other resource that is negative 57% effective is bid at negative $30. Point C on Figure 8 and Figure 9, on the other hand, illustrates that if the source and sink bid difference was $30, the redispatch of such resources would occur even if the relative effective difference was 2%. Note that points B and C, which represent combinations of differences in shift factor effectiveness of two resources and the price difference of two resources, on Figures 8 and 9 are the same in each chart. The only difference between Figures 8 and 9 is that Figure 8 reflects the transmission constraint relaxation parameter limit of $1500. Figures 8 and 9 above, therefore, illustrate that at the higher $5,000 setting, the market optimization run is likely to select many more combinations of costly bids that are not less and less effective. Points B and C illustrate that even at the lesser parameter setting of $1,500, the market optimization is likely to produce a combination of bids that are just as effective at relieving the constraint when it is binding. The diagrams illustrate that as the parameter exceeds $1,500 the optimization continues to select more and more expensive economic bid combinations that have marginal benefit at relieving the constraint than it does at the $1,500 setting.

Figure 10. Range of Congestion Shadow Price using $1500 Parameter.

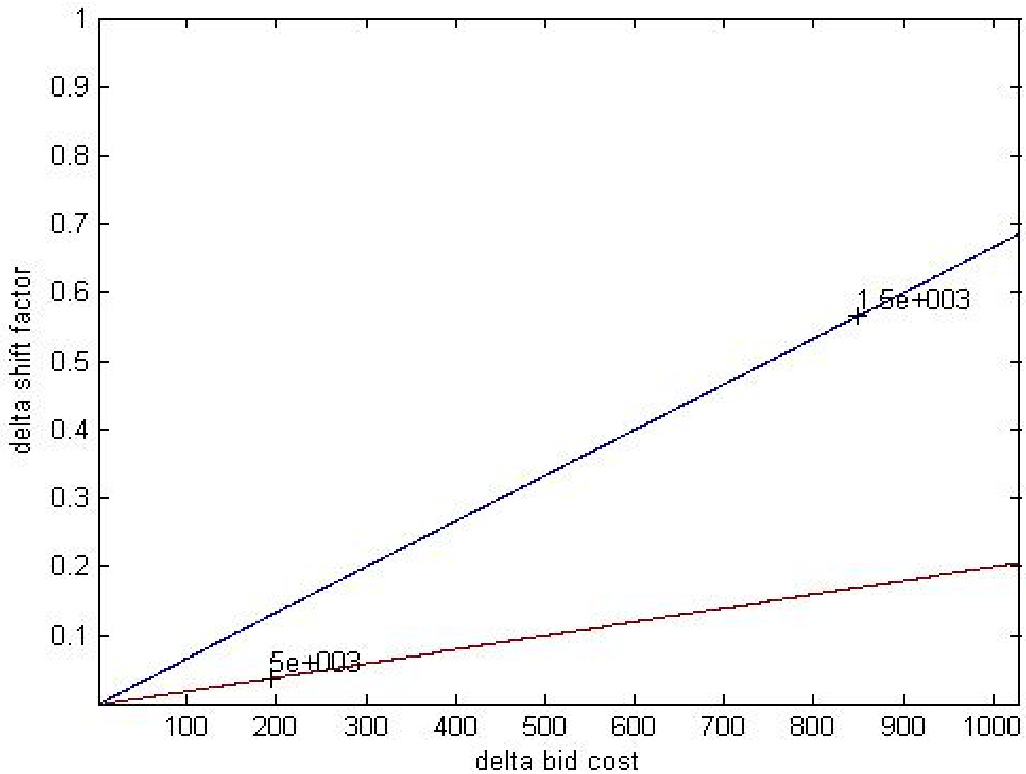


Figure 10 provides an alternative way of representing the relationship between the transmission constraint relaxation parameter and the effectiveness and price difference between resources considered for redispatch. The two lines reflect the intersection or combination of relative effectiveness and bid price difference that would result from either a $1500 or $5000 transmission constraint relaxation parameter. The upper line represents the $1500 relaxation parameter. The lower line represents the $5000 relaxation parameter. The area between the two lines represents the potential combinations of bid pairs that the software would use if the parameter is $5000 but would not use if the parameter is $1500. In other words, a pair of bids with a difference between shift factors and a difference between bid costs that falls in between the two lines would be utilized if the parameter is $5000 but will not be used if the parameter is $1500.

Q. Please summarize the information provided by these diagrams.

A. The diagrams above illustrate that there is a diminishing value in the use of a higher parameter to achieve a viable market solution. Figures 8 and 9 show that the higher parameter setting can provide additional congestion relief, but that the effectiveness of the bid combinations selected is significantly reduced as you increase the parameter value.

Q. How do these system conditions and constraints on the system you have previously described interact with the real-time scheduling transmission relaxation parameter?

A. Essentially, when the system is more constrained due to reductions in transfer capability, the transmission relaxation parameter settings are more likely to bind. When it binds, prices are more likely to be set by the parameter and not by bids. The higher parameter exacerbates the cost of the increased constraints that the ISO is experiencing on the system, thereby resulting in inefficiencies and unnecessarily increased costs on ratepayers. Because the system is more constrained currently, the modeled constraints are likely to bind more frequently, thereby causing the prices to increase more frequently in the real-time. A lower parameter setting would limit the extent of the increased costs with the more frequent binding actions.

Q. Did you validate this analysis?

A. Yes. The ISO conducted a series of market re-runs to observe the actual sensitivity of the market to the alternative parameter settings over the prior year. While we understood the relationship in the degree of effectiveness and the market solution as the parameter increased described above, it was important to validate that the ISO could and would obtain as good a dispatch solution at a lower parameter setting, thereby lowering cost.

V. SENSITIVITY ANALYSIS EVALUATING EFFECTIVENESS OF MARKET SOLUTION AT RELIEVING SYSTEM CONSTRAINTS

Q. Please describe your analysis.

A. The ISO has studied this issue extensively. After observing the increase in the real-time congestion offset last summer, the ISO launched a stakeholder process to consider modifications to the transmission constraints parameter. During the stakeholder process, the ISO conducted an initial sensitivity analysis to evaluate the impacts of lowering the transmission constraint relaxation parameter from $5,000. The ISO re-ran cases exhibiting a high frequency of high congestion costs from 2012 with alternative parameter settings and calculated the percentage of congestion relief reduction compared to relief reduction using the $5,000 setting. The congestion relief provided is measured by the difference between the resultant flows on the constraints with high shadow prices when using $5000 constraint relaxations parameter versus $1500 parameter. If there is only a small difference in congestion relief, it indicates that there is little operational value in allowing ineffective and costly redispatch using higher constraint relaxation parameters. If the difference is large, it indicates that there is potential operational value in using the higher parameter because not doing so could result in forgoing dispatches that would have materially helped relieved the constraint. Said another way, had a large amount of relief been observed, it would have indicated that meaningful combinations redispatch were available in the space between $1500 and $5000, as illustrated by vertical axis on Figures 8 versus Figure 9, where the maximum cost of resolving the constraint is limited to $1500.

Q. How many cases did the ISO re-run and evaluate?

A. Prior to submitting this proposed tariff amendment, we re-ran a total of 97 market intervals out of a possible 2,400 real-time market intervals. These occurred during the twelve month period from January 2012 to December 2012. When the ISO first launched a stakeholder process to identify and address the cause, because it considered the matter urgent, the ISO focused on a more limited scope of constraints with the highest congestion levels and the highest frequency of constraints. When the parameter was lowered to $1,500, there were 91 constraints that bound in the 2,400 real-time market intervals. Initially, the analysis focused on the 18 most frequently binding constraints out of the 2,400 and investigated the impact on the market solution in terms of the effectiveness in relieving the constraints and the cost of managing the observed congestion. As the stakeholder process unfolded, in response to stakeholder concerns that the ISO's analysis might overlook dispatch solutions that provide meaningful relief on the system when one looked at less frequently binding constraints, the ISO conducted a second round of analysis with an additional 14 cases. The study sample included less severe congestion and less frequently occurring congested transmission constraints. After the ISO obtained approval from its board of governors for the proposed tariff amendment, the ISO observed that the real-time congestion offset costs dipped downward due to seasonal factors, as I have discussed. This provided the ISO with an opportunity to conduct an additional round of analysis, in which it analyzed additional cases such that a total of 97 cases, covering 74 of the 91 constraints, were ultimately analyzed. This additional analysis was conducted in response to stakeholder concern expressed during the December board of governors meeting that the previous analysis was too narrowly tailored and that the lack of analysis of a number of intervals in which smaller constraints were binding could have revealed that the $5,000 is providing significant dispatch benefits.

Q. Please discuss your findings.

A. The sensitivity analysis confirmed that the $5,000 parameter did not provide a market solution that was more effective at relieving the transmission constraints than if the parameter had been set at a lower level. Table 1 below provides the results of the complete set of market intervals studied. The first column in the table identifies the intervals studied by trade date and hour ending and five minute interval in that hour. The second identifies the name of the constraint or particular outage studied. The last provides the percentage reduction in congestion relief provided when the transmission constraint parameter is set at $1,500 compared to the current $5,000 parameter setting. For example, on trade date March 12, 2012, hour-ending 2 interval 7, due to the need to enforce a particular constraint to identify a particular outage, the $1,500 setting provided only 1 percent less congestion relief than did the $5,000 setting. The results show that, excluding certain intervals during which the ISO had to rely on the redispatch of import or export resources to relieve the congestion, which I describe further below, the overall reduction in congestion relief was minimal in most of the re-run intervals. More specifically, the results show that in most instances, the $5,000 parameter provided no more than a five percent increase in congestion, with the bulk of the intervals studied ranging from 0 percent to 3 percent.

Table 1: Results of Sensitivity Analysis Determining the Percentage Flow Increase using the $5,000 Parameter as compared to the Lower Parameter Setting at $1,500

Date	Hour Ending	Interval	Constraint	Flow increase with reduced parameter from $5000 to $1500 (%)
3/12/2012	2	7	SLIC 1908221_22_23028-9_NG	1%
4/25/2012	14	7	32990_MARTINEZ_115_33016_ALHAMTP2_115_BR_1 _1	0
6/10/2012	6	10	SCE_PCT_IMP_BG	0
6/10/2012	6	8	SCE_PCT_IMP_BG	0.20%

Date	Hour Ending	Interval	Constraint	Flow increase with reduced parameter from $5000 to $1500 (%)
6/11/2012	20	2	T-165 SOL-13_NG_SUM	0
6/12/2012	20	9	6110_TM_BNK_FLO_TMS_DLO_NG	0.30%
6/30/2012	22	5	T-165 SOL-13_NG_SUM	1%
7/3/2012	21	5	T-165 SOL-13_NG_SUM	2%
7/13/2012	13	6	14013_HDWSH _500_22536_N.GILA _500_BR_1 _1	6% *
7/13/2012	11	8	14013_HDWSH _500_22536_N.GILA _500_BR_1 _1	1%
7/13/2012	15	5	14013_HDWSH _500_22536_N.GILA _500_BR_1 _1	10% *
8/10/2012	21	9	6110_TM_BNK_FLO_TMS_DLO_NG	0.20%
8/14/2012	17	9	6110_TM_BNK_FLO_TMS_DLO_NG	0.20%
8/17/2012	13	12	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	5%
8/18/2012	12	6	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	0.60%
8/26/2012	15	3	SDGE IMPORTS	0.10%
8/31/2012	12	6	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	0.20%
9/4/2012	21	5	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	5%
9/15/2012	15	6	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	6% *
9/25/2012	12	8	7820_TL 230S_OVERLOAD_NG	3%
9/25/2012	12	7	7820_TL 230S_OVERLOAD_NG	2%
9/25/2012	11	8	7820_TL 230S_OVERLOAD_NG	0%
10/13/2012	5	7	SCE_PCT_IMP_BG	1.70%
4/20/2012	16	5	24086_LUGO _500_24085_LUGO _230_XF_1 _P	-0.01%
4/16/2012	13	2	24086_LUGO _500_24085_LUGO _230_XF_2 _P	0.41%
9/8/2012	16	6	25406_J.HINDS _230_24806_MIRAGE _230_BR_1 _1	0.00%
5/5/2012	14	4	30005_ROUND MT_500_30015_TABLE MT_500_BR_1 _2	0.15%
7/19/2012	15	5	30060_MIDWAY _500_24156_VINCENT _500_BR_1 _2	2.16%
7/11/2012	15	4	30500_BELLOTA _230_38206_COTTLE A_230_BR_1 _1	0.48%
4/25/2012	14	7	30550_MORAGA _230_33020_MORAGA _115_XF_3 _P	0.51%
5/31/2012	12	8	31482_PALERMO _115_31506_HONC JT1_115_BR_1 _1	1.24%
6/15/2012	16	10	31482_PALERMO_115_31516_WYANDJT2_11_115_31516_WYANDJT2_115_BR_2 _1	-0.17%
2/27/2012	10	3	32214_RIO OSO _115_30330_RIO OSO _230_XF_1	0.14%
4/2/2012	11	4	32342_E.NICOLS_60.0_32344_PLUMAS _60.0_BR_1 _1	10.19% *
5/15/2012	11	10	33006_GRIZLYJ1_115_33012_EST PRTL_115_BR_1 _1	0.31%
5/15/2012	11	9	33008_GRIZLYJ2_115_33010_SOBRANTE_115_BR_2 _1	1.14%
10/11/2012	11	5	7430 SOL-8_NO_HELMS_PUMP_NG	0.32%
3/31/2012	6	11	7680 Sylmar_1_NG	0.18%

Date	Hour Ending	Interval	Constraint	Flow increase with reduced parameter from $5000 to $1500 (%)
3/14/2012	20	12	BARRE-LEWIS_NG	0.34%
6/29/2012	13	11	HASYAMPA-NGILA-NG1	2.15%
4/13/2012	11	4	LBN_S-N	24.73% *
4/13/2012	12	5	LOSBANOSNORTH_BG	19.69% *
3/29/2012	13	9	PATH26_N-S	10.42% *
3/7/2012	6	12	SCE_PCT_IMP_BG	2.16%
9/14/2012	15	9	SCIT_BG	1.29%
12/7/2012	6	12	SDGE_PCT_UF_IMP_BG	0.00%
11/5/2012	12	7	SLIC 1356082_PVDV-ELDLG_NG	0.16%
1/15/2012	18	10	SLIC 1649002 VINCENT BANK	3.39%
2/28/2012	19	8	SLIC 1883001 Miguel_BKS_NG_2	0.00%
3/22/2012	12	8	SLIC 1883001_SDGE_OC_NG	0.00%
4/9/2012	5	11	SLIC 1884984 Gould-Sylmar	0.00%
4/2/2012	8	7	SLIC 1903365_PAL_NIC_SOL2_NG	5.00%
3/13/2012	24	3	SLIC 1910891_2_23028-9_NG	1.83%
3/15/2012	7	1	SLIC 1910907_08_23028-9_NG	0.00%
9/30/2012	14	2	SLIC 1953261 ELD-LUGO PVDV	1.26%
6/1/2012	19	10	SLIC 1953921 TESLA_MANTECA	0.00%
6/3/2012	15	12	SLIC 1954841 SAN MATEO SOL-1a	0.00%
6/3/2012	10	4	SLIC 1954841 SAN MATEO SOL-1b	0.93%
11/16/2012	11	3	SLIC 1956086_ELD-MCCUL EL-LU	0.74%
11/9/2012	18	7	SLIC 1956086_ELD-MCCUL HDW	3.99%
6/6/2012	11	4	SLIC 1977990 SYL_PAR_NG	0.51%
10/17/2012	20	8	SLIC 2020108 IV500 NBUS_NG	0.88%
10/18/2012	10	7	SLIC 2020109 IV500 SBUS_NG	0.00%
11/23/2012	7	5	SLIC 2023497 TL50003_CFERAS	2.36%
9/23/2012	20	10	SLIC 2034755 TL23040_NG	0.00%
9/22/2012	11	10	SLIC 2038031 VICTORVILLE_LUGO-1	1.98%
11/20/2012	24	7	SLIC 2041286 TL50003_NG	0.14%
10/5/2012	12	1	SLIC 2042305 ELD-LUGO PVDV	0.00%
11/21/2012	18	2	SLIC 2043728 DRUM CB 310	11.11% *
10/29/2012	9	8	SLIC 2049607 TL23050_NG_2	0.00%
11/2/2012	19	12	SLIC 2051354 TL23050_NG	0.41%
11/9/2012	18	7	SLIC 2057673 TL23050_NG	1.59%
11/10/2012	18	4	SLIC 2057674 TL23050_NG	0.41%

Date	Hour Ending	Interval	Constraint	Flow increase with reduced parameter from $5000 to $1500 (%)
11/16/2012	17	10	SLIC 2057684 TL23050_NG	0.00%
11/20/2012	18	2	SLIC 2057688 TL23050_NG	0.43%
12/6/2012	21	8	SLIC 2077489 SOL3	0.24%
6/23/2012	18	5	SLIC-1832324-SOL7	0.90%
2/22/2012	18	8	SOUTHLUGO_RV_BG	5.61%
7/18/2012	12	10	T-135 VICTVLUGO_EDLG_NG	2.88%
6/15/2012	19	5	T-165 SOL-12_NG_SUM	0.00%
6/30/2012	21	8	T-165 SOL-13_NG_SUM	0.00%
7/21/2012	17	7	T-165 SOL-4_NG_SUM	1.86%
6/16/2012	21	4	T-167 SOL 1_NG_SUM	0.00%
8/1/2012	20	7	TMS_DLO_NG	0.60%
5/15/2012	17	2	230S overload for loss of PV	37.08% *
6/15/2012	17	9	6110_TM_BNK_FLO_TMS_DLO_NG	0.22%
6/15/2012	18	10	6110_TM_BNK_FLO_TMS_DLO_NG	0.21%
10/26/2012	12	5	7820_TL 230S_OVERLOAD_NG	0.35%
8/13/2012	13	1	7830_SXCYN_CHILLS_NG	0.43%
5/14/2012	17	11	230S overload for loss of PV	29.58% *
10/30/2012	13	8	24086_LUGO _500_26105_VICTORVL_500_BR_1 _1	0.00%
4/20/2012	17	9	32990_MARTINEZ_115_33014_ALHAMTP1_115_BR_1 _1	-0.11%
4/24/2012	13	12	32990_MARTINEZ_115_33016_ALHAMTP2_115_BR_1 _1	1.17%
4/29/2012	3	11	34112_EXCHEQUR_115_34116_LE GRAND_115_BR_1 _1	0.94%
3/12/2012	8	3	34408_BARTON _115_34412_HERNDON _115_BR_1 _1	3.38%
11/5/2012	15	11	7830_SXCYN_CHILLS_NG	0.00%
4/3/2012	21	3	SLIC 1902749 ELDORADO_LUGO-1	1.39%

* The flow increases were due to 1) firm export cuts in the original $5000 case, 2) power balance constraint (PBC) relaxation in favor of flow reduction in the original $5000 case and 3) small, 1 to 2 MW, increase over small limits of less than 20 MW. Firm exports could not be cut unless the ISO was simultaneously cutting ISO firm load.

Q. Can you explain the results in which the decrease in congestion relief exceeded five percent from the $5,000 to $1,500 parameter setting?

A. In 10 of the 97 market runs shown in Table 1 above, the $5,000 setting provides more than a 5 percent increase in congestion relief. For example, for trade date September 15, 2012, hour ending 15, interval 6, for the Hoodoo Wash constraint, the $1,500 parameter provided a market solution that was 6 percent less effective in relieving the constraint. Similarly, for trade date April 2, 2012, hour ending 11, interval 4, the $5,000 higher level parameter yielded a 10.19 percent increase in flow or reduced congestion relief than would have occurred using a $1,500 parameter. However, this increase in relief at the higher parameter is not an operational solution as the additional congestion relief could only have been enabled either through actions the ISO seeks to avoid in operating the system, *i.e.,* (1) a curtailment of firm exports that occurred under the parameter setting of $5,000, (2) relaxation of the power balance constraint in favor of a reduction in flow in the case of the $5,000 parameter. In one case the higher percentage relief was a result of enforcement of a constraint with a very small limit less than 20MW. For example, firm exports are not curtailed unless the ISO also employs the curtailment of firm internal load. Also, in actual operations, curtailment of firm interties in real-time would not be made through the market solution but rather would result from manual decisions made by the ISO operator based on their assessment of actual conditions. In actual operations these measures would require curtailment of firm load which did not occur. This means that in actuality the ISO operators had to consider other actions to obtain the observed congestion relief. Similarly, in some cases the optimization relaxed the power balance constraint to achieve the desired flow relief at the higher parameter setting. Again, to achieve the flow relief identified in the solution the ISO operators would have had to shed load to retain power balance constrain. Under the actual condition, such actions were not warranted and do not reflect a realizable operational solution using economic bids to redispatch.

Q. Why did you decide to lower the parameter to $1,500 and not to $2,500?

A. When the ISO first released the straw proposal back in October 2012, the ISO proposed to lower the transmission constraint parameter to $2,500 from $5,000. The ISO conducted its first round of the sensitivity analyses discussed above, the results of which are shown in Table 2. The analysis revealed that a parameter setting of $2,500 produced market solutions that provided only minimal degradation in the congestion relief reductions compared to the $5,000 parameter, and that a further reduction to $1,500 caused only an insignificant additional reduction in congestion relief. Table 3 below presents the effect different parameters would have on the real-time congestion offset costs.

As shown by this data, the $2500 threshold produced only an 18 percent reduction in congestion offset cost, with a reduction of congestion relief between zero percent and six-tenths of a percent. The $1500 threshold, on the other hand, provided twice the reduction in congestion offset costs (36 percent), with, as noted above, still only a minimal reduction in congestion relief (zero percent to one percent). The ISO continues to try to balance the two competing goals identified in 2008 by Dr. Kristov in his testimony (setting the parameter high enough to avoid overuse of constraint relaxation in the markets and setting it low enough to avoid accepting extreme scheduling outcomes). Because there were only marginal benefits from lowering the $2,500 from an economic dispatch perspective, while the cost savings to lowering to $1,500 were significant, the ISO could not justify the additional costs of a $2,500 parameter**.**

Table 2: Results of Initial Round of Sensitivity Analysis

		Transmission Constraint Parameter		
		$ 2,500	$ 1,500	$ 1,000
Cases	Constraint	Congestion Relief Reduction (MW/%)		
TD 4/25/2012 HE 14 Interval 7	32990_MARTINEZ_115_33016_ALHAMTP2_115 _BR_1 _1	0	0	0
TD 6/10/2012 HE 6 Interval 10	SCE_PCT_IMP_BG	0	0	0.4%
TD 6/10/2012 HE 6 Interval 8	SCE_PCT_IMP_BG	0.2%	0.2%	0.2%
TD 6/11/2012 HE 20 Interval 2	T-165 SOL-13_NG_SUM	0	0	0
TD 6/12/2012 HE 20 Interval 9	6110_TM_BNK_FLO_TMS_DLO_NG	0.2%	0.3%	0.3%
TD 8/10/2012 HE 21 Interval 9	6110_TM_BNK_FLO_TMS_DLO_NG	0.2%	0.2%	0.4%
TD 8/17/2012 HE 13 Interval 12	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	0	5%*	5%*
TD 8/18/2012 HE 12 Interval 6	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	0	0.6%	0.6%
TD 8/26/2012 HE 15 Interval 3	SDGE IMPORTS	0.1%	0.1%	0.1%
TD 8/31/2012 HE 12 Interval 6	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	0	0.2%	0.3%
TD 8/18/2012 HE12 Interval 6	22342_HDWSH _500_22536_N.GILA _500_BR_1 _1	0.6%	0.6%	0.6%
TD 10/13/2012 HE5 Interval 7	SCE_PCT_IMP_BG	0	1.7%	1.7%

Cases	Constraint	Transmission Constraint Parameter		
		$ 2,500	$ 1,500	$ 1,000
		Congestion Relief Reduction (MW/%)		
TD 8/14/2012 HE17 Interval 9	6110_TM_BNK_FLO_TMS_DLO_NG	0.2%	0.2%	0.3%

* The flow increases were due to firm export cuts in the original $5000 case. Firm exports could not be cut unless the ISO was simultaneously cutting ISO firm load.

This was further explained above in the full list. These were cases where the result of uneconomic adjustment of exports that were occurring to achieve the higher relief in the $5,000 case. Such uneconomic adjustment of exports should be avoided.

Table 3: Changes to real-time congestion offset costs based congestion constraint parameter.

Real-Time Congestion Offset	Original Congestion Offset (Millions)	% Reduction in Congestion Offset based on different relaxation parameter value		
		$2,500	$1,500	$1,000
(Based on Aug 1, 2012-October 22, 2012)	$71.6	-18%	-36%	-50.20%

Q. Table 2 indicates that there is no significant change in the percentage reduction in congestion relief if you reduced the parameter even lower to $1,000. Why do you not propose to reduce it further to $1,000?

A. A reduction to $1000, in conjunction with the current energy bid cap, would interfere with optimal dispatch. Some of the other software parameters are tagged to the current energy bid caps. The ISO's current energy bid cap is set at $1,000/MWh. If the ISO were to set transmission constraint parameter to the $1,000/MWh, the constraint relaxation parameter would be competing with those other constraints pegged to the bid cap. To provide the software some flexibility to dispatch resources optimally, therefore, the ISO does not need to set it to $1,000. Using a parameter of $1500 strikes a reasonable balance between allowing effective economic bids to be used and avoiding unreasonably high real-time congestion offset costs.

Q. Are there any reliability concerns that the observed reduction in congestion relief provided at the lower settings would create that would require more manual interventions by the operators?

A. No. In some cases, where the most effective resource to adjust is a firm intertie schedule, the reduction of the transmission constraint parameter may have a small increase in the need to firm intertie schedule in cases where the operators find they are not able maintain the actual flows below an actual constraint limit. The ISO does not expect this increase to be significant because the sensitivity analysis shows that the reduction in the scheduling transmission parameters results in a minimal reduction in congestion relief that is well within the operational margin operators use in real-time. As I explained, the ISO's operational margin in real-time is normally set 3 to 5 percent below the actual limit of the transmission constraint to avoid having flows on transmission near the actual operating limit. With an average reduction of only 3 percent, the results indicate that it should not be necessary to make more out-of-market adjustments in order to ensure the ISO is operating within its reliability limits. The study results provide no evidence lowering the parameter setting will make the market solution more likely to encroach upon the existing operational margins such that operators will need to intervene more frequently through exceptional dispatch.

In contrast, lowering the parameter below $1,500 might increase manual intervention. Using a parameter of $1,500 also provides a margin above the economic bid range (-$30 to $1000) such that economic bids will be used prior to adjusting potentially more effective self-schedules. Lowering the parameter below $1500 would increase the potential where self-schedules are adjusted prior to exhausting less effective resources that have been in the economic bid range. Lowering the parameter below $1500 also increases the potential that congestion would be unresolved increasing the potential for exceptional dispatches.

Q. Will this reduction in the parameter reduce generation revenues?

A. In general a resource that is dispatched and follows the ISO dispatch instruction will not be compensated less than its bid. In cases where a resource is fully dispatched based on its capability, it will be received compensation in excess of its bid. Even using a transmission constraint relaxation parameter of $1500, an effective resource that is fully utilized will be eligible to receive compensation well in excess of its bid even if its bid was $1,000. The ISO's analysis of the difference in the amount of relief using a $5,000 transmission constraint relaxation parameter versus a $1500 parameter supports the conclusion that resources are compensated in excess relative to the congestion relief value such resources provide. Figure 1 above also illustrates that the bulk of the real-time congestion offset revenue is driven by liquidation of convergence bids rather than actual redispatch of physical resources in real-time to relieve congestion. The final observation with respect to real-time congestion is that the high price events are largely fleeting, typically lasting one to three intervals. In such cases, resources often find that they may not have enough time to respond to the fleeting events. Stated differently, a resource that finds itself falling behind such dispatch instructions under such fleeting events may find the extreme real-time congestion prices detrimental to their revenue because any negative real-time deviations would be financially exposed.

Q. Does the ISO expect to need to reduce the effectiveness threshold set currently at 2 percent?

A. There may be other reasons to reduce the effectiveness threshold, but we do not anticipate that the reduction in the 2 percent threshold would change the need to modify lower the real-time scheduling transmission relaxation constraint parameter. A reduction in the effectiveness threshold would not accomplish the overall goal of reducing the real-time congestion offset costs that arise from uneconomic dispatches that provide minimal congestion relief. The lower threshold may allow more resources to be considered for congestion management, however, as described above, the effectiveness threshold ultimately does not limit the ineffective combination of redispatch that results when attempting to increase and decrease resources dispatch to resolve a constraint. Furthermore lowering the effectiveness threshold below the current 2% increases the operational concern that large resource adjustments far from the constraint will occur to relieve a constraint. Such large redispatch is not consistent with good utility practice because large resource redispatch to relieve a constraint may exacerbate challenges in balancing the system at a time when there may be limited ability to absorb such large changes resource output.

Q. Did you analyze how the parameter change will impact individual resources?

A. It goes without saying that setting the parameter at a lower level will result in a different dispatch solution than the market experiences in any given interval under the current setting. Certain stakeholders asked for an analysis of whether the lower parameter setting would reduce the dispatch of certain generation in the market solution at the lower parameter setting and whether their higher economic bids would be more likely to be overlooked. We did not conduct such an analysis because it was not necessary. It is clear that the dispatch solution will change. The dispatch changed in all the market runs the ISO conducted its sensitivity analyses discussed above. However, the fact that a resource is or is not dispatched under a parameter setting is not pivotal to the decision to lower the parameter. Some generator bids will not be selected at the lower parameter setting because the bids are not as effective in relieving a particular constraint in light of the lower penalty price. The more appropriate question to ask is whether there is value in incurring a higher cost dispatch when the added benefit in terms of relieving congestion on the system is limited. In other words, the ISO should seek to lower the cost of congestion management and not be forced to redispatch a resource when there is very little operational value. The ISO's proposal results in more efficient dispatch and congestion management.

Q. How do you know you won't be forgoing effective bids by lowering the constraint to $1,500?

A. As illustrated by Figures 8 and 9 above, and the analysis performed indicated little material change in constraint relief that occurs using the $1500 parameter, the ISO is reasonably confident that lowering of transmission constraint parameter will not result in forgoing effective combinations of economic bids. Further, we are only proposing to use the lower parameter in the real-time dispatch process where available options for economic redispatch are significantly limited to available 5 minute ramping capability on committed internal generation resources. In order to avoid forgoing legitimate economic commitment or considering of effective redispatch of interties based on economic bids, the ISO does not propose to reduce the transmission constraint relaxation parameter of $5000 used in the day-ahead market, the hour ahead scheduling process, or the real-time unit commitment processes.

Q. Was the real-time scheduling transmission constraints relaxation parameter set too high previously?

A. No. Our analysis shows that previously the system was simply not as congested as it is now and did not have as many constraints. Therefore, even if the cost of relaxing a constraint was so high, the infrequency with which this occurred resulted in little harm to the market. However, as the frequency of real-time transmission constraints has increased, the costly ineffective redispatch has increased. Furthermore, with additional volume created by convergence bids coupled with the increased frequency of congestion resulting from real-time system conditions, the impact on the real-time congestion offset costs using the existing parameters is increased.

Q. Would a suspension of convergence bidding reduce the real-time congestion offset back to levels prior to July 2012?

A. Suspending convergence bidding would reduce the real-time congestion offset in total numbers, but it would not eliminate the upward trend and it would not address the root of the problem. That is, the increased constraints on the system, and the inability for prices to actually converge due to differences in constraints between the day-ahead and the real-time markets. Even if we were to suspend convergence bidding, we would still have to take other measures I discuss below to address the constraints differences between the two markets, or we would still continue to have the issues I discussed above, which would continue to perpetuate high real-time congestion costs and consequently high real-time congestion offset levels. To illustrate this point, the suspension of convergence bidding would not eliminate the loop flow we have observed and the discrepancy in how it is captured in the day-ahead market relative to the real-time market. The ISO is considering other measures to address this issue. Moreover, convergence bidding does provide a necessary function to the market in that if is working appropriately and as intended, virtual bids would push the convergence of day-ahead and real-time prices.

However, here we have observed that these structural differences between the day-ahead and real-time markets are inhibiting the convergence of prices. In other words, prices will never converge if there continue to be structural forces to push them apart.

Q. Have you considered allocating some of the real-time congestion offset to convergence bidders?

A. Because of the initial urgency of the increasing real-time congestion offset trend, the ISO sought to make changes that eliminated factors that unnecessarily contributed to the real-time congestion offset or exacerbated it. It is certainly possible for the ISO to consider cost allocation methodologies that would allocate a share of the real-time congestion offset to virtual bidders. In 2009, we looked into this and determined that there are significant difficulties in finding a method that equitably identified the causal effects. However, the ISO has committed to take a closer look at all of its cost allocation methodologies over time with the intent of identifying whether there is a need to modify the current cost allocation methods to better align them with a number of cost allocation principles it recently adopted for determining proper cost allocation. These principles were established through a stakeholder process and shared with the ISO board of governors on February 7, 2013. The idea behind these principles is to use them as we consider changes to current allocation methodologies going forward. The ISO did not take this on in the stakeholder process that preceded this filing because it would have taken much longer to do so. There is no reason to let the scheduling transmission constraints relaxation parameter continue to exacerbate the cost of relaxing a constraint while the ISO considers other measures. As discussed below, the reduction of the real-time scheduling transmission constraint parameter to $1,500 immediately and significantly reduces the unnecessary real-time congestion offset expenses incurred at the current parameter setting of $5,000.

VI. OTHER ACTIONS TO ADDRESS INCREASE IN REAL-TIME CONGESTION OFFSET

Q. You stated that the reduction of the parameter alone will not eliminate the real-time congestion offset. What other actions is the ISO taking to address the issues you have identified?

A. To summarize, the main contributors to the real-time congestion offset has been the increase in constraints on the ISO system, due to decreased supply, increased loop flow, increased outages and the need for additional measures to account for regional reliability coordination. The ISO has already taken the following measures to address these issues which have already affected the real-time congestion offset**:** (1) Use of Transmission Reliability Margin (TRM), (2) adjustment of day-ahead conditions to better reflect real-time observed difference, (3) accounting for available ramping capability when making real-time conforming and margin adjustments to limits. The ISO also plans to take the following actions which will require additional time: (1) physical upgrades to reduce constraints and (2) consideration of the congestion costs when performing outage coordination.

Q. Once all these measures are adopted can you reinstate the $5,000 per MW setting?

A. It is not possible for the ISO to ensure that there will never be any transfer of transmission capability from the day-ahead market to the real-time. Therefore, there is always the possibility that there will be an offset. However, the ISO's goal in this proceeding is to calibrate the scheduling transmission constraint parameter so that it is able to obtain valuable congestion relief for the resources it dispatches for that purpose. As illustrated by the analysis discussed above, it is not evident that the ISO is obtaining more valuable congestion relief at the higher parameter setting yet its load is paying more for congestion management under the higher parameter. The ISO is committed to continuing analysis evaluating the impact and appropriateness of the proposed transmission constraint relaxation parameter. Therefore, if the ISO were to find over time that at the lower setting the ISO is not able to obtain more favorable market solutions, it would consider whether it should increase the parameter. However, this additional analysis has demonstrated that there is basis for simply increasing the parameter. Furthermore, the ISO will be considering enhancements to the structure of scheduling transmission constraint relaxation parameter. For example, in reviewing similar parameter settings in other markets, the ISO noted that it may be able to enhance the performance of this parameter if it were able to calibrate it at different levels depending on either level of constraint relaxation, voltage level of constraint, or the system impact of the constraint. However, the ISO has not had an opportunity to evaluate these options and would do so through a robust stakeholder process before recommending any such changes. Therefore, it is premature before such analysis and consideration occurs to determine if the $5,000 setting should be reinstated for all real-time constraints or specific types of constraints.

Q. Thank you. I have no further questions.

I affirm under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Mark Rothleder

Executed this 8th day of March, 2013.

Attachment D – December 6, 2012, Memorandum from Mark A. Rothleder

to the ISO Board of Governors

Tariff Revisions – Transmission Constraint Relaxation Parameter

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

March 8, 2013

Memorandum

To: ISO Board of Governors

From: Mark Rothleder, VP of Market Quality and Renewable Integration

Date: December 6, 2012

Re: Decision on Transmission Constraint Relaxation Parameter Modification

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This memorandum requires Board action.

EXECUTIVE SUMMARY

Management recommends the Board approve the reduction of the real-time scheduling run transmission constraint relaxation parameter from $5,000/MW to $1,500/MW. This parameter reflects the cost at which the market software will cease to attempt to reduce flows on a transmission constraint to a level within an operating margin of the actual flow limit through dispatch of effective bids. Lowering this parameter will reduce the cost of congestion when reasonably effective economic bids have been exhausted to relieve the constraint.

In recent months, the real-time congestion offset costs have increased significantly. Congestion offset costs account for real-time surpluses or shortages of congestion revenue. The real-time congestion offset costs are allocated to load and exports. The increase in congestion offset costs is a result of increased frequency of high prices to resolve real-time congestion below the level scheduled in the day-ahead market. At the current transmission parameter setting, the market is pricing the relaxation of transmission constraint at significantly higher prices than is necessary to dispatch resources reliably to achieve flows within actual limits. This has resulted in significantly higher real-time congestion prices, and a corresponding significant increase in the congestion offset costs.

Sensitivity analysis comparing the impact of different parameter settings on schedules and congestion costs show that lowering the parameter to $1,500/MW would reduce unnecessary high real-time congestion costs by 36% while continuing to use effective economic bids resulting in reliable dispatch solutions consistent with actual system conditions and constraint limits.

> ***Moved, that the ISO Board of Governors approves the proposal to lower the transmission constraints relaxation parameter from $5,000/MW to $1,500/MW as described in the memorandum dated December 6, 2012; and***

Moved, that the ISO Board of Governors authorizes Management to make all the necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed tariff change.

DISCUSSION AND ANALYSIS

In 2008, prior to the start of the ISO's nodal market, the Board approved a new policy governing the setting and management of market software parameters that would determine the extent of measures taken to relieve congestion and adjustment of self-schedules in the event that the market lacks sufficient effective bids to relieve the constraints modeled in the various market runs. At the time, Management also committed to consider revising the parameter values in the event the parameters are found to be causing significant unintended consequences in terms of either software performance or market results.

The market software attempts to balance supply and demand subject to relieving a transmission constraint or respecting self-schedules based on the assigned parameters. At times, all operationally reasonable economic measures are exhausted, yet the flow on the transmission constraint is still over its modeled limit. In such cases, the optimization must adjust uneconomic schedules or relax constraints to produce a market solution. The priority with which constraints and self-schedules are adjusted is governed by a series of hierarchical rules reflected in the scheduling and pricing parameters. These are referred to as uneconomic adjustment parameters. One of the established uneconomic adjustment parameters is the scheduling run transmission constraint relaxation parameter of $5,000/MW. This parameter reflects the price beyond which the software will relax a transmission constraint rather than continue to dispatch ineffective resources to relieve congestion. In cases where a transmission constraint must be relaxed, the price of relieving the constraint could be between the pricing run parameter of $1,000/MW and the scheduling run parameter of $5,000/MW.

Since the start of the new nodal market in April 2009, the ISO and market participants have monitored and evaluated the performance of the software parameters. Starting in July 2012, however, the ISO observed a significant increase in real-time congestion prices and consequently real-time congestion offset costs. The real-time congestion offset costs for August 2012 was $50 million, which is ten times the normal monthly level of less than $5 million observed prior to August 2012. The increased frequency of the high priced congestion, coupled with reduced limits in real-time versus the day-ahead market, resulted in the increase in the real-time congestion offset costs. In the months of August, September and October, real-time congestion prices on some constraints were at $3,000/MW to $5,000/MW for a large number of intervals. High real-time congestion prices were caused by a combination of: 1) increased frequency of constrained conditions in real-time, 2) increased amounts of unscheduled flow, 3) operational margin, and 4) reduced or lack of controls to relieve the constraint.

Reducing the parameter to $1,500/MW would have reduced the real-time congestion offset costs for the period of August 1 to October 22, 2012 by 36% while providing little change in flow relief.

ISO staff conducted a sensitivity analysis to assess the impact of various parameter settings on prices and measured flows. Initially, staff considered reducing the parameter to $2,500/MW. This analysis proved to provide robust market schedules while reducing congestion offset costs by 18%. Additional analysis of results using lower parameters demonstrated that the market solution continues to be robust even at lower parameter levels. Specifically, when the transmission constraint relaxation parameter was reduced to $1,500/MW, the price on the overloaded constraint was reduced to $1,500/MW, while power flow on the constraint increased only slightly, less than 1% of the constraint limit in most cases. If congestion cannot be relieved at a cost of $1,500/MW, it would be appropriate for the operators to consider other measures to relieve the congestion, including consideration of adjustment of intertie schedules, reduction of margins established to maintain the flows below the actual limit, or transmission switching, where appropriate. The analysis demonstrated that there is a diminishing rate of return as the parameter increases to higher levels. In contrast, the analysis also showed that lowering the parameter beyond $1,500/MW poses a risk that the market run would overlook an effective economic bid (*i.e.*, a bid with a price that could help relieve the constraint) that would provide a reliable market solution and avoid the need for manual intervention by operators.

The recommended parameter adjustment is only one measure the ISO has taken to address high real-time congestion offset costs. The ISO staff undertook other measures such as conforming the day-ahead limit to be more aligned with the real-time limit in order to converge the day-ahead and real-time market conditions. While these steps helped lower the real-time congestion offset costs in the months after August, they did not bring the levels back to the lower levels experienced in prior months. Management will continue to consider and address other root causes to further reduce the real-time congestion offset costs.

POSITIONS OF THE PARTIES

In response to the sustained significantly high levels of the real-time congestion offset, Management launched a stakeholder process on October 19, 2012 to consider lowering the transmission constraint relaxation parameter to achieve more reasonable levels of the congestion offset. After receiving initial comments on the ISO staff proposal to lower the parameter to $2,500, ISO staff conducted additional analysis to further inform the decision to lower the parameter to lower levels. While certain stakeholders requested additional confirmation that the reduction was necessary, others sought confirmation that further reductions would not undermine an efficient market outcome. As discussed above, the additional analysis confirmed that a reduction of the parameter to $1,500 strikes the proper balance between protecting the transmission constraints and proper utilization of available effective bids in clearing the market to serve demand.

ISO staff also provided additional explanation of the actions it has taken to address the root causes of the discrepancies in modeled constraints and flows between the day-ahead and real-time markets, which also will contribute to the reduction of the real-time congestion offset costs.

The generator and marketer communities continue to express concern over lowering the parameter to $1,500/MW. In particular, the generator community is concerned that the lower parameter would take millions of dollars out of the locational marginal prices cleared in the market and would erode price signals for investment in locally constrained areas. In addition, parties have expressed concerns that lowering the $1,500/MW will result in an increased reliance on exceptional dispatches (*i.e.*, out-of-market actions). Some commented that instead of lowering the parameter, the ISO should increase the resource effective threshold at which the ISO considers an economic bid to be effective. Finally, parties have requested that if the ISO adopts the lower parameter, it should be reset back to $5,000 automatically on a sunset date.

In response to concerns regarding the possibility that the lower parameter would reduce congestion revenue to suppliers, the ISO conducted further analysis and determined that the bulk of the revenue associated with the higher congestion offset costs was earned by convergence bidders taking the opportunity to arbitrage diverging day-ahead real-time prices. The ISO analysis shows that even with a lower parameter, generators with effective bids in relieving local transmission constraints will continue to be part of the market solution and will be compensated at a price equal or greater than their dispatched bid. In addition, because the market is able to continue to dispatch adequate generation and maintain flows well within the margins of actual transmission constraint limits, it does not appear the lower parameter would increase reliance on exceptional dispatches. Management also has determined that increasing the resource effectiveness threshold is not helpful in all cases in selecting the necessary generation to relieve the constraints at reasonable costs. This is because when all effective bids from resources internal to the constraint are exhausted, re-dispatching resources outside the constraint will not provide operationally relevant congestion relief.

Management understands, however, that there may be a need to revise the parameter again in the future. In response to stakeholders concerns, Management commits to continue to perform sensitivity analyses after the parameter has been lowered and provide updates to market participants at the regularly held Market Performance and Planning Forum.

In contrast, the load serving entities supported the reduction of the parameter and urged the ISO to consider reducing the parameter further to a level as low as $1,000/MW. At this time, Management does not believe lowering the parameter to a level lower than $1,500/MW would be appropriate because the sensitivity analysis conducted by ISO staff and shared with stakeholders shows that such a lower level risks the software by-passing effective economic bids. This would erode the robustness of the market solution observed at the $1,500/MW level and above.

CONCLUSION

Management proposes to reduce the scheduling run transmission constraint in the real-time market from $5,000/MW to $1,500/MW as it would significantly reduce the cost of congestion. The proposed parameter reduction would have reduced the real-time constraint offset cost in August, September and October this year by 36%. Moreover, the impact on reliability measured by power flow increase has shown to be very small. Management therefore concludes that the parameter reduction is justified and appropriate in reducing market cost while maintaining reliability.

Attachment E – December 14, 2012, Presentation to the ISO Board of Governors

on the Decision on Transmission Constraint Relaxation Parameter Modification Tariff

Revisions – Transmission Constraint Relaxation Parameter

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

March 8, 2013

Decision on Transmission Constraint Relaxation Parameter Modification

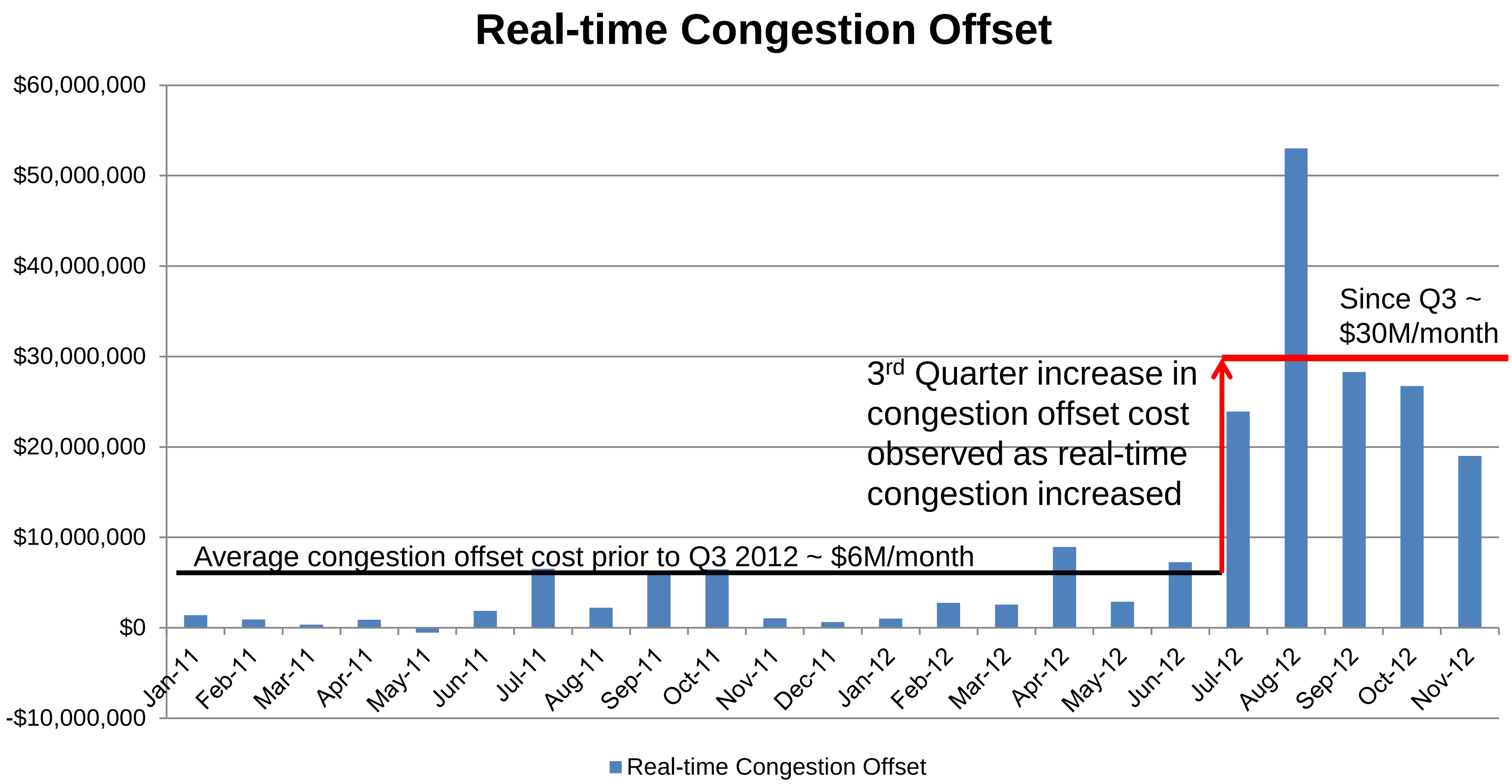
Nan Liu
Manager, Market Development and Analysis

Board of Governors Meeting
General Session
December 13-14, 2012

Transmission constraint parameter background:

- Establishes reasonable limit on the extent to which effective bids are used to resolve congestion.
- Similar parameters exist in all ISOs' optimization software.
- Current setting of $5,000 established in 2008 by the Board.
  - The ISO committed to revise if significant impact on market results.
- Contributed to significant increase in real-time congestion offset costs that occurred in 3rd quarter of 2012, due to:
  - Reductions of transfer capability in real-time vs. day ahead.
  - Increased price of congestion in real-time vs. day ahead.

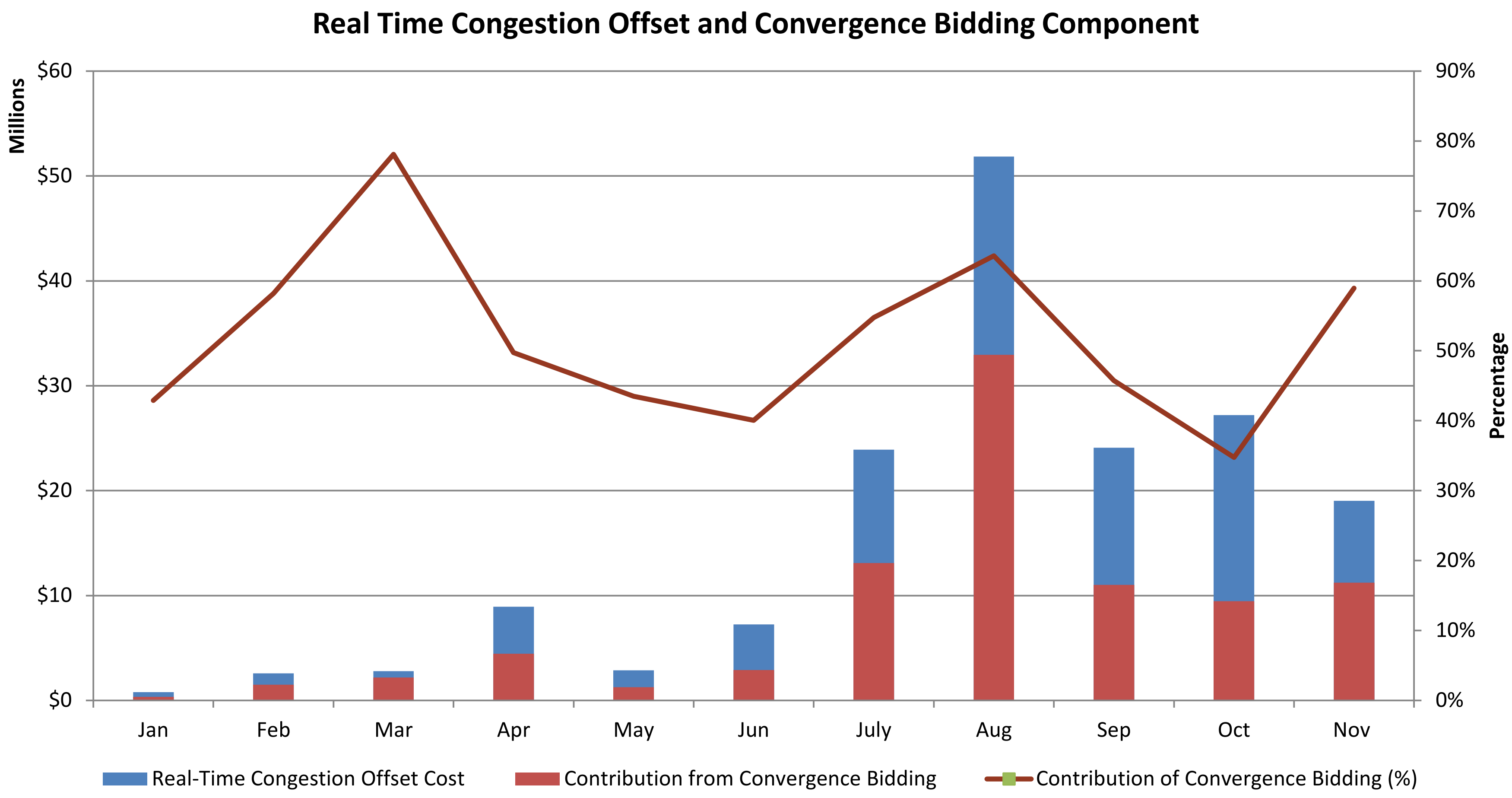
Real-Time congestion offsets allocated to load increased by a factor of five in 3rd quarter.



Other contributing causes and actions to address increases in real-time congestion offset costs.

Cause	Action
• Increased number of outages and binding constraints.	• Improve outage coordination. • Increase cost impact transparency. • Physical upgrades.
• Available dispatch options are significantly limited in real time, 5 minute interval.	• Limit the amount of constraint adjustment to available ramping capability. • Address constraint in day ahead.
• Unscheduled flow in real time.	• Account for expected flow differences in the day ahead market. • Impose transmission reliability margin in hour ahead.
• Convergence bidding increases the amount of transactions settled between day ahead and real-time markets.	• Improve constraint modeling in day ahead market. • Increase constraint transparency.

Convergence bidding contributes to the cost increase.



Sensitivity analysis – significant reduction of real-time congestion offset cost when parameter is reduced with minimal impact on congestion relief.

Transmission constraint Relaxation Parameter	Reduction in real-time congestion offset cost (Based on August 1-October 22 results)	Observed reduction in congestion relief: (13 real-time cases)
$5000	N/A	N/A
$2500	18%	0-0.6%
$1500	36%	0-5.0[1]%
$1000	50%	0-5.0[1]%

Note 1: Excluding an outlier, the reduction in relief observed is between 0% to 1%. In the outlier case, the 5% reduction is due to cuts of firm export that could not be cut unless the ISO was simultaneously curtailing ISO firm load.

Stakeholder comments reflect supplier concerns and demand support.

Position	Comments	Response
Do not support: (Calpine, NRG, WPTF, DC Energy)	• Supplier revenue reduction • Increase exceptional dispatch • Insufficient sampling size • Suggests change in effectiveness threshold rather than proposed parameter.	• Convergence bidders benefiting the most with no physical relief • Exceptional dispatch not expected to increase based on insignificant relief. • Additional analysis performed, ISO commits to continuing to perform analysis. • Resource specific effectiveness threshold does not address ineffective dispatch of multiple resources.
Support: (PG&E, SCE, Six Cities, Powerex, CDWR)	• Some recommend reducing to $1000 • Recommend changes in allocation of congestion offset costs.	• Reducing to $1000 could result in effective economic bids being ignored • Different allocation mechanism would require additional consideration.

Comparison with other ISO/RTOs practices:

ISO/RTO	Comments
SPP	Price curve approach: 5 segments depending on loading/congestion. • $500 for loading between 100% to 101% • $750 for loading between 101% and 102% • $1000 for loading between 102% and 103% • $1250 for loading between 103% and 104% • $1500 if the loading is above 104%

ERCOT	• Base case or voltage violation: $5000
	• N-1 contingency constraint violation:
	  • $4500 for 354 kV
	  • $3500 for 138 kV
	  • $2800 for 69 kV

ISO NE	• Parameter not publicly available. • Constraint enforced in real time by exception based on conditions.
MISO	• $3,000 for Interconnection Reliability Operating Limit 500 kV constraints. • $2,000 for System Operating Limit constraint between 161kV and 500kV. • $1,000 for SOL constraint below or equal to 131kV. • $500 for SOL constraint below or equal to 69kV.
NYISO	• $4,000/MW.
PJM	• Parameter not publicly available.

Summary of proposal

- Reduce the transmission constraint relaxation parameter from $5,000 to $1,500
- Continue to pursue other enhancements that would improve consistency of congestion in the day-ahead and real-time
- Consider tiered and constraint differentiated relaxation parameter modifications in the future

Attachment F – Matrix of Stakeholder Comments Presented to the ISO Board of Governors

Regarding the Decision on Transmission Constraint Relaxation Parameter Modification

Revisions – Transmission Constraint Relaxation Parameter

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

March 8, 2013

Attachment A

Stakeholder Process: Transmission constraint relaxation parameter change

Summary of Submitted Comments

Stakeholders submitted two rounds of written comments to the ISO on the following date: Round One: 11/1/2012, Round Two, 11/28/12

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

Other stakeholder efforts include: None

Participant	Position	Proposal to change the penalty parameter	Studies and data provided to support the proposal	Proposed change of the penalty price from $5000 to $1500	Drivers for high congestion costs	Schedule and scope of the proposal	Alternatives
Calpine	Does not support	Does not support the proposal. Prefers the ISO to address fundamental structural issues and test the current mitigation measures.	Analysis inadequate. Sample size too small.	Amounts to price cap which would strip millions of dollars of revenues from physical and virtual supplies in some local constrained areas in need of investment signals. May limit the use of highly effective resources. Should have a sunset date within 12 months of implementation. Raise the effectiveness factor threshold from 2%.	Structural issues.		
CDWR	Supports	Should evaluate if the parameter can be further reduced to $1,250.		Strongly believes that the transmission constraint relaxation parameter should be reduced as low as possible to mitigate the recent unreasonably high real-time congestion offset costs.			
DC Energy	Not in favor	Proposal is short sighted. More effort should be given to longer-term impacts.	Insufficient number of intervals in the sensitivity analysis.	It would erode price signals for reliable and efficient operations, new resource development, demand response and import/outage scheduling. Increased out-of-merit dispatch would not foster long-run efficiency.			Focus more on longer-term impacts.

Participant	Position	Proposal to change the penalty parameter	Studies and data provided to support the proposal	Proposed change of the penalty price from $5000 to $1500	Drivers for high congestion costs	Schedule and scope of the proposal	Alternatives
NRG	Not in favor	The proposal only addresses the symptoms, not the fundamental problem – ISO unable to manage real-time congestion.	Should provide data and analysis to explain why the proposed parameter is lower than other ISOs.	The reduction may only serve to reduce the incentive and urgency to deal with the fundamentals of this problem.	Not having or not using the tools to manage the real-time congestion lies at the heart of the problem.		Focus on addressing the fundamentals of this problem
PG&E	Supports	A reasonable step to address the magnitude of price spikes in the real-time market without compromising reliability.		It is prudent to address the high real-time congestion offset costs immediately through parameter change while it is important to address some root causes.		Urges the ISO to address the issue immediately.	
Powerex	Supports	Supports the efforts to address the dramatic rise in congestion related uplift charges. Concerned that the ISO continues to pursue approaches that primarily address the symptoms of market inefficiency as they arise rather than root cause.			A major cause of the high levels of unscheduled flow on path 66 is the WECC Reliability Based Control trial that permits balancing authorities to have very large imbalances in their real-time load-resource balance provided grid frequency is acceptable.	Have the same for all markets and in both scheduling and pricing runs.	Pursue immediate suspension of WECC Reliability Based Control trial. Align day ahead and real time limits as much as possible.
SCE	Supports	Supports the parameter revision. Also supports the proposal of alternative efforts such as using demand curve, different parameter levels for different voltage levels.	Analysis provides sufficient support that $1,500 would not harm market operations.	Urges to explore lowering the parameter to $1,250. Also would like the ISO to address the uplifts driven by convergence bids that load is forced to pay even though it is not responsible for such costs.		Supports the expedited process for the proposal. Should be prioritized over other unnecessary initiatives.	
Six Cities	Supports	Asks to implement the parameter change as quickly as possible and consider further lowering the parameter to $1,200.	Analysis provides reasons to reduce the parameter further.	Suggests reducing the penalty price beyond the proposed $1,500 to a value of $1,200. Also would like the ISO to address the uplifts driven by convergence bids to the extent that convergence bidding contributes to phantom congestion or exploiting the deficiencies in the model without contributing to price convergence.		Would like to implement the parameter change ASAP.	

Participant	Position	Proposal to change the penalty parameter	Studies and data provided to support the proposal	Proposed change of the penalty price from $5000 to $1500	Drivers for high congestion costs	Schedule and scope of the proposal	Alternatives
WPTF	Does not support	Does not support the proposal. Urges the ISO to address the root causes as its first priority.	The sensitivity analysis data set is too limited and therefore couldn't be used to argue for the law of diminishing return.	$1,500 is too low because it limits the use of effective and/or economic bids to relieve congestion.		WPTF believes exceptional dispatch should not be relied upon when there are economic bids available for managing congestion.	
Management Response		The ISO will continue to address the root causes. However, independent of other actions taken and planned, parameter reduction provides meaningful and reasonable cost relief while maintaining operationally effective constraint relief.	The ISO agrees there is value of revisiting the transmission constraint relaxation parameter mechanism to assess if further modifications are appropriate. The ISO commits to performing additional ongoing sensitivity analysis and provide updates to the market participants at the regularly held Market Performance and Planning Forum.	Raising the resource specific effectiveness threshold can be effective in some instances. However, it does not work when combinations of movement on resources have nearly the same individual effectiveness. In such cases, to achieve constraint relief, very ineffective combinations of movement and potentially high costs would occur. The ISO finds that lowering the transmission constraint relaxation parameter is a more direct and effective approach than raising the resource effectiveness factor threshold. At $1,500, the relaxation parameter provides a reasonable and strong price signal at congested locations in need of investments. Reducing the parameter below the proposed $1,500 could work. However, the risk of leaving out economic bids would increase. For example, if a resource with an effective factor of 50% on a congested constraint bids at $700, it will not be dispatched by the market software to relieve the congestion because the cost of $1,400 would exceed the relaxation parameter of $1,250 or $1,000. In addition, some difference between the economic bid cap and the transmission constraint relaxation parameter is appropriate to account for losses and self-schedules adjustment before constraint relaxation.	The ISO continues to address other drivers to increased congestion offset including accounting for expected congestion when running the day-ahead market.	Exceptional dispatch is a useful and approved tool to manage reliability when the market optimization solution falls short. As demonstrated in the sensitivity analysis, the increase of the power flow is minimal with the lowered relaxation parameter. Such relaxation often falls within the range of margin between modeled and actual constraint limits. Therefore, the impact on exceptional dispatch is expected to be small.	The ISO will continue to address the root causes. However, independent of other actions taken and planned, parameter reduction provides meaningful and reasonable cost relief with minimal impact on effective constraint relief.