

# Transmission Constraint Relaxation Parameter Revision

*ISO Draft Final Proposal*

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California Independent System Operator



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## 1.0 Purpose

The ISO proposes to modify the real-time scheduling run transmission constraint relaxation parameter from \$5,000 to \$1,500. The ISO has determined that the \$5,000 value uneconomically constrains the real-time dispatch (RTD) optimization thereby producing high shadow prices on congested and relaxed transmission constraints in RTD. This modification will allow for a more economic dispatch, while continuing to provide and operationally feasible solution.

## 2.0 Summary

The ISO has observed that high shadow prices on transmission constraints and corresponding high LMPs in real-time, coupled with reduced transmission constraints limits are causing high real-time congestion offset (RTCO) cost. While resources are being dispatched at these high shadow prices, there is little or no materially meaningful reduction in overloads on a transmission constraint through such dispatches. Stated differently, high market costs are incurred without providing any meaningful reduction of overloads on the congested transmission constraints that such pricing is designed to relieve. Generally, the RTD is more sensitive to the impact of the transmission constraints relaxation parameter because in the real-time the ISO system is more constrained due to ramping and limited dispatch options in given real-time system conditions.

To address these uneconomic outcomes, the ISO proposes to reduce the scheduling run parameter from \$5,000 to \$1,500. Analysis has shown that reducing this parameter reduces the high transmission constraint shadow prices while still maintaining effective flow mitigation through market optimization. Based on the results of further sensitivity analysis, the ISO is proposing to reduce this parameter further to \$1500 from its previous proposal of \$2,500. The ISO's further analysis revealed that at \$1,500, we can still maintain effective power flow mitigation through the market optimization.

The ISO seeks to implement the proposed changes as soon as possible after completing this stakeholder process and obtaining approval by the Federal Energy Regulatory Commission of the required tariff changes discussed further below.

## 3.0 Background

When the market optimization attempts to meet the objective of balancing supply and demand subject to relieving a transmission constraint, there are times when operationally reasonable economic measures are exhausted yet the flow on the transmission constraint<sup>1</sup> cannot be resolved. In such cases, the optimization must rely on uneconomic adjustment parameters to produce a market solution. Prior to the start of the new market, the ISO conducted an extensive stakeholder process to establish the initial uneconomic

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<sup>1</sup> The transmission constraint limit enforced in the market may incorporate an operational margin of approximately 5% to accommodate variability of flows.

adjustment parameters.<sup>2</sup> On October 28, 2008, the ISO Board of Governors approved the policy related to these parameters.<sup>3</sup> In approving the uneconomic adjustment parameter policy, the ISO committed to consider revising the parameter values only in the event the parameter was found to be causing a significant unintended consequence in terms of either software performance or market results.

“Once these values are published in the BPM and incorporated into the software the ISO would revise a parameter value only in the event that that parameter value is found to be causing a significant unintended consequence in terms of either software performance or market results.”

Ultimately, certain pricing and scheduling run parameters were filed and approved by FERC.<sup>4</sup> The ISO included these parameters in the Market Operations BPM<sup>5</sup> Section 6.6.5, along with certain other parameters that the ISO determined through the stakeholder process would be set in the BPM but not the tariff.

One of the uneconomic adjustment parameters established was the scheduling run transmission constraint relaxation parameter. This parameter was set at \$5,000/MW. This is the price beyond which the software will relax a transmission constraint rather than continue to re-dispatch resources to relieve congestion. This parameter used in the scheduling run establishes the MW scheduled. In the pricing run this parameter was established to match the bid cap; currently set to \$1,000/MW. As described in the October 28, 2008 Board memo, the pricing run parameter established at the bid cap does not suppress possible economic solutions that could be achieved in clearing the market. This could result in an economic solution for relieving the constraint at a price that could be between the pricing run parameter of \$1,000/MW and the scheduling run parameter of \$5,000/MW.

There are other parameters associated with adjusting a resource beyond its economic bid range to ensure the economic bids are used before price-taker self-schedules or higher priority self-schedules using existing transmission contract (ETC) rights or transmission ownership rights (TOR) are adjusted. The scheduling run parameter for adjusting price-taker self-scheduled supply is -\$1,100 and between -\$3,200 and -\$4,500 for ETC/TOR self-scheduled supply. Based on the existing transmission constraint parameter of \$5,000, it is possible for an ETC/TOR self-scheduled supply to be adjusted before a transmission constraint is relaxed. Currently, the market solution would only occur where the ETC/TOR schedules feed radially into a constraint. Operationally, procedural mechanisms are in place to manually adjust such ETC/TOR schedules if necessary. For

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<sup>2</sup> <http://www.caiso.com/Documents/RevisedDraftFinalProposalUpdate-UneconomicAdjustmentPolicyandParameterValues29-Oct-2008.pdf>

<sup>3</sup> <http://www.caiso.com/Documents/081028DECISIONonUneconomicAdjustmentPolicy-MEMO.pdf>

<sup>4</sup> See

[http://www.caiso.com/Documents/June10\\_2009OrderonComplianceFilinginDocketNo\\_ER09-240-002\\_Amendment-Tariffre-MarketParameters\\_.pdf](http://www.caiso.com/Documents/June10_2009OrderonComplianceFilinginDocketNo_ER09-240-002_Amendment-Tariffre-MarketParameters_.pdf)

<sup>5</sup> <https://bpm.caiso.com/bpm/bpm/doc/00000000001219>

the pricing run, the adjustment parameter for adjusting supply is established at the bid floor currently set at -\$30. When the bid floor is modified, the parameter will be modified accordingly

#### 4.0 Recent market events (What has changed?)

In August and September 2012, real-time congestion shadow prices on some constraints were at \$4,000/MW to \$5,000/MW for a large number of intervals. These high real-time shadow 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.

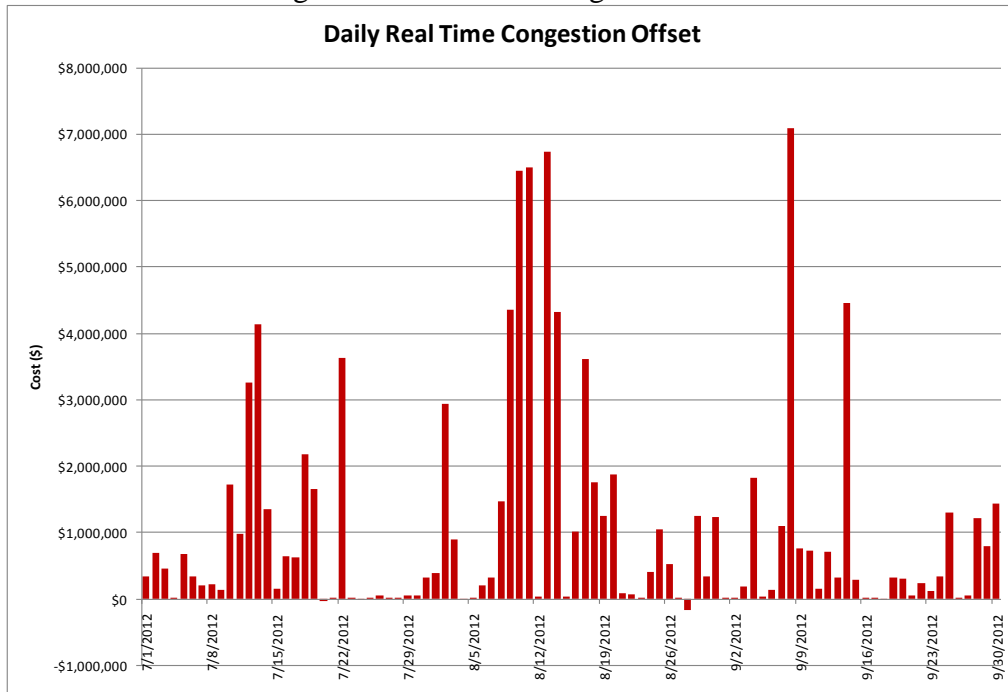
Constrained system conditions in August and September caused an increase in real-time congestion, which was notably greater than the congestion and constraints observed in day-ahead. The ISO observed that real-time conditions were systematically more constrained due to the following conditions:

- Unscheduled flow observed in real-time, not modeled in day-ahead.
- Nomogram limits being more limiting in the real-time due to conditions observed outside the ISO that limit the simultaneous flow limits within the ISO.
- In 2012, the ISO enforced some new constraint due to new regional operational modeling and study efforts that had identified operational vulnerabilities and limits not previously identified. In addition, topographical and generational and transmission outages contributed to increases in real-time transmission constraints this summer.
- Limitations of available dispatchable resources to relieve constraints due to fires.
- Intertie schedules being locked in the hour-ahead scheduling process and unavailable to relieve congestion in real-time even though intertie adjustment may be the most effective adjustment.
- In ability to commit additional resources via real-time dispatch.
- Real-time dispatch is limited to 5-minute ramping capability of resources.

The increased frequency of the high shadow priced congestion, coupled with a combination of reduced limits in real-time versus the day-ahead market, resulted in high real-time congestion offset costs in August. The total congestion offset in for August was almost \$50 million, which is ten times the normal \$5 million a month.

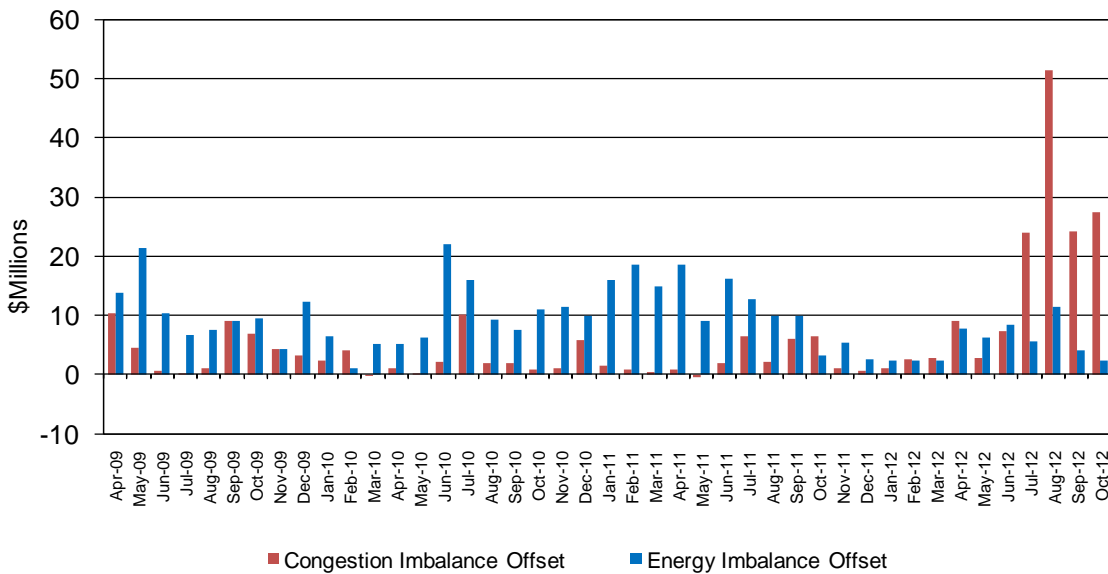
As a result of the increased frequency and market impact as measured by the real-time congestion offset (Figure 1) costs observed in August and September, the ISO finds it necessary to review the transmission constraint relaxation parameters and propose changes where appropriate.

Figure 1: Real-Time Congestion Offset Costs



In September and October, the RTCO cost leveled off to some extent, but remained at elevated levels (red bars in Figure 2). The reductions are reflective of a combination of changes in underlying system conditions and measures taken to converge the DA and RTD market conditions such as conforming DA limits.

Figure 2. Monthly RTCO and RTIEO



## 5.0 Proposal: To reduce transmission constraint relaxation parameter in real-time

In order to reduce the financial impact of frequent high shadow price congestion occurring in real-time, the ISO proposes to reduce the real-time scheduling run penalty price from the current \$5,000 to \$1,500. The ISO does not propose to change the day-ahead level of this parameter. This recommended change requires a change to section 27.4.3.1 of the tariff as follows.

### 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 and RTM 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 transmission constraint relaxation parameters are being utilized more frequently in real-time dispatch than originally anticipated, contributing to the higher real-time congestion costs. Real-time transmission constraints appear more constrained than in the day-ahead or hour-ahead scheduling process pricing runs due to actual flow conditions not identified in the day-ahead, outages and an operational margin. The available market options to relieve transmission constraints are significantly limited in real-time due to a reduction in the amount of available resources. In the real-time, the ISO has lesser ramping capability for resources available for dispatch than it has in the day-ahead because by the time it is in the real-time, many of the resources it would have had available in the day-ahead market are no longer available if not dispatched in the day-ahead due to long-start up times. In addition, many other potential options to relieve the constraint, such as adjusting intertie schedules, are no longer available in the economic range. As a result, the cost to relieve the transmission congestion in real-time is higher and such higher costs occur more frequently than in the day-ahead market.

This proposed change will only be applied to the real-time dispatch in recognition of more limited congestion relief available in real-time. The real-time transmission congestion is more susceptible to extreme outcomes because of the reduced controls available to relieve the congestion. The transmission constraint relaxation parameter for day-ahead and HASP will remain at \$5,000.

The ISO initially considered reducing the parameter to \$2,500 as indicated in the initial draft proposal. Initial sensitivity analysis demonstrated that while this reduced the cost of managing congestions significantly, as explained previously in the straw proposal, it did not have a material impact on the optimization's ability to arrive to a reliable market solution. Further analysis demonstrates that while \$2,500 was effective in reducing the cost of managing congestion, a further reduction to \$1,500 does not degrade the market

solution but does provide further reductions in costs. This demonstrates that there is a diminishing return in terms of the market optimization's ability to find a solution that appropriately relieves congestion as the parameter is increased. Therefore, there is no justifiable cause for imposing the additional costs on the market when the ISO can obtain as solid a solution at the lower parameter than it can at the current \$5,000 setting. On the other hand, a reduction below \$1,500 would cause a degradation of the solution given the current bid cap of \$1,000. As we approach the bid cap, there is a greater risk that viable economic bids are bypassed to relieve the constraints. Therefore, setting the parameter at \$1,500 balances these competing interests.

## 6.0 Stakeholder comments and responses

On October 19, 2012, the ISO launched an expedited stakeholder process with the release of the issue paper/straw proposal on Transmission Constraint Relaxation Parameter Change. On October 25, the ISO conducted a web conference call in which it presented and discussed with the stakeholders the October 19 issue paper/straw proposal. On November 1, stakeholders submitted comments on the straw proposal. These comments are available at:

<http://www.caiso.com/Documents/Transmission%20constraint%20relaxation%20parameter%20change%20-%20stakeholder%20comments%7CComments%20on%20straw%20proposal>

The ISO reviewed all the comments and appreciates stakeholders' immediate response and participation in this matter.

A total of 11 written comments were received. The comments can be separated in the following categories:

### Group 1: Possibly Support.

Calpine believes the proposal is solely driven by the increases in congestion costs and that the proposal is a simple and convenient mechanism to cut RTCO costs, but that such costs are driven by structural and situational conditions. Calpine states that it could support the proposal if the data confirms the law of diminishing returns is at play.

### Group 2: Inconclusive.

WPTF seeks refinements and clarifications and recommended the ISO address the root causes. DC Energy agrees that there is an appropriate level of the parameter and request more information and sensitivity studies. NRG does not believe the ISO has justified the need to reduce the parameter, but understands the desire to reduce high real-time congestion prices that cannot be addressed through real-time re-dispatch of resources. JP Morgan supports expedited fixes to anomalous market outcomes but it is concerned about this proposal moving too quickly without considering more fundamental issues and solutions.



### Group 3: Supports.

NCPA, CDWR, PG&E, SCE, SDG&E and Six Cities (Anaheim, Azusa, Banning, Colton, Pasadena, and Riverside) support the proposal. CDWR supports the proposal and believes the ISO should consider further reduction from the proposed \$2,500 to levels as low as \$1,000. The ISO appreciates all the comments submitted in response to its initial proposal and findings. In response to requests for additional analysis, the ISO ran additional cases with lower parameter settings of \$2,500, \$1,500, and \$1,000 to identify the responsiveness of the market solution to these parameters and provides a report on several of the notable constraints. These results are provided in Section 7 below.

Participants also requested that the ISO address the underlying market issues causing the increase in the RTCO and take additional measures to mitigate for this. In section 8, the ISO explains the measures it has taken and is taking in conjunction with its proposal to reduce the transmission constraints relaxation parameter.

## 7.0 Market and reliability impacts

When evaluating what impacts the parameter change would have, the first consideration is reliability. Therefore, the ISO believes it is necessary to ensure that the proposed parameter change still allows the market runs to reasonably dispatch all available effective resources to resolve any congestion on all modeled and enforced transmission constraints. To this end, sensitivity studies were performed for select cases to confirm that no reasonably effective resources are left out from dispatch because of the penalty value changes. The second consideration is market efficiency or cost. Through sensitivity studies, the ISO assessed the impacts of the proposed reduced transmission constraint parameters on prices and power flow changes.

In response to stakeholder requests and its own desire to ensure an adequate and appropriate reduction in the parameter, the ISO ran additional cases with the lower parameters of \$2,500, \$1,500, and \$1,000, based on saved cases from actual market runs with the current \$5,000 relaxation parameter. This analysis enabled the ISO to compare the responsiveness of the market system to the lower parameter in terms of the percentage of fewer MW of congestion relief the real-time market software would schedule. Further analysis shows that lowering the parameter from the originally proposed \$2,500 in the straw proposal to \$1,500 would result in little or no incremental power flow increase in all the sample cases re-run. That is because when the transmission constraint relaxation was reduced from \$5,000/MW to \$1,500/MW, the amount of difference in flow relief observed was very small, less than 1% in most cases. In the exceptional case of flow increase of 5%, the increase in power flow was due to maintaining import schedules protected in the RTD scheduling run. At higher transmission constraint relaxation parameter levels, imports were observed to be adjusted by solution to gain additional constraint relief. Any import reduction would be manually implemented by operator actions, not by a software solution. It should be noted that the sensitivity analysis were

performed in software environments separate from the production environment and may not be identical. Due to software and modeling changes over time, the re-run results may not be duplicating the original production run results 100%.

In Table 1, under the heading of “Transmission Constraint Parameter”, there are 3 columns from the right edge of the table labeled as “\$2500”, “\$1500” and “\$1000”. The values the under these labels show “Congestion Relief Reduction (MW)”. In other words, they show how many MW the power flow would increase when the parameter is reduced to different levels.

The results reinforce the need to lower the scheduling run transmission constraint relaxation parameter. The results indicated that a reduction of the parameter would not have a significant impact on the reliability as measured by the power flows. For example, in the third case, the values are 8.3 MW under \$2500, 10.4 MW under \$1500, and 10.4 MW under \$1000. This means that the power flow on SCE\_PCT\_IMP\_BG would increase by 8.3 MW if the parameter is \$2500, and would increase by 10.4 MW if the parameter is \$1500, and 10.4 MW if it is \$1000.

Table 1. Re-run results

Cases	Constraint	Original Shadow Price (Pricing Run)	Transmission Constraint Parameter			
			\$ 5,000	\$ 2,500	\$ 1,500	\$ 1,000
			Congestion Relief Reduction (MW/%)			
TD 4/25/2012 HE 14 Int 7	32990_MARTINEZ_115_33016_ALHAMTP2_115_BR_1_1	\$4,818.27	N/A	0	0	0
TD 6/10/2012 HE 6 Int 10	SCE_PCT_IMP_BG	\$3,582.00	N/A	0	0	20.3/0.4%
TD 6/10/2012 HE 6 Int 8	SCE_PCT_IMP_BG	\$3,339.67	N/A	8.3/0.2%	10.4/0.2%	10.4/0.2%
TD 6/11/2012 HE 20 Int 2	T-165 SOL-13_NG_SUM	\$4,992.47	N/A	0	0	0
TD 6/12/2012 HE 20 Int 9	6110_TM_BNK_FLO_TMS_DLO_NG	\$4,999.54	N/A	2/0.2%	3/0.3%	3/0.3%
TD 8/10/2012 HE 21 Int 9	6110_TM_BNK_FLO_TMS_DLO_NG	\$4,964.42	N/A	2/0.2%	2/0.2%	4/0.4%
TD 8/17/2012 HE 13 Int 12	22342_HDWSH_500_22536_N.GILA_500_BR_1_1	\$4,647.70	N/A	0	77.1/5%*	78.1/5%*
TD 8/18/2012 HE 12 Int 6	22342_HDWSH_500_22536_N.GILA_500_BR_1_1	\$4,492.96	N/A	0	7.7/0.6%	8.2/0.6%
TD 8/26/2012 HE 15 Int 3	SDGE IMPORTS	\$4,971.81	N/A	1/0.1%	1/0.1%	2/0.1%
TD 8/31/2012 HE 12 Int 6	22342_HDWSH_500_22536_N.GILA_500_BR_1_1	\$4,479.13	N/A	0	3.3/0.2%	4/0.3%
TD 8/18/2012 HE12 Interval 6	22342_HDWSH_500_22536_N.GILA_500_BR_1_1	\$4,475.00	N/A	7.5/0.6%	7.7/0.6%	8.2/0.6%
TD 10/13/2012 HE5 Interval 7	SCE_PCT_IMP_BG	\$2,350.70	N/A	0	86.3/1.7%	87.5/1.7%
TD 8/14/2012 HE17 Interval 9	6110_TM_BNK_FLO_TMS_DLO_NG	\$4,112.60	N/A	2/0.2%	2/0.2%	3/0.3%
Real-Time Congestion Offset		Original Congestion Offset (Millions)	% Reduction in Congestion Offset			
(Based on Aug 1, 2012-October 22, 2012)		\$71.6	N/A	-18%	-36%	-50.20%

\* The increase in power flow was due to maintaining import schedules protected in the RTD scheduling run. At higher transmission constraint relaxation parameter levels, imports were observed to be adjusted by solution to gain additional constraint relief. Any import reduction would be manually implemented by operator actions, not by a software solution.

The congestion relief reduction number is relevant because if the parameter is set too low, the constraint will not bind as soon in the market optimization run than if it was set at \$5,000 and will not schedule as many MWs to ensure that the market solution is within the limits within which the ISO must operate reliably. This may lead to the need for greater out-of-market actions by the ISO operators.

In contrast, the cost of the limited additional relief provided by the \$5,000 parameter is significant in terms of the high levels of real-time prices when the parameter binds. 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, exceptional dispatch, or transmission switching, where appropriate.

## 8.0 Other causes and mitigation measures taken or planned

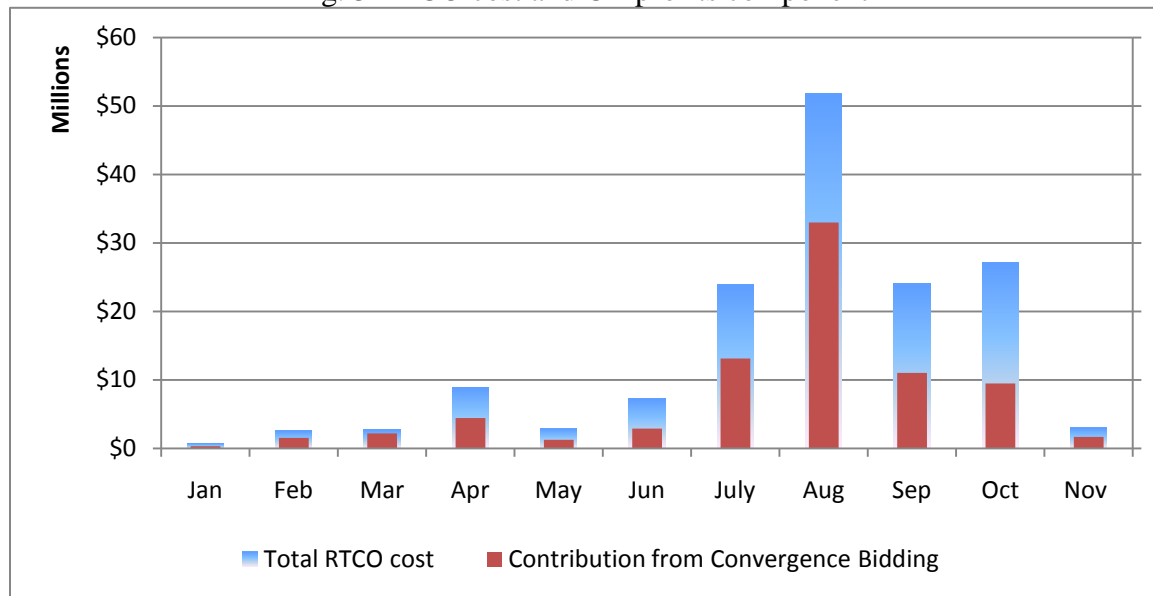
In addition to higher real-time prices and lower real-time limits relative to DA results, there are other factors that impact the real-time congestion offset cost. The ISO is considering or has taken steps to address some of the causes and/or root causes.

One of the causes or factors is the shortage of local ramping capacity to resolve a transmission constraint in real-time that was not present or the congestion was not as severe in the day-ahead market. Where appropriate, the ISO is conforming the day-ahead limit of these constraints to converge better to real-time market conditions. In the long run, the ISO is considering a 30-minute capacity product/constraint to secure adequate local capacity ready to be deployed in real-time market to resolve the congestion in real-time.

Another cause is the unscheduled or loop flows in real-time that are not yet modeled in day-ahead market and/or the hour-ahead process. The ISO recently deployed the first phase of the TRM (transmission reliability margin) in the hour-ahead process. Where appropriate, TRM can be used to reserve capacity on the interties in anticipation or in response to unscheduled flows that can impact real-time flows on internal transmission constraints close to or heavily impacted by the unscheduled flows, thus reducing the impact of unscheduled flows on the real-time market (RTD). In the long run, the ISO is considering options to model or account for the unscheduled flows in the day-ahead market and would need additional tariff authority to do so.

Convergence bids have a significant impact on the magnitude of RTCO. Analysis shows profits from convergence bids contribute to approximately 50% of all the RTCO cost (Fig 3). The ISO is monitoring the situation but has no immediate plans to change existing designs and implementation of convergence bidding (CB). Any potential changes of CB would be out of scope of this proposal.

Fig. 3 RTCO cost and CB profits component



While the proposed change to the real-time transmission constraint relaxation parameter can be expedited without changes to the software, other longer term modifications to the transmission constraint relaxation parameters that would require additional software enhancement should be considered. For example, a tiered approach based on voltage levels may be appropriate with 500 kV constraint having the highest relaxation cost and 60 kV the lowest, recognizing the reliability impact and available resources to mitigate congestion at different voltage levels. Another approach could be using a demand curve that recognizes operating impacts of different magnitudes of relaxations versus the current approach of one relaxation parameter.

The ISO is also working to address the physical limitations by planning and approving new transmission projects.

Finally, market designs to be compliant with FERC order 764 may provide yet another opportunity to further mitigate or resolve the RTCO and other real-time uplift cost issues.

## 9.0 ISO/RTO transmission constraint relaxation practice review

All ISO/RTOs perform competitive transmission congestion management. As a result, all ISO/RTOs must have similar type of parameters that establish the reasonable limit for market relief of congestion. Therefore, it is appropriate to compare and consider the transmission constraint parameter thresholds used at other ISO/RTOs.

### PJM Interconnection

PJM transmission constraints can be relaxed by maintaining their shadow prices not exceeding so-called market based transmission constraint limits. At this time, we do not have information on how to set such limits for different transmission constraints and their

actual values. However, these values are used in the market runs for the determination of both the resource MW schedules and their locational prices.

### NYISO

On April 2007, NYISO filed with FERC to establish a \$4,000 shadow price to reflect their locational based marginal cost during transmission shortage. This value is used in the market runs for the determination of both resource MW scheduled and their locational prices.

### MISO

The relaxation of constraints, including transmission constraints, in MW scheduling is governed by a set of configurable penalty prices, similar to the ISO scheduling run with the exception of regulating reserve and operating reserve for which their requirement violations are governed by a demand curve. The set of penalty price current values have not been found in their website. In the past, under penalty price constraint relaxation, the market prices are set by the maximum value of the supply curve, i.e. last economic signals. However, the shadow prices of the transmission constraints being set under each approach according to the MISO are too low and do not truly reflect the cost of reliability. Since February 2011, MISO used a new set of pricing values, called marginal value limits (MVL), to govern the shadow prices for transmission constraints that have been relaxed.

\$3,000 for IROL (Interconnection Reliability Operating Limit) 500 kV constraint  
\$2,000 for SOL (System Operating Limit) constraint above or equal to 161kV  
\$1,000 for SOL constraint below or equal to 131kV  
\$500 for SOL constraint below or equal to 69kV

## **10.0 Conclusion**

A \$1,500 transmission constraint relaxation parameter is sufficient to exhaust reasonable operational dispatch solutions in real-time. If additional relief is necessary, the operators should consider other options beyond the market re-dispatch including, intertie schedule adjustment, exceptional dispatch, transmission switching or outage cancellation.

Due to the magnitude of the August and September real-time congestion offset, the ISO management decided to proceed with an expedited tariff modification with shortened stakeholder review process with an aim to bring the tariff change to the ISO Board of Governors in December 2012. If an expedited tariff change is determined to be appropriate, the ISO will request the appropriate relief to ensure that the scheduling transmission constraint relaxation parameter change can be implemented in the software as soon as possible.

## 11.0 Next Steps

The ISO is proposing an aggressive schedule in order to allow us to file required tariff changes at FERC to be effective as early as possible.

Date	Event	Status
10/18	Post straw proposal	Complete
10/25	Stakeholder call 10 a.m. to 12 p.m.*	Complete
11/1	Comments due**	Complete
11/14	Post draft final proposal	Complete
11/20	Stakeholder call 1 to 3 p.m.*	
11/27	Comments due**	
December	Seek Board Approval	

\* RSVP to [TransConstraint@caiso.com](mailto:TransConstraint@caiso.com)

\*\* Please submit comments to [TransConstraint@caiso.com](mailto:TransConstraint@caiso.com)