
# Technical Bulletin

# 2010-01-05

# Price Validation

# January 20, 2010

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## 1 Description of Price Correction Process

Prior to and after posting market clearing prices, the California Independent System Operator Corporation (ISO) continuously monitors its energy and ancillary services markets solutions, which include the Integrated Forward Market (IFM) and the Residual Unit Commitment (RUC) process in the Day-Ahead Market, the Hour-Ahead Scheduling Process (HASP), and the Real-Time Market.[1] The ISO monitors its market solutions to identify anomalous resource commitment, dispatch levels, and prices that may have resulted from erroneous input data and/or hardware/software failure of the market applications. Consistent with the rules in Section 35 of the ISO Tariff and the procedures in Section 8 of the Business Practice Manual for Market Operations, the ISO may correct prices before and after initial posting to ensure that prices produced by the ISO market systems are consistent with the ISO Tariff and reflect all pertinent operational data and system conditions.

While the ISO makes every effort to ensure that prices are accurate and correct prior to posting, it is possible that even after prices are posted, the ISO may determine the prices were not calculated consistent with the ISO Tariff. In running the Day-Ahead Market, there is normally sufficient time to verify prior to posting whether the market solutions are accurate and if necessary, make any adjustments to prices. In contrast, in the real-time, the market run execution time frames are much shorter, which makes it impossible in most instances to verify whether the resulting prices are correct. Therefore, price corrections after posting may be necessary.

The ISO has developed price correction procedures that to the extent feasible will ensure that any price corrections necessary after the prices are posted will occur within the Price Correction Time Horizon. The current Price Correction Time Horizon is five calendar days after prices are initially posted. Only under limited circumstances, as described further in this document, may the ISO make a price correction after the Price Correction Time Horizon has elapsed.

Price corrections can be made by replacing prices for a given interval with prices from an adjacent interval, or by correcting prices at the specific resource level or Pricing Node level based on selective recalculation or market re-execution. For any Pricing Node level changes, all affected hubs and Load Aggregation Point (LAP) prices are also recalculated. The ISO also applies the maximum and minimum price restrictions provided in Section 27 of the ISO Tariff through the price correction process. Prices in excess of or less than the tariff specified maximum and minimum amounts, are first screened and capped at the $2500 and negative $2500 amounts. After posting the maximum or minimum amounts, the ISO verifies the accuracy of the market clearing

[1] Capitalized terms not otherwise defined herein have the meanings set forth in the Master Definitions Supplement, Appendix A to the currently effective ISO FERC Electric Tariff (ISO Tariff) or the Business Practice Manual for Definitions and Acronyms.

prices and either corrects them or, if they are correctly in excess of the tariff specified maximum or minimum amounts, leaves the prices at the maximum or minimum amounts.

Price corrections may be made to the following types for prices.

- ✓ Day-ahead Locational Marginal Price (LMP) at Pricing Nodes and aggregate Pricing Nodes
- ✓ Day-ahead resource-specific LMPs
- ✓ Day-ahead LMPs at Transmission Interfaces (branch group) or Scheduling Points
- ✓ Day-ahead Shadow Prices at Interties or Scheduling Points
- ✓ RUC resource-specific prices
- ✓ Day-ahead Ancillary Services Marginal Prices (ASMP)
- ✓ Real-time LMPs at Pricing Nodes and aggregate Pricing Nodes
- ✓ Real-time ASMPs at Pricing Nodes
- ✓ HASP Intertie LMPs at Scheduling Points
- ✓ HASP resource-specific prices
- ✓ HASP ASMPs (after implementation of the procurement of Ancillary Services in HASP functionality)
- ✓ Real-time LMPs at Transmission Interfaces (branch group) or Scheduling Points
- ✓ Real-time Shadow Prices at Interties or Scheduling Points

## 2 Price Changes due to Processing, Implementation and Technical Issues

The ISO adopted the current price correction procedures with the start of its new market design on April 1, 2009. However, certain changes in posted prices observed after the start of its new market were not due to price corrections made pursuant to the price corrections process, but rather were due to processing, implementation, or technical issues that resulted in the need to repost or to delay the posting of prices.

The following describes two situations where prices on OASIS were modified, which may have appeared to have resulted from a price correction, but in fact, there was no actual price correction for the affected intervals.

1. Certain price changes on OASIS occurred due to re-publications of the same data and resulted in no change in the prices. This was a result of the system architecture utilized under the new market design. More specifically, when the Market Quality System publishes its corrected market results data, the payloads are consumed by six other internal ISO systems. When the Market Quality System republishes a payload at the request from one system for synchronization purposes, as currently designed, all six systems receive the updates. As a result, an update designed to synchronize data in the settlement system may have had the appearance that a price correction was made outside of the Price Correction Time Horizon on OASIS, when in fact there was none.

2. Currently, market participants cannot distinguish price changes on OASIS that result from a price fill to a single missing Pricing Node from price changes for every Pricing Node for that same time interval. For example, the ISO may change a price due to a price correction in a single interval, which results in the republishing of other prices at other Pricing Nodes without an actual price change at those other Pricing Nodes. This functionality limitation may create the appearance that prices were corrected for all intervals, when in fact they were only corrected for a single interval.

## 3 Summary Report of Price Corrections Made Since April 1, 2009

For the period April 1 – October 31, the ISO has corrected only 1.2% of the total Pricing Node prices published. Almost all of these price corrections were made within the Price Correction Time Horizon. These corrections fall in the following general categories:

- Defect – a software defect contributed to invalid prices.

- Tariff – the software did not calculate prices as required by the ISO Tariff. Therefore, the ISO adopted procedures to ensure that price corrections within the Price Correction Time Horizon captured the actual price until a redesign of the process or software, or a change in the tariff were adopted.

- Calculation – an error occurred in the development of a constraint equation or in the calculation of a constraint limit, resulting in congestion that did not physically exist.

- Constraint Application – a constraint was enforced by mistake either because the constraint was applied for an equipment outage that was expected to occur at the time, because they were redundant with other constraints, or because they did not apply to the grid facilities under ISO control. These errors resulted in congestion that did not physically exist.

- Forecasting – errors in the forecasting of load or distribution of load resulted in price spikes or in congestion that did not physically exist.

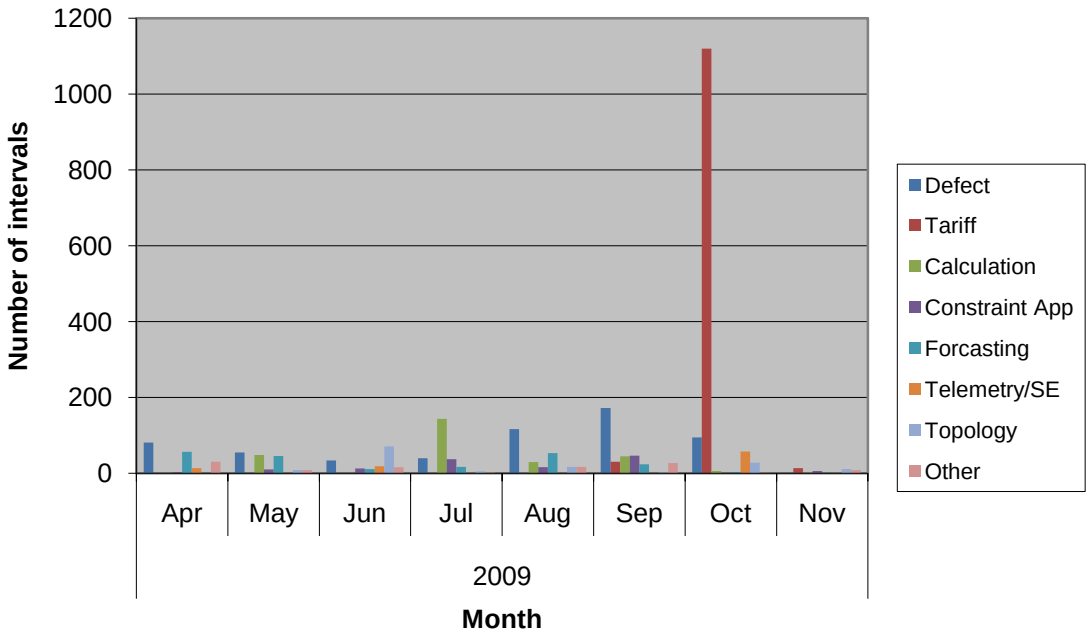
- Telemetry/SE – errors in equipment telemetry or state estimator solutions contributed to invalid results.

- Topology – switching status errors in the network model contributed to invalid results. For example, a breaker was modeled as open when in reality it was closed.

- Other – other issues, including system maintenance (switching between network models), data entry errors, and database errors.

A comparison of these corrections on an interval basis, i.e. number of intervals in which a correction has taken place, is shown in Figure 1.

**Figure 1: Corrections by Type**

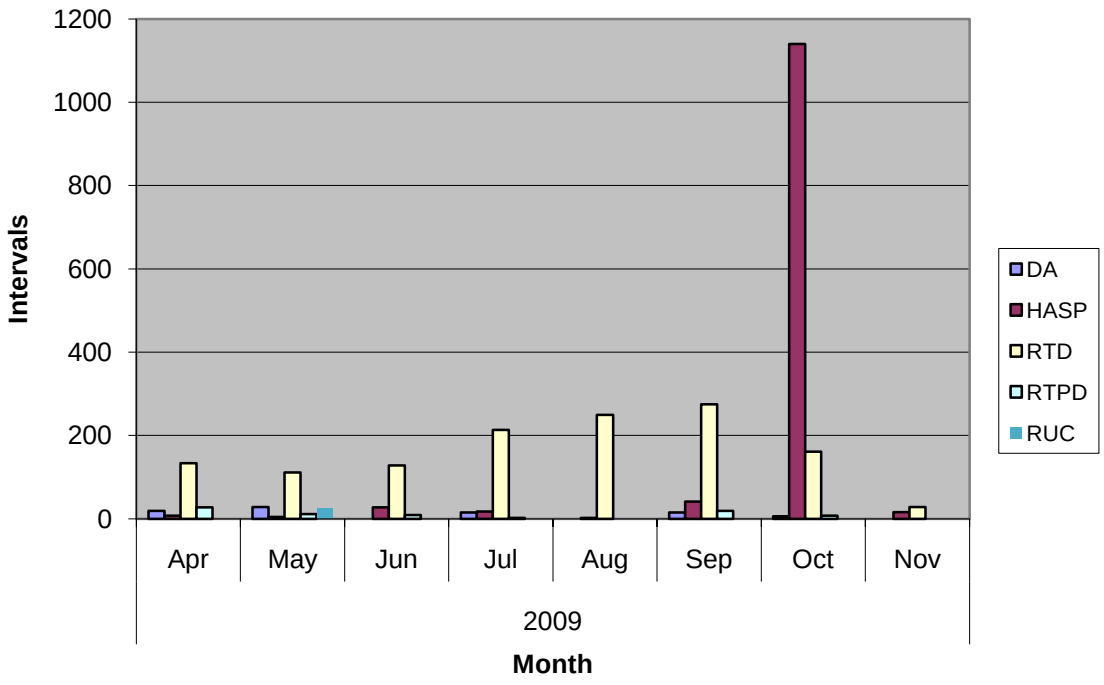



The largest contributor, on an interval basis, was tariff-related issues. The bulk of these price corrections were due to a lack of functionality that prevents the ISO from removing bids at locations were the ISO had posted a zero Operating Transfer Capability (OTC) in both directions at an intertie. The tariff does not allow bidding on an open intertie (where the OTC limit is zero in both the import and export directions) and an automated process that would remove bids in these situations has not yet been implemented. Although the ISO has a manual process for removing bids that are submitted at such locations in the Day Ahead Market, a day-of manual process for the HASP and Real-Time Market has proved to be problematic due to tight market timelines.

Another major contributor is software defects. In particular, the corrupted shift factor issue, where shift factors were inadvertently read from two different Real-Time Unit Commitment (RTUC, also at times referred to as the real-time pre-dispatch process) solutions into the Real-Time Dispatch in the Real-Time Market. The wrongly selected shift factors resulted in an erroneous price. This error made up the vast majority of defect-related corrections in August through September 24, 2009, when a defect fix was placed into production eliminating the erroneous selection of the shift factors.

A comparison between the different markets, on an interval basis, is shown in Figure 2. Most of the corrections were made in the Real-Time Market, partly because the timeline of the Day-Ahead Market allows for input related issues to be resolved before publishing occurs, and partly because the real-time contains more inputs, such as state estimator generation, and involves coordination of data between the Real-Time Dispatch and RTUC processes, which may result in more opportunities for input error.

**Figure 2: Corrections by Market**




In large part, the corrections in the HASP were due to the open tie issue described earlier.

## 4 Post-Price Correction Process Time Horizon Price Changes

As provided in Section 35.3 of the Tariff and in Section 8 of the BPM for Market Operations, the ISO may only make price corrections beyond the Price Correction Time Horizon under limited circumstances. Specifically, Section 35.3 provides that "prices for each Trading Day shall be considered final for purposes of this Section 35 once the price correction process for that Trading Day has ended, except that the CAISO may adjust, recalculate, or otherwise correct such prices after the conclusion of the price correction process to the extent authorized by the provisions of the CAISO Tariff other than this Section 35." This provision is necessary to allow the ISO to re-run or adjust prices so that they are consistent with other tariff authority. If it is determined that the ISO has not applied prices consistent with its tariff requirements, it may be necessary to modify prices after the Price Correction Time Horizon to ensure that the ISO provides service consistent with the rates, terms and conditions of service specified in its tariff.

## 5 Summary Report of Post-Price Correction Time Horizon Changes Made Since April 1, 2009

Since the new market design was implemented on April 1, 2009, through the end of 2009 there were isolated instances where prices were updated outside of the price correction time horizon. These corrections can be grouped into the following categories:

1. Corrections outside of the Price Correction Time Horizon where there was an error that rendered the posted prices inconsistent with a specific tariff requirement. Reasons for these changes were provided in an associated market notice. For example, the recalculation and republication of trading hub prices as a result of the weighting calculation error identified shortly after the start of the new market.

2. Updates for corrections outside of the Price Correction Time Horizon where a defined ISO correction process was rerun due to a computer system issue or failure. While all these should have also been accompanied by a market notice, in some instances notification only occurred in the Market Issues Forum. Two examples of a price correction process impacted by system availability issues include the Southern Participating Transmission Owner correction[2] and the Integrated Balancing Authority Area losses adjustments.[3] When these isolated

[2] Section 27.1.1.2 of the ISO Tariff states "The CAISO Controlled Grid facilities outside the CAISO Balancing Authority Area, the CAISO shall assess the cost of Transmission Losses to Scheduling Coordinators using each such facility based on the quantity of losses agreed upon with the neighboring Balancing Authority multiplied by the LMP at the PNode of the Transmission Interface with the neighboring Balance Authority Area."

[3] The details for the Integrated Balancing Authority Area losses adjustment are specified in Section 27.5.3 of the Tariff for scheduling coordinators that certify that a) the transaction used either the California-Oregon Transmission Project or Western Area Power Administration (Western)

corrections were rerun for specific resources, there was an appearance that OASIS updated all prices (see section 7 of this document for a discussion on OASIS publishing improvements).

Since April 2009, a total of eight market notices have been released, covering post Price Correction Time Horizon corrections in various markets.

**Table 1: Summary of Post-Price Correction Time Horizon Changes**

| Description | Market | Trade Date | Date Corrected | Intervals Affected |
|---|---|---|---|---|
| Trading Hub recalculation<br>Market Notice Title: Revised Trading Hub Prices<br>Posted June 8, 2009 | All | Various | Various | Many |
| Incorrect load distribution factors used in IFM<br>Market Notice Title: Day Ahead Price Corrections for May 2, 2009<br>Posted June 4, 2009 | IFM, RUC | 5/2/09 | 6/4/09 | One Trade Date |
| Internal miscommunication of correction. Correction identified within the Price Correction Time Horizon but not processed.<br>Market Notice Title: Day Ahead Default LAP Price Adjustments for May 11 and May 12, 2009<br>Posted June 4, 2009 | IFM, RUC | 5/11/09, 5/12/09 | 6/4/09 | Two Trade Dates |
| Internal miscommunication of correction. Correction identified within the Price Correction Time Horizon but not processed.<br>Market Notice Title: Real-Time Periodic Dispatch Price Correction for 6/8/09<br>Posted June 18, 2009 | RTUC | 6/8/09 | 6/17/09 | One interval |
| Data processing error. Correction identified within the Price Correction Time Horizon but not processed.<br>Market Notice Title: HASP Price Corrections for April 22 and April 23, 2009<br>Posted June 30, 2009 | HASP | 4/22/09 and 4/23/09 | 6/26/09 | Five hours |
| Recalculated prices because scheduling run prices were erroneously used for correction instead of pricing run prices.<br>Market Notice Title: Price Corrections for May 19, May 22, May 27, May 29 and June 10, 2009<br>Posted July 13, 2009 | RTD | Various | 7/13/09 – 7/16/09 | Twelve intervals |
| Due to technical issues, operators were not able to incorporate a contingency event in the market. The issue was identified within the correction timeline, but was not made until afterwards.<br>Market Notice Title: Real-Time Market Price Corrections for April 17, 2009<br>Posted July 17, 2009 @10:48am | RTD | 4/17/09 | 7/16/09 | Four intervals |

transmission facilities, and b) the transaction will be charged for losses by either Western or the Transmission Agency of Northern California.

| Description | Market | Trade Date | Date Corrected | Intervals Affected |
|---|---|---|---|---|
| Correction identified within the Price Correction Time Horizon but not processed.<br>Market Notice Title: HASP Price Corrections for June 26, 2009<br>Posted July 21, 2009 | HASP | 6/26/09 | 8/5/09 | One hour |

In addition, in the fall of 2009, the ISO implemented a change to its pricing mechanism to determine the applicable price of a disconnected Pricing Node. This price alignment became effective as of trade date August 1, 2009, and revised prices were published to OASIS and the settlements system starting on November 4, 2009. While this was not considered a price change under the Tariff Section 35.3, disconnected node prices were updated and their associated trading hubs recalculated. A market notice on this event titled "Disconnected PNode Price Alignment**"** was posted November 3, 2009 at 1:47pm.

## 6 Process for Price Corrections Identified through Valid Settlements Disputes

Market participants have the ability to dispute their settlements, which is approximately 30 days after the end of the Price Correction Time Horizon. After the start of the new market, the ISO's business practice of correcting prices identified through valid disputes and of republishing the corrected prices to OASIS has remained largely the same to its prior practice. In the event dispute research shows that an incorrect resource level price was used in the settlements calculation, the ISO corrects the resource level price within Market Quality System and then re-publishes the corrected price to CMRI and the settlements system for accurate settlement statements. In the event dispute research shows that the root cause of the pricing issue impacted the entire market, the ISO makes the price corrections via the Market Quality System and republishes the correct prices to OASIS, CMRI and the settlements system. In addition, a market notice is issued to alert participants.

From trade dates April 1 through September 30, the ISO has received 608 disputes where price discrepancy was given as the dispute reason. Two percent of these disputes impacted the general market price. The remaining 98 percent were resource specific prices or were due to a price mismatch between OASIS and the settlement system.

## 7 Recent Improvements to the Price Correction and Publication Processes

Since the start of its new market design, the ISO has improved a number of business processes that also improve the performance of its price corrections process:

1. A significant improvement was made in the processing and publishing of price corrections. As a result of price synchronization issues described earlier in section 2 of this document, the ISO improved its publishing processes. More specifically, after the start of its new market design, the ISO often republished

prices on OASIS which appeared to be outside of the Price Correction Time Horizon. Table 2 shows this improvement, indicating that the ISO dramatically reduced the number of republishing events since August 8, 2009. More specifically, an analysis of the publishing logs reveals that Day-Ahead Market republishing was reduced to a total of five intervals since August 8, 2009 and Real-Time Market republishing was reduced to a total of 19 publishing events (or 679 intervals) down from 43,192 intervals prior to August 8, 2009. In other words, events after August 8, 2009, represent less than 1.5 percent of the republishing.

**Table 2: Summary of Number of Republishing Events**

| Market Type | Sum of Number of Intervals | Sum of Number of Publishing |
|---|---|---|
| **Day-Ahead Market** | | |
| Before 8/8/09 | 59 | 58 |
| After 8/8/09 | 5 | 5 |
| Day-Ahead Market Total | 64 | 63 |
| **Real-Time (including HASP and the Real-Time Market)** | | |
| Before 8/8/09 | 43,192 | 186 |
| After 8/8/09 | 679 | 19 |
| Real-Time Total | 43,871 | 205 |
| **Grand Total** | 43,935 | 268 |

2. To reduce the number of corrections being made, ISO staff implemented a proactive process for reviewing congestion in the real-time market. In many cases a new congestion point is now reviewed in the same hour in which it occurs. When problems are identified, they tend to be resolved within hours, thus reducing the scope of corrections. This process reduced the number of corrections for the month of November.

3. ISO staff made several process improvements to the price correction process, including secondary review of corrections and tool enhancements that help identify data inconsistencies. These new processes have greatly reduced the number of erroneous corrections.

## 8 OASIS Posting Improvements

In early December, the OASIS team implemented an improved monitor to ensure that OASIS does not have missing data. This monitor utilizes a sampling approach to ensure all results are posted to OASIS completely and accurately.

A second effort is also underway to improve the message log information provided on OASIS. As mentioned previously, in the current implementation an update of

corrected data from the Market Quality System of one single Pricing Node is noted no differently than a change of every Pricing Node for that same time interval. At present, the message log only notes a generic “Updated” message regardless of the size or magnitude of the update. This log will be updated with more meaningful data as follows for the following three general categories:

1. Republishing for internal systems where no price changes were made.

2. Updates for specific Pricing Nodes or resources where the specific price corrections can be noted.

3. Updates for corrections outside of the Price Correction Time Horizon either due to an error that rendered the prices inconsistent with the tariff or a processing issue occurred.

The improved OASIS log should reduce any confusion and provide better information for market participants to distinguish which of the above types of OASIS updates are occurring. This enhancement is expected to be implemented in the first quarter of 2010.