

February 19, 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-**

Amendment to Enhance Price Consistency

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 is intended to reduce the incidence of inconsistencies between settlement prices and bid-in prices associated with the amounts scheduled through the ISO’s markets. Specifically, the amendment revises the manner in which the ISO calculates prices for load aggregation points and trading hubs to take into account the effectiveness of the aggregated nodes in relieving congestion, rather than the average effectiveness of the individual nodes.

The ISO proposes an effective date for the amendment proposed in this filing of May 1, 2013.

I. BACKGROUND

A. Price Inconsistencies

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 executes these markets using a software program that performs a mathematical algorithm known as constrained optimization. The goal of the constrained optimization algorithm is to produce a least-

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.

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.

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. The software does not, however, use all bids in attempting to reach a feasible solution. Rather, it uses only “effective” bids. 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.

Ideally, a market solution will produce awards (dispatches, in the case of energy) and prices that are consistent with one another; that is, if there are no ramping constraints or commitment constraints, a supply bid should only result in an award if the clearing price is equal to or greater than the bid price and for demand bids, only if the clearing price is equal to or lower than the bid-in price. Because of the interplay of market design features in both the day-ahead and real-time markets, the market software may not always produce the expected outcome.

In recent months, the ISO has been exploring the causes of price inconsistencies and potential mechanisms for reducing the frequency of these inconsistencies. This stakeholder process identified four revisions to the ISO’s scheduling and settlement processes that should improve consistency: (1) calculation of the settlement prices for default load aggregation points in the same manner that the software determines prices for determining awards; (2) calculation of the settlement prices for trading hubs in the same manner that the software determines prices for determining awards; (3) use of the pricing run rather than the scheduling run to determine awards; and (4) implementation of a hard, rather than soft, bid floor. The proposed amendment implements the first two of these process revisions. The ISO has determined that the third does not require a tariff amendment, but will describe it below. The ISO has deferred the implementation of a hard bid floor until a later filing.

B. Price Inconsistencies at Default Load Aggregation Points

1. The Cause of Price Inconsistencies at Default Load Aggregation Points

In the day-ahead market, with certain exceptions,² load submits demand bids at default load aggregation points, which comprise a set of individual pricing nodes. Currently, the ISO uses three default load aggregation points.

Under the current ISO tariff, the market software determines the settlement price for a default load aggregation point based on the weighted average price of all constituent pricing nodes, weighted by the quantity of load at each pricing node. As a result of this, the price published and used for settlement purposes at such aggregated locations will reflect any redispatch adjustments the software makes to the dispatch of supply resources at the individual constituent pricing nodes based on the effectiveness of those resources in relieving congestion. In contrast, the software determines awards (schedules) for the demand bid in at a default load aggregation point based on the effectiveness of adjustments of the aggregated resource in relationship to the congested constraint. Thus, the aggregate resource may not be used to relieve congestion if its assigned effectiveness in addressing the constraint (“shift factor”) is under the defined threshold, even though supply at some constituent pricing nodes may be adjusted to relieve congestion on the same constraint. The result may be that the price used to determine the schedule reflects no adjustment for congestion relief while the settlement price reflects the adjustment at some constituent nodes. This creates a price inconsistency between the price at which resources are scheduled based on their bid-in price as compared to the price at which they are settled.

The following example illustrates the manner in which such price inconsistencies arise with default load aggregation points. Assume a demand bid at a default load aggregation point with two segments: the load will pay up to \$40 per megawatt for the first 5 megawatts of energy and up to \$30.20 for the next 5 megawatts:

Figure 1. Example Demand Bid Curve



² The tariff exempts certain load such as participating load, load scheduled under an existing contract agreement, or load scheduled by a metered subsystem from this requirement. See Sections 27.2.1 and 30.5.3.2 of the ISO tariff.

Also assume that the market outcome is such that the marginal energy component is \$30 per megawatt-hour, that there are no losses and that there is one transmission constraint with a shadow price of -\$20 per megawatt hour. Finally, assume that the load aggregation point has five constituent nodes.

The market software will evaluate the effectiveness of the demand bid at the load aggregation point according to its effectiveness as a whole in relieving the congestion constraint. It calculates that effectiveness using both the weighing factors and the shift factors of each constituent node. Table 1 assumes certain weighting factors for our example and shows the calculated aggregate shift factor.

Table 1. Weighted Shift Factors for Constituent Nodes of Example Load Aggregation Point.

Node	Weighting Factor	Shift Factor	Weighted Shift Factor
A	40%	0%	0.00%
B	30%	0%	0.00%
C	13%	20%	2.60%
D	13%	-35%	-4.55%
E	4%	5%	0.20%
Aggregated Shift Factor			-1.75%

The weighted shift factor is -1.75 percent, which means that if this bid is incrementally dispatched, each MW will relieve congestion by 0.0175 MW on the binding transmission constraint. As noted, the ISO currently applies an effectiveness threshold of 2 percent. With a shift factor of -1.75 percent, the bid for the aggregate node will not be used to manage congestion and there will be no marginal cost of congestion at the load aggregation point. The software will thus use a locational marginal price of \$30 per megawatt hour to clear the market, and will dispatch the bid at 10 megawatts.

For settlement purposes, however, the software calculates the price at the load aggregation point differently. During the process of clearing the market, the software determines the price of each constituent node based on its individual effectiveness in managing the congestion. It calculates the marginal congestion component of each constituent node as the shift factor multiplied by the shadow price of the constraint. Then, using the weighting factors, it calculates a weighted locational marginal price. Under the current tariff, the weighted average of the constituent node prices, as shown in Table 2, is the locational marginal price for the load aggregation point for the purposes of settlement.

Table 2: Settlement Price at the Example Load Aggregation Point.

Node	Weighting Factor	Shift Factor	Marginal Energy Cost	Marginal Congestion Cost	Locational Marginal Price	Weighted Locational Marginal Price
A	40%	0%	\$30	$0\% \times \$-20 = \0	$\$30 - \$0 = \$30$	$40\% \times \$30 = \12
B	30%	0%	\$30	$0\% \times \$-20 = \0	$\$30 - \$0 = \$30$	$30\% \times \$30 = \9.0
C	13%	20%	\$30	$20\% \times \$-20 = -\4	$\$30 - \$4 = \$26$	$13\% \times \$26 = \3.4
D	13%	-35%	\$30	$-35\% \times \$-20 = \7	$\$30 + \$7 = \$37$	$13\% \times \$37 = \4.8
E	4%	5%	\$30	$5\% \times \$-20 = -\1	$\$30 - \$1 + \$29$	$4\% \times \$29 = \1.2
Weighted Average Locational Marginal Price for Load Aggregation Point						\$30.4

The settlement price for the 10 megawatts of demand scheduled is thus \$30.4 per megawatt-hour. As is apparent, this price is not consistent with the award; based on the bid curve submitted by that resource, the ISO would only have scheduled 5 megawatts of the demand at this price.

C. Price Inconsistencies at Trading Hubs

Like load aggregation points, trading hubs are aggregations of pricing nodes used by the ISO markets for settlement and trading purposes. Trading hub prices are part of the ISO's settlement service for bi-lateral transactions that occur outside the ISO markets referred to as inter-scheduling coordinator trades in the ISO tariff. Prices at existing zone generation trading hubs are trading hubs designed to represent the average price paid to generation resources within each of the congestion zones that the ISO used prior to the implementation of its nodal market in 2009.

Prior to the ISO's implementation of convergence bidding, the ISO did accept energy bids and did not clear energy schedules at the existing zone generation trading hubs and only offered these for settlement of inter-scheduling coordinator trades and congestion revenue rights. With the adoption of convergence bidding, it became possible for scheduling coordinators to submit virtual bids at the existing zone generation trading hub level.

Under the current tariff, for the purposes of scheduling the convergence bids at trading hubs, the ISO takes congestion into account when the effectiveness of the entire trading hub is greater than the effectiveness threshold and does not take it into account when the effectiveness is below the threshold. This is analogous to the process for awarding schedules at default load aggregation points. Also similar to the settlement of

demand at load aggregation points, the ISO uses a different process for determining trading hub prices for settlement purposes than it does for clearing supply at these locations. The trading hub prices are simply weighted average prices of each constituent node. The ISO determines the weights applied to the constituent nodal locational marginal prices in each zone annually and separately for each season and on-peak and off-peak period based on the ratio of the prior year's total output of energy at that pricing node to the total output of energy in the zone for the corresponding season and on-peak or off-peak period. The difference between the two processes, as in the case of default load aggregation points, may cause price inconsistencies.

D. The Impact of Price Inconsistencies at Default Load Aggregation Points and Trading Hubs

Figure 2 and Figure 3 show the cost of the price differential at default load aggregation points and trading hubs between the prices used for awards and those used for settlements under the current ISO tariff. A positive differential represents incidences where the settlement price is greater than the price used for determining awards, and a negative price represents the converse. The period covered in this metric is from the activation of convergence bids, February 2011, up to June 2012.

Figure 2: Cost of Pricing Load at Default Load Aggregation Points under the Current versus the Proposed Methodology.

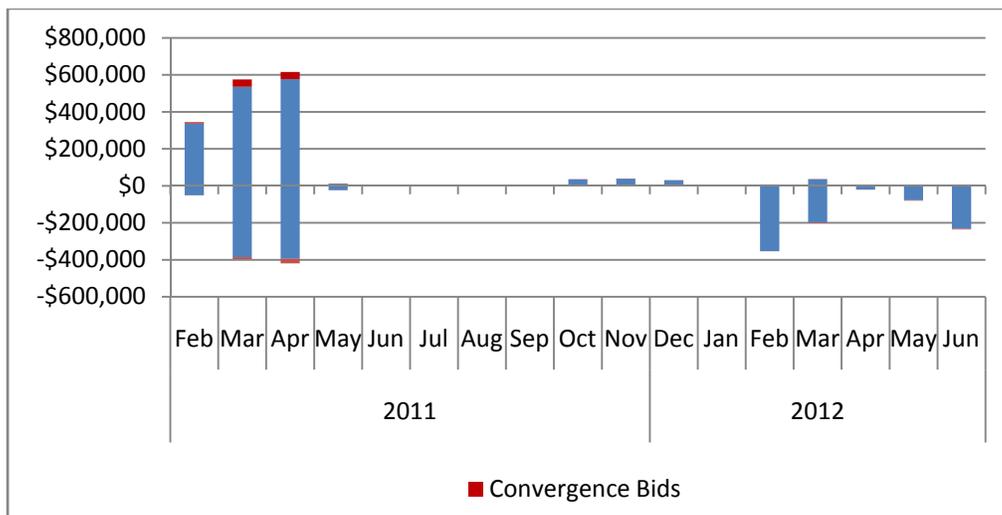
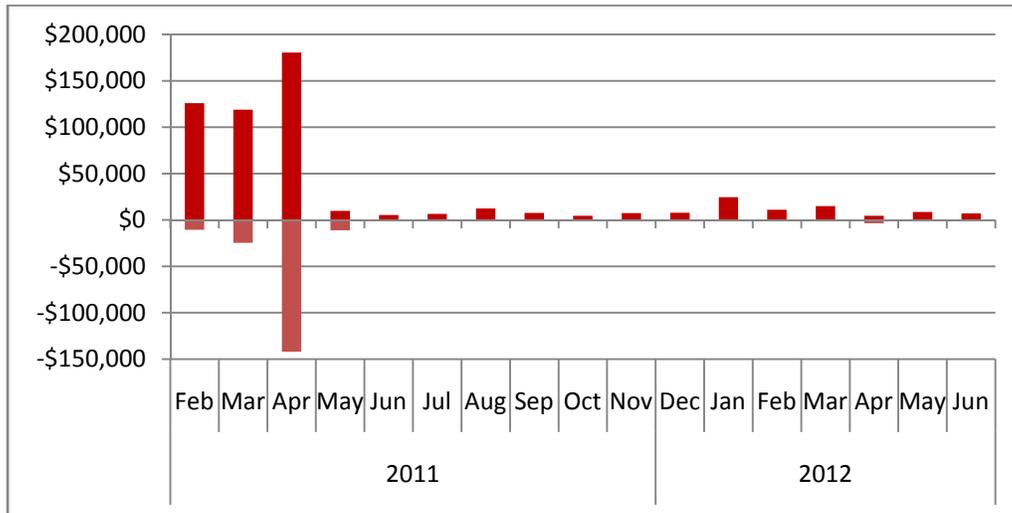


Figure 3: Cost of Pricing Supply at Trading Hubs under the Current versus the Proposed Methodology.



E. Stakeholder Process and Board Consideration

On June 18, 2012, the ISO initiated a stakeholder process on possible market enhancement to reduce price inconsistency and posted an issue paper and straw proposal.³ On June 26, the ISO conducted a stakeholder web conference to discuss the proposal. Following the receipt and review of comments from nine stakeholders, the ISO issued a revised straw proposal on August 3, 2012.⁴ The ISO issued its draft final proposal on August 31, 2012, and conducted a teleconference on the proposal on September 10, 2012.⁵ Five stakeholders provided comments.

The ISO presented the proposed amendment to the ISO Board of Governors on November 1, 2012.⁶ The Board unanimously approved the proposal. The ISO posted

³ The issue paper and straw proposal is available at http://www.caiso.com/Documents/IssuePaper_StrawProposal-PriceInconsistencyMarketEnhancements.pdf.

⁴ The revised straw proposal is available at <http://www.caiso.com/Documents/RevisedStrawProposal-PriceInconsistencyMarketEnhancements.pdf>.

⁵ The draft final proposal is available at <http://www.caiso.com/Documents/FinalDraftProposal-PriceInconsistencyMarketEnhancements.pdf>.

⁶ 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 C, D, and E, respectively.

draft tariff language on February 4. One stakeholder submitted comments providing minor clarifying changes, which the ISO accepted. A stakeholder call was held on February 14, 2013. No objects to the proposed tariff amendment were received.

F. Determination of Awards In The Pricing Run

As discussed in part A above, in addition to the changes being proposed in this amendment, the ISO identified the need to change its current practice of scheduling and pricing resources based on different market runs. The ISO's market software optimizes its markets through two runs: the scheduling run and the pricing run. In the scheduling run, the software will seek to achieve a solution using economical bids as much as possible but it will use uneconomical adjustment (cutting self-schedules or relaxing of constraints) as a last resource to be able to attain a solution. The prices from the scheduling run, however, may not reflect the actual economical signal as this run uses penalty prices as a mechanism to enforce self-schedules and constraint relaxation priorities when there is a need for such uneconomical adjustments. In the pricing run, the software no longer uses the higher penalty prices; it models self-schedules as well as constraint relaxations with lower prices that are coordinated with the bid price cap and floor such that resulting prices from the pricing run can reflect economic signals and be used for settlement purposes. Currently, the ISO uses the scheduling run to determine awards and the pricing run to determine settlement prices. Under certain circumstances, this can result in a mismatch between the price submitted in cleared bids awarded and the settlement price in the hour ahead scheduling process. This is primarily a problem in the hour-ahead scheduling process, but also causes inconsistencies in the day-ahead market.

In order to resolve this inconsistency, the ISO intends to establish both awards and settlement prices through the pricing run in both the day-ahead market and the hour-ahead scheduling process. The software will continue to have a scheduling run followed by a pricing run, and there will be no changes to the run's set-up. Priorities for self-schedules and constraint relaxations and their associated penalty prices will remain unaltered and the scheduling run will continue to use these values. The pricing run will continue to use the information from the scheduling run. There will be no changes to the mathematical modeling, set-up or market engine. Rather, the ISO will revise the process of transferring the market results to downstream systems such that they will use the award from the pricing run. This approach will resolve most of the instances of price inconsistencies on the ties in the hour ahead scheduling process.

The process being revised involves only implementation details for the market rules set forth in the tariff. This detail is currently not included in the ISO tariff and the Commission has not required that this level of detail be included in the tariff. The ISO is thus able to implement these changes without a tariff revision, but is including this discussion to inform the Commission of the revision.

II. DESCRIPTION OF TARIFF AMENDMENTS

In order to eliminate these sources of price inconsistency discussed above, the ISO proposes to revise the ISO tariff to provide that the settlement prices for default load aggregation points and for trading hubs will be calculated in the same manner that the software determines prices for determining awards. Thus the ISO proposes to revise section 27.2.2.1 and create two sections that describe the pricing at the default load aggregation point and those at a custom load aggregation point separately. In new section 27.2.2.1.1 the ISO proposes to add the detail that pricing at default load aggregation points in the integrated forward market will be based on a price as determined by the market optimization based on the distribution of the ISO's system Load to the Default LAP's constituent Pricing Nodes and is determined by the effectiveness of the Load within the Default LAP in relieving a Transmission Constraint within the effectiveness threshold as specified in Section 27.3.4.6. This reflects the new pricing approach described above. The weights will be based on the load distribution at the constituent nodes of the load aggregation point that are used in the market run and the price will reflect the aggregate effectiveness of all the load in the load aggregation point in relieving congestion. The ISO proposes to add a new section 27.2.2.1.2 to reflect the pricing at custom load aggregation points, which does not change from the existing practice and tariff requirements. The ISO proposes to add the following description of the average load-weighted pricing currently in effect and to remain after the Commission accepts the proposed tariff revisions in this filing.

Similar to the language in Section 27.2.2.1 for the integrated forward market, Section 27.2.2.2 provides details on aggregate pricing in the real-time market. The ISO proposes to also divide this in two and add the details regarding real-time pricing at default load aggregation points and those at custom load aggregation points.

To address price inconsistencies at trading hubs, the ISO proposes to revise section 27.3 to provide that the ISO software will produce a trading hub price that consists of a generation-weighted price where the weights are based on scheduled energy at the constituent nodes of the trading hub. The price will reflect congestion if the effectiveness factor for the trading Hub in resolving the constraint is greater than the effectiveness threshold.

The proposal also deletes language in Appendix C that sets forth the current methodology for establishing prices for load aggregation points and trading hubs. It sets forth in section F of Appendix C the determination of the weight to be provided to constituent nodes of a load aggregation point. The weights will represent the fractional share of each node relative to the total load in the load aggregation point.

Finally, the proposed amendment revises sections 11.2.1.2, 11.2.1.3, 11.2.4.2 and 11.5.2.2 to clarify the language so that it is clear which price the ISO will be using for settling the awards specified in these sections. These revisions are not substantive.

A stakeholder raised concern over whether the proposed pricing changes for settling default load aggregation points and trading hubs might create opportunities for exploitive market behavior. The ISO and its Department of Market Monitoring carefully considered this concern and concluded it would not pose a credible opportunity for such behavior due to the difficulty in effectively predicting when such a strategy would be profitable. Moreover, applying the same aggregate pricing methodology to both the day-ahead market and the real time market will minimize the opportunity for exploitive behavior. Nonetheless, it is something that the ISO will closely monitor.

III. EFFECTIVE DATE AND REQUEST FOR WAIVERS

The ISO requests an effective date of May 1, 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.⁷ The CAISO requests waiver of any applicable requirement of Part 35 if necessary, in order to permit this filing to become effective as proposed.

IV. 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 Outcropping Way
Folsom, CA 95630
Tel: (916) 608-7287
Fax: (916) 608-7296
amckenna@caiso.com

V. 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.

⁷ 18 C.F.R. Part 35 (2012).

VI. 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 | October 25, 2012, Memorandum from Keith Casey to the ISO Board of Governors |
| Attachment D | November 1, 2012, Presentation to the ISO Board of Governors on the Decision on Enhancement to Improve Price Consistency |
| Attachment E | Matrix of Stakeholder Comments Presented to the ISO Board of Governors Regarding the Decision on Enhancements to Improve Price Consistency |

VII. 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 1, 2013.

Respectfully submitted,

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

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

Dated: February 19, 2013.

Attachment A – Clean Tariff

Tariff Amendment to Enhance Price Consistency

California Independent System Operator Corporation

February 19, 2013

11.2.1.2 IFM Charges for Demand at LAPS

For each Settlement Period that the CAISO clears Energy transactions in the IFM, except as specified in Section 30.5.3.2 and except for Participating Loads, which shall be subject to the charges specified in 11.2.1.3, the CAISO shall charge Scheduling Coordinators for the MWh quantity of Demand scheduled at an individual LAP in the Day-Ahead Schedule, in an amount equal to the IFM LMP for the applicable LAP multiplied by the MWh quantity scheduled in the Day-Ahead Schedule at the relevant LAP. The applicable Default LAP IFM LMP is as described in Section 27.2.2. For Scheduling Coordinators whose Demand scheduled at the individual LAP is subject to an upward price correction as specified in Section 11.21, the CAISO will use the Price Correction Derived LMP to settle the MWh quantity of Demand scheduled in the Day-Ahead Schedule at the relevant LAP.

11.2.1.3 IFM Charges for Demand by Participating Loads, Including Aggregated Participating Load

For each Settlement Period that the CAISO clears Energy transactions in the IFM for Demand by Participating Loads, the CAISO shall charge the Scheduling Coordinators an amount equal to the MWh quantity of Demand scheduled in the Day-Ahead Schedule for the relevant Participating Load at the PNode (or Custom LAP, in the case of Aggregated Participating Load), multiplied by the IFM LMP at that PNode (or Custom LAP, in the case of Aggregated Participating Load). The Custom LAP Price is determined as described in Section 27.2.2. For Scheduling Coordinators whose Demand scheduled at the individual PNode or Custom LAP is subject to an upward price correction as specified in Section 11.21, the CAISO will use the Price Correction Derived LMP to settle the MWh quantity scheduled in the Day-Ahead Schedule for that Scheduling Coordinator at the relevant PNode or Custom LAP.

11.2.4.2 Settlement Calculation for the Different CRR Types

For the purposes of determining the CRR Payments and CRR Charges based on the various CRR Types, the CAISO shall calculate the Settlement of CRRs as described in this Section 11.2.4.2. When CRR Source or CRR Sink is a LAP, the Load Distribution Factors used in the IFM will be used to produce the LAP Price at which CRR Payments or CRR Charges will be settled. When CRR Source or CRR Sink is a Trading Hub the weighting factors used in the IFM and the CRR Allocation and CRR Auction processes will also be used to produce the Trading Hub prices that will be used to settle CRR Payments and CRR Charges.

11.5.2.2 Hourly Real-Time LAP Price

The Hourly Real-Time Default LAP Price will apply to Demand and MSS Demand under net Settlement of Imbalance Energy, except for Demand not settled at the Default LAP as provided in Section 30.5.3.2. The Default or Custom LAP Hourly Real-Time LAP Price is calculated as the simple average of the Dispatch Interval LMPs for the Default or Custom LAP for the applicable Trading Hour. The Dispatch Interval LMP for CAISO Demand settled a given Default LAP is determined as specified in in Section 27.2.2.2.1. The Dispatch Interval LMP for CAISO Demand settled at a Custom LAP is determined as specified in Section 27.2.2.2.2.

27.2.2 Determination Of LAP Prices

27.2.2.1 IFM LAP Prices

27.2.2.1.1 Default LAPs Pricing

The IFM LAP Price for Settlement of Demand at Default LAPs for a given Trading Hour is the price as produced by the IFM optimization run based on the distribution of system Load at the constituent Pricing Nodes within the applicable Default LAP and is determined by the effectiveness of the Load within the Default LAP in relieving a Transmission Constraint within the effectiveness threshold as specified in Section 27.3.4.6.

27.2.2.1.2 Custom LAP Pricing

The IFM LAP Price for Settlement of Demand at Custom LAPs for a given Trading Hour is calculated as a Load-weighted average of the individual IFM LMPs at the PNodes within the Custom LAP, where the weights are equal to the nodal proportions of CAISO Demand associated with that Custom LAP scheduled by the IFM.

27.2.2.2 Real-Time Market LAP Prices

27.2.2.2.1 Default LAP Pricing

The Real-Time Default LAP Price for a five minute Dispatch Interval is the price as produced by the Real-Time Market optimization run based on the distribution of system

Load at the constituent Pricing Nodes within the applicable Default LAP and is determined by the effectiveness of the Load within the Default LAP in relieving a Transmission Constraint within the effectiveness threshold as specified in Section 27.3.4.6. Default LAP Hourly Real-Time Price is then determined for Settlement purposes as further described in Section 11.5.2.2.

27.2.2.2.2 Custom LAP Pricing

The RTM LAP Price for Settlement of Demand at Custom LAPs for a given five minute Dispatch interval is calculated as a Load-weighted average of the individual RTM LMPs at the PNodes within the Custom LAP, where the weights are calculated based on Meter Data. Custom LAP Hourly Real-Time LAP Price is then determined for Settlement purposes as further described in Section 11.5.2.2.

27.3 Trading Hubs

The CAISO shall create and maintain Trading Hubs, including Existing Zone Generation Trading Hubs, to facilitate bilateral Energy transactions in the CAISO Balancing Authority Area. Each Trading Hub will be based on a pre-defined set of PNodes. The CAISO Market run will produce a Trading Hub price for each Settlement Period or Settlement Interval that is derived from the CAISO Market optimization based on the effectiveness of the Trading Hub aggregation in relieving congestion. The Trading Hub price will reflect congestion on Transmission Constraints whose effectiveness factor for the respective Trading Hub is greater than the effectiveness threshold specified in Section 27.3.4.6. There are three Existing Zone Generation Trading Hubs, which correspond geographically to the three Existing Zones. Each Existing Zone Generation Trading Hub is comprised of an aggregation of PNodes for Generating Units within the corresponding Existing Zone. The specification of seasons will be identical to the seasons

used in the annual CRR Allocation, and the annual calculation of Existing Zone Generation Trading Hub weights will be performed in a timely manner to be coordinated with the annual CRR Allocation and CRR Auction processes.

Appendix C

Locational Marginal Price

E. Trading Hub Price Calculation

The CAISO calculates Existing Zone Generation Trading Hub prices, as provided in Section 27.3, based on the LMP calculations described in this Attachment and in Section 27.2.

F. Load Zone Price Calculation

The CAISO calculates LAP prices as described in Sections 27.2.2.

Attachment B – Marked Tariff

Tariff Amendment to Enhance Price Consistency

California Independent System Operator Corporation

February 19, 2013

11.2.1.2 IFM Charges for Demand at LAPS

For each Settlement Period that the CAISO clears Energy transactions in the IFM, except as specified in Section 30.5.3.2 and except for Participating Loads, which shall be subject to the charges specified in 11.2.1.3, the CAISO shall charge Scheduling Coordinators for the MWh quantity of Demand scheduled at an individual LAP in the Day-Ahead Schedule, in an amount equal to the IFM LMP for the applicable LAP multiplied by the MWh quantity scheduled in the Day-Ahead Schedule at the relevant LAP. The applicable Default LAP IFM LMP is as described in Section 27.2.2. For Scheduling Coordinators whose Demand scheduled at the individual LAP is subject to an upward price correction as specified in Section 11.21, the CAISO will use the Price Correction Derived LMP to settle the MWh quantity of Demand scheduled in the Day-Ahead Schedule at the relevant LAP.

11.2.1.3 IFM Charges for Demand by Participating Loads, Including Aggregated Participating Load

For each Settlement Period that the CAISO clears Energy transactions in the IFM for Demand by Participating Loads, the CAISO shall charge the Scheduling Coordinators an amount equal to the MWh quantity of Demand scheduled in the Day-Ahead Schedule for the relevant Participating Load at the PNode (or Custom LAP, in the case of Aggregated Participating Load), multiplied by the IFM LMP at that PNode (or Custom LAP, in the case of Aggregated Participating Load). The Custom LAP Price is determined as described in Section 27.2.2. For Scheduling Coordinators whose Demand scheduled at the individual PNode or Custom LAP is subject to an upward price correction as specified in Section 11.21, the CAISO will use the Price Correction Derived LMP to settle the MWh quantity scheduled in the Day-Ahead Schedule for that Scheduling Coordinator at the relevant PNode or Custom LAP.

11.2.4.2 Settlement Calculation for the Different CRR Types

For the purposes of determining the CRR Payments and CRR Charges based on the various CRR Types, the CAISO shall calculate the Settlement of CRRs as described in this Section 11.2.4.2. When CRR Source or CRR Sink is a LAP, the Load Distribution Factors used in the IFM will be used to ~~produce~~calculate the LAP Price at which CRR Payments or CRR Charges will be settled. When CRR Source or CRR Sink is a Trading Hub the weighting factors used in the IFM and the CRR Allocation and CRR Auction processes will also be used to produce the Trading Hub prices that will be used to settle CRR Payments and CRR Charges.

11.5.2.2 Hourly Real-Time LAP Price

The Hourly Real-Time Default LAP Price will apply to Demand and MSS Demand under net Settlement of Imbalance Energy, except for Demand not settled at the Default LAP as provided in Section 30.5.3.2. The Default or Custom LAP Hourly Real-Time LAP Price is calculated as the ~~simple weighted~~ average of the ~~hourly average of the~~ Dispatch Interval LMPs for the Default or Custom LAP, ~~using as weights the Real-Time LAP nodal Loads in the relevant Trading Hour for the applicable Trading Hour. The Dispatch Interval LMP for CAISO Demand settled a given Default LAP is determined as specified in in Section 27.2.2.2.1. The Dispatch Interval LMP for CAISO Demand settled at a Custom LAP is determined as specified in Section 27.2.2.2.2.~~

27.2.2 Determination Of LAP Prices

27.2.2.1 IFM LAP Prices

27.2.2.1.1 Default LAPs Pricing

The IFM LAP Price for Settlement of Demand at Default LAPs for a given Trading Hour is the price as produced by the IFM optimization run based on the distribution of system Load at the constituent Pricing Nodes within the applicable Default LAP and is determined by the effectiveness of the Load within the Default LAP in relieving a Transmission Constraint within the effectiveness threshold as specified in Section 27.3.4.6.

27.2.2.1.2 Custom LAP Pricing

The IFM LAP Price for Settlement of Demand at Custom LAPs for a given Trading Hour is calculated as a Load-weighted average of the individual IFM LMPs at the PNodes within the Custom LAP, where the weights are equal to the nodal proportions of CAISO Demand associated with that Custom LAP scheduled by the IFM.

27.2.2.2 Real-Time Market LAP Prices

27.2.2.2.1 Default LAP Pricing

The Real-Time Default LAP Price for a five minute Dispatch Interval is the price as produced by the Real-Time Market optimization run based on the distribution of system Load at the constituent Pricing Nodes within the applicable Default LAP and is determined by the effectiveness of the Load within the Default LAP in relieving a

Transmission Constraint within the effectiveness threshold as specified in Section 27.3.4.6. Default LAP Hourly Real-Time Price is then determined for Settlement purposes as further described in Section 11.5.2.2.

27.2.2.2.2 Custom LAP Pricing

The RTM LAP Price for Settlement of Demand at Custom LAPs for a given five minute Dispatch interval is calculated as a Load-weighted average of the individual RTM LMPs at the PNodes within the Custom LAP, where the weights are calculated based on Meter Data. Custom LAP Hourly Real-Time LAP Price is then determined for Settlement purposes as further described in Section 11.5.2.2.

27.3 Trading Hubs

The CAISO shall create and maintain Trading Hubs, including Existing Zone Generation Trading Hubs, to facilitate bilateral Energy transactions in the CAISO Balancing Authority Area. Each Trading Hub will be based on a pre-defined set of PNodes. The CAISO Market run will produce a shall calculate Trading Hub prices for each Settlement Period or Settlement Interval that is derived from the CAISO Market optimization based on the effectiveness of the Trading Hub aggregation in relieving congestion. based on an average of the LMPs at the PNodes that constitute the Trading Hub. The Trading Hub price will reflect congestion on Transmission Constraints whose effectiveness factor for the respective Trading Hub is greater than the effectiveness threshold specified in Section 27.3.4.6. There are will be three Existing Zone Generation Trading Hubs, which correspond geographically to the three Existing Zones. Each Existing Zone Generation Trading Hub is will be comprised of an aggregation of PNodes for Generating Units within the corresponding Existing Zone, whose associated LMPs will be used to establish an Existing Zone Generation Trading Hub price representing the weighted average

~~price paid to Generating Units in that Existing Zone. The weights applied to the constituent nodal LMPs in each Existing Zone will be determined annually and separately for each season and on peak and off peak period based on the ratio of the prior year's total output of Energy at that PNode to the total Generation output in that Existing Zone, for the corresponding season and on peak or off peak period.~~ The specification of seasons will be identical to the seasons used in the annual CRR Allocation, and the annual calculation of Existing Zone Generation Trading Hub weights will be performed in a timely manner to be coordinated with the annual CRR Allocation and CRR Auction processes.

Appendix C

Locational Marginal Price

E. Trading Hub Price Calculation

The CAISO calculates Existing Zone Generation Trading Hub prices, as provided in Section 27.3, based on the LMP calculations described in this Attachment and in Section 27.2.

~~NG~~

$$\text{EZ-Gen-Trading-Hub-Price}_j = \sum_{i=1}^{NG} W_{Gist} * LMP_i$$

~~i=1~~

~~where:~~

~~NG is the number of Generation buses defined in the Existing Zone Generation Trading Hub~~

~~j:~~

~~□ WG_{ist} is the generation-weighting factor for bus i for season s for time period t representing peak or off-peak period in Existing Zone Generation Trading Hub j . The sum of the weighting factors must add up to 1. These weights are based on the previous years actual generation output as described in Section 27.3.~~

F. Load Zone Price Calculation

~~The CAISO calculates LAP prices as described in Sections 27.2.2, based on the LMPs for a set of buses that comprise the LAP. These LAP prices represent the weighted average of the LMPs at the set of buses that comprise the LAP. The LAP bus weight is equal to the fractional share of each Load bus in the total Load in the LAP during the hour.~~

~~The price for LAP j is:~~

~~NZ~~

$$\text{LAP Price}_j = \sum_{i=1}^{NZ} WZ_i * LMP_i$$

~~$i=1$~~

~~where:~~

~~□ NZ is the number of Load buses in LAP j .~~

~~□ WZ_i is the load-weighting factor for bus i in LAP j . The sum of the weighting factors must equal 1 (i.e., 100 percent). These weights are based on State Estimator results for similar day.~~

~~Each LAP includes only the buses of Market Participants who are in the LAP and who have Load that is represented by that LAP's definition. Market Participants that have metered Load must either be settled at a Default LAP or a Custom LAP created for each Load point of the Market Participant (nodal Settlement).~~

Attachment C

October 25, 2012, Memorandum from Keith Casey to the ISO Board of Governors

California Independent System Operator Corporation

February 19, 2013

Memorandum

To: ISO Board of Governors

From: Keith Casey, Vice President – Market & Infrastructure Development

Date: October 25, 2012

Re: **Decision on Enhancements to Improve Price Consistency**

This memorandum requires Board action.

EXECUTIVE SUMMARY

Management is seeking Board approval of a proposal to implement three market functionality enhancements that will improve price and dispatch consistency in the ISO market. Pending approval from the Board of Governors and the Federal Energy Regulatory Commission, Management is targeting spring 2013 for implementing these changes.

Moved, that the ISO Board of Governors approves the proposal to implement the price consistency enhancements as described in the memorandum dated October 25, 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

The ISO market software optimizes supply and demand bids offered by scheduling coordinators to determine awards and prices for energy and ancillary services markets while respecting operational and market constraints. In a market solution, awards and prices are expected to be consistent with one another. In the simplest scenario, a supply bid is expected to be awarded only if the clearing price is equal to or greater than the bid-in price. Similarly, a demand bid should only be awarded if the clearing price is equal to or lower than the bid-in price. However, given the interplay of market design features, this expected outcome may not always be achieved. In some market solutions, the clearing price at an intertie location may not support the import or export award. In other market situations, physical or convergence bid

awards at trading hubs or default load aggregation points may not be consistent with bid-in prices.

While such price and dispatch inconsistencies are infrequent, the ISO has observed that most of them occur due to three specific situations. As a result, Management proposes to implement three enhancements that will address price inconsistencies arising from these three scenarios. These enhancements address several stakeholder concerns and increase the efficiency of the ISO market.

After careful consideration of input from stakeholders and ISO software developers, Management recommends that the price consistency enhancements listed below be incorporated into the tariff and ISO systems. The recommended solutions balance stakeholder feedback and system software capabilities to accommodate the enhancements.

Management recommends the following three enhancements to the market functionality:

1. *Use both awards and prices from the pricing run.*

Due to the way constraints are enforced in the market optimization, the ISO energy market requires two market runs, a scheduling run and a pricing run. Each run produces awards (dispatches) and prices. Currently, the binding awards are taken from the scheduling run while the binding prices are taken from the pricing run. Management proposes to use both awards and prices from the pricing run.

Under normal conditions when the solution can be achieved using submitted bids that are in the normal bid range of -\$30 and bid cap of \$1000, the outcomes between the scheduling and pricing runs are expected to be reasonably consistent to one another. However, in cases where a solution cannot be achieved using economic bids, the scheduling run uses administrative price parameters for relaxing market constraints (e.g., self-schedules) that are outside of the economical bid range but are necessary to adjust in order to achieve a market solution. These administrative price parameters are set to different levels for different market constraints to ensure such uneconomical adjustments are consistent with established priorities. When the market solution uses uneconomic parameters to achieve a solution, the resulting prices in the scheduling run would no longer strictly reflect economic bids but rather would reflect the higher administrative price parameters.

To achieve a solution that is reflective of economic bids, a pricing run is introduced. In the pricing run, the administrative parameters used in the scheduling run are replaced by parameter values that reflect the bid floor or cap depending on the nature of the scheduling run solution. The prices and schedules in the pricing run should be consistent with one another. As a result, Management proposes to use both the pricing and awards from the pricing run.

2. *Use a hard bid floor.*

Another reason for the inconsistency between the scheduling run and pricing run is due to the use of a soft bid floor. Under the current market rules, the bid floor is a soft floor such that bids below the bid floor may be submitted and are still included in the determination of the market solution. However, such bids below the bid floor are not allowed to set the price. Based on historical data, bids below the bid floor have been consistently submitted to the ISO market. A soft bid floor creates the opportunity for inconsistent price and bid awards at least for the resource that submitted the bid below the bid floor. Such bids may also create price inconsistencies for other resources elsewhere in the system.

To eliminate inconsistencies due to the soft bid floor, Management proposes to replace the soft floor with a hard bid floor. Management recommends making this change effective concurrent with the change of the bid floor from -\$30 to -\$150, as defined in the scope of the initiative for Renewable Integration: Market and Product Review, Phase I. Having a hard bid floor will eliminate the corresponding inconsistencies between the scheduling and pricing.

3. *Use a different price to settle default aggregate points and trading hubs.*

The third mechanism for price and award inconsistencies relates to how aggregate prices for default aggregate load points and trading hubs are formed. Currently, the price for such aggregations is determined based on the weighted average price of all constituent pricing nodes weighted by the quantity of load or supply at each node. As a result, an aggregate price may be affected by any redispatch adjustments the market software makes to resources at individual nodes that are effective in relieving congestion. Due to the way these aggregated scheduling points are used to manage congestion, the weighted average price of the constituent nodes may be inconsistent with the bid price of an awarded bid at an aggregated scheduling point.

To address this issue, Management proposes to use an aggregated price that is derived directly from the market optimization based on the effectiveness of the total aggregation on relieving congestion, rather than the weighted average price of the total awarded quantities at the constituent nodes, which is based on the effectiveness of individual nodes at relieving congestion. This change would minimize price inconsistencies arising from the use of weighted average prices. This enhancement will be applied to both the day-ahead market and real-time market.

POSITION OF PARTIES

The price consistency enhancements recommended herein received wide support from stakeholders. There was some concern raised over whether the proposed pricing changes for settling default load aggregation points and trading hubs might create opportunities for

exploitive market behavior. The ISO carefully considered this concern and concluded it would not pose a credible opportunity for such behavior due to the difficulty in effectively predicting when such a strategy would be profitable to engage in. To further address this concern, the ISO will apply the same aggregate pricing methodology to both the day-ahead market and the real time market. Nonetheless, it is something that Management will closely monitor. A stakeholder matrix is attached for your reference.

MANAGEMENT RECOMMENDATION

The enhancements proposed here will effectively address the three most common causes for pricing inconsistencies in the ISO market. These enhancements are designed to improve market efficiency and received wide support from stakeholders. For these reasons, Management recommends that the Board approve the proposed pricing enhancements described above.

Attachment D

November 1, 2012, Presentation to the ISO Board of Governors on the Decision on

Enhancement to Improve Price Consistency

California Independent System Operator Corporation

February 19, 2013

Decision on Enhancements to Improve Price Consistency

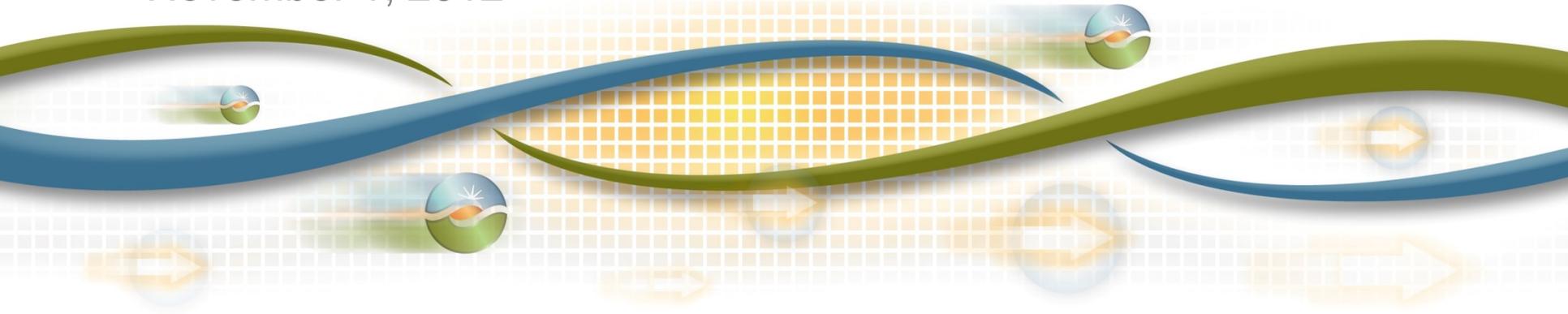
Mark Rothleder

Executive Director, Department Analysis and Development

Board of Governors Meeting

General Session

November 1, 2012



Issue to address:

In certain scenarios the ISO market has observed inconsistencies between prices and dispatches, which may lead to uneconomical awards.

Proposal:

Implement three enhancements to the ISO market functionalities in both the day-ahead and real-time markets to improve price consistency.

Issue	Enhancement
Scheduling run vs. Pricing run	Use MW and prices from the pricing run
Soft bid floor	Replace the soft bid floor with a hard bid floor concurrently with the change to -\$150
Aggregate price	Use aggregate price generated by optimization instead of weighted average price of constituent nodes of aggregation calculated outside of optimization

This proposal addresses price inconsistencies as a part of the ISO continued improvement process.

- Interplay of market functionalities may lead to price inconsistencies.
- While inconsistencies are infrequent, the integrated forward market and the hour ahead scheduling process may experience price inconsistencies.
- Price inconsistencies create uncertainty and risks.

Enhancement 1: Scheduling run vs. Pricing run

The interplay of the scheduling run and pricing run may lead to uneconomical awards.

Proposal:

Management proposes to use both MW awards and clearing prices from the pricing run

- Current setup of both runs will remain unaltered.
- Priorities and relaxations are already preserved in the pricing run.
- Use MW from pricing run in downstream processes.

Enhancement 2: Soft bid floor

A soft bid floor currently allows bids below $-\$30$ but such bids do not set price.

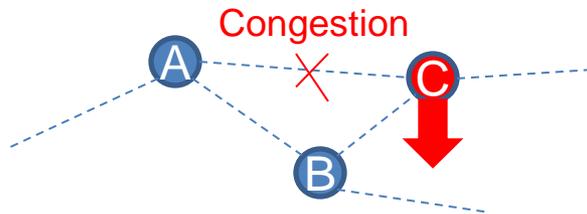
One reason for inconsistency between the scheduling run and pricing run is the use of a soft bid floor.

Proposal:

Management recommends to implement a hard bid floor concurrently with the implementation of the $-\$150$ bid floor.

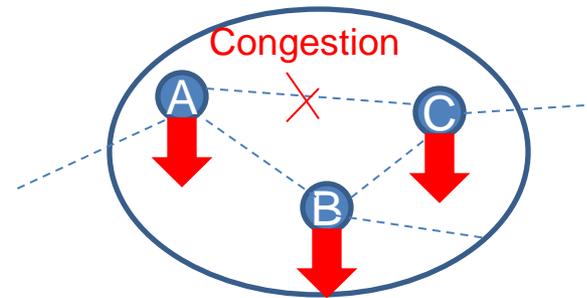
Enhancement 3: Use aggregate price produced by solution instead of weighted average price of individual nodes

Individual Node



- If load at C is effective, it can be moved independent of any adjustment at A and B

Aggregation



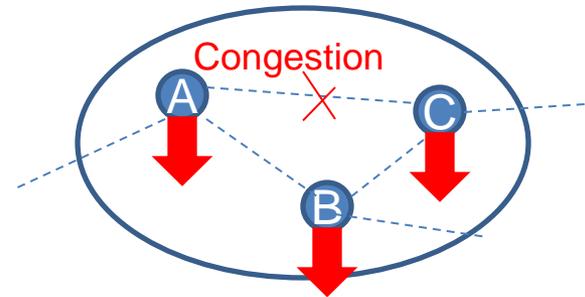
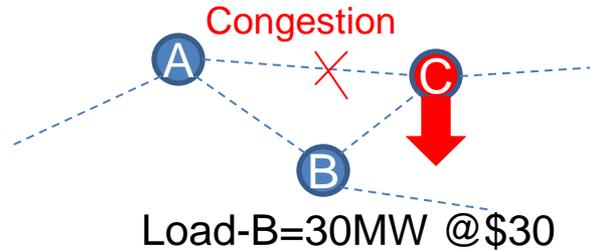
- Load at C can only move to relieve congestion if proportional movement at A and B is effective

Enhancement 3: Use aggregate price produced by solution instead of weighted average price of individual nodes

Load-C=40MW @ \$50
 Load C is effective at relieving congestion

Load-ABC=100MW @ \$30
 Aggregation ABC is NOT effective in relieving congestion

Load-A=30MW @ \$30



Current Aggregate Pricing	Proposed Aggregate Pricing
Weighted Average Price = $(30\text{MW} \times \$30 + 30\text{MW} \times \$30 + 40\text{MW} \times \$50) / 100\text{MW} = \$38.00$	Aggregate Price = \$30.00

This proposal is widely supported by stakeholders.

- Based on stakeholders' feedback the ISO:
 - Modified the proposal to address consistency concerns between day-ahead and real-time markets.
 - Considered concerns regarding potential exploitative opportunities created by proposed aggregate pricing mechanism.
 - Deferred publishing information regarding disconnected nodes due to concerns about potential exploitative opportunity.

Benefits of price consistency enhancements proposal:

- The enhancements will effectively address the three most common causes for pricing inconsistencies in the ISO market.
- The enhancements are designed to improve market efficiency and received wide support from stakeholders.

Management recommends that the Board approve the proposed pricing enhancements

Attachment E

Matrix of Stakeholder Comments Presented to the ISO Board of Governors Regarding the

Decision on Enhancements to Improve Price Consistency

California Independent System Operator Corporation

February 19, 2013

Stakeholder Process: Price Inconsistency Enhancements

Summary of Submitted Comments

Stakeholders submitted three rounds of written comments to the ISO on the following dates:

- Round One, 07/06/12
- Round Two, 08/16/12
- Round Three, 09/17/12

Stakeholder comments are posted at:

<http://www.caiso.com/informed/Pages/StakeholderProcesses/PriceInconsistencyMarketEnhancements.aspx>

Other stakeholder efforts include:

- Stakeholder Teleconference/Web Conference, June 26, 2012
- Comments on Issues Paper and Straw Proposal, July 6, 2012
- Stakeholder Meeting, August 9, 2012
- Comments on Revised Proposal, August 16, 2012
- Stakeholder Teleconference/Web Conference, September 10, 2012
- Comments on Final Proposal, September 17, 2012.

	Use both awards and prices from the pricing run	Implement a hard bid floor	Use prices produced by optimization to settle default load aggregation points and trading Hubs
Pacific Gas and Electric	No comment	No Comment	Conditional, Concerned with participants exploiting settlements differences between proposed aggregate prices and weighted average prices. Requires DMM be involved in analyzing exploitive opportunities.
Powerex	Support	Generally Support Suggest to use a symmetrical floor/cap bid	General Support Wants clarification how equivalent aggregate prices in the real-time will be calculated.
Southern California Edison	Support Suggest to monitor closely the mixed-integer programming gap	Support	Conditional, Suggest having the ability to have as a backstop to use weighted average prices if there are implementation barriers for the proposed pricing approach. Wants clarification on how congestion revenue rights will be priced and settled. Suggests to involve DMM in exploring arbitrage concerns.
SESCO	No comment	No comment	No comment
Six Cities	Support	Support	Support
Western Power Forum	Support	Support	Support
Management Response	The ISO already monitors the mixed-integer programming gap and will keep doing after the enhancement.	This stakeholder initiative did not undertake the analysis of the bid floor cap. Its proper value was part of another stakeholder initiative (Renewables Phase I). In the scope of the price inconsistency effort, it was only about the change from soft to a hard floor.	Although conceptually an arbitrage opportunity between the proposed aggregate price and weighted average price, the ISO and DMM carefully considered this concern and concluded it would not pose a credible opportunity for such behavior due to the difficulty in effectively predicting when such a strategy would be profitable to engage in. Furthermore, to further address concerns, the ISO will ensure the same aggregate pricing methodology proposed for the day-ahead market will be applied in the real time market. The ISO has consulted with DMM on this matter. The ISO will closely monitor.