# TECHNICAL BULLETIN

# Market Impact of Partial Failure of the Local Market Power Mitigation Process

# September 5, 2013

# Revision History

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| 2013-09-4 | 1.0 | | Xu, Lin |

*Note:* **Consistent with Attachment G to the Business Practice Manual For Market Operations, the purpose of this technical bulletin is to provide the ISO's market participants with information concerning the partial failure of the ISO's local market power mitigation application between December 13, 2012 and February 20, 2013.**

# Contents

## Executive Summary

As part of the ISO's local market power mitigation (LMPM) process,  the ISO employs the residual supply index (RSI) test to determine whether a constraint is competitive or non-competitive.  The RSI test involves calculating demand for counterflow and the fringe supply for counter flow for each binding flowgate and nomogram constraint as set forth in ISO tariff section 39.7.2.2.  From December 13, 2012 to February 20, 2013, the RSI was incorrectly calculated in the day-ahead market resulting in constraints managed by flowgates to be treated as competitive.  The ISO performed a market impact assessment to determine the extent to which bids that should have been mitigated were not mitigated and determined that the impact was limited to two trading days: December 14, 2012 and January 11, 2013.

As explained in more detail below, the ISO used two methods to determine the market impact depending on whether the ISO was able to use the offline RSI calucation or had to rerun the market.  First, because January 11, 2013 was a day with unrelated modeling errors, which would make the offline RSI invalid, the ISO had to rerun the market, including the LMPM process, which generated RSI values for both flowgates and nomograms.  For this day, the ISO estimated the cost impact to load of $577,000 in higher compensation paid to suppliers as a result of the incorrect RSI calculation and lack of bid mitigation.  For the other 66 days, the ISO was able to use offline RSI calculation to estimate the market impact.  The ISO concluded that 25 of the 66 days had binding non-competitive flowgate constraints, and thus mitigation could be triggered.  Among these 25 days, there was only one day (December 14, 2012) where bids were high enough for bid mitigation to have actually occurred.  The ISO estimated the impact to load to be $390,000 in higher compensation paid to suppliers for the day of December 14, 2012 as a result of the incorrect RSI calculation.  Thus, for the 67 days involved, the total market impact in terms of the incremental higher cost paid by load is estimated to be $967,000.  The ISO did not issue any price corrections, and does not plan to do so due to the relatively immaterial market impact and that fact that the impact was broady distributed over many hours and market participants.

## Background

The purpose of this technical bulletin is to explain the partial failure of the local market power mitigation (LMPM) process that occurred between December 13, 2012 and

February 20, 2013 and to provide an assessment of the market impact caused by the partial failure.  The partial failure concerned a component of the new features implemented in the day-ahead market in April 2012 by which the ISO determines, dynamically, whether a constraint is competitive or non-competetive.

The new LMPM implemented in April 2012 consists of two important parts: one is to use the non-competitive component of the locational marginal price (LMP) as the local market power indicator; the other is to assess the competitiveness of each constraint dynamically as part of the LMPM process, also known as the dynamic competitive path assessment (DCPA).  The day-ahead market starts with the LMPM run, which co-optimizes energy and ancillary services using the original bids.  For each binding transmission constraint, the residual supply index (RSI) is calculated to determine whether the residual supply is competitive.  RSI is defined as the ratio of the fringe counter flow and the original counter flow supply as set forth in ISO tariff section 39.7.2.2.  The fringe or residual counter flow is the counter flow provided by the remaining capacity after the three largest suppliers are completely removed from the market.  The purpose of RSI is to see if the residual supply capacity is sufficiently competitive to manage congestion to the same extent in terms of counter flow as the original counter flow supply.  There are three possible RSI outcomes:

- RSI >= 1 means sufficient residual counter flow supply is available, and the constraint is competitive,

- 0 =< RSI < 1 means insufficient residual counter flow supply is available, and the constraint is non-competitive,

- RSI is undefined because the original counter flow supply is zero.  The constraint is deemed competitive in this case.

Given the RSI results of constraint competitiveness, we can further decompose the LMP congestion component from the LMPM run into:

- a competitive congestion component, which reflects the impact of congestion from only competitive constraints, and

- a non-competitive congestion component, which reflects  the impact of congestion from only non-competitive constraints.

The non-competitive congestion component is an indicator of potential market power, because the non-competitive constraints may allow resources to increase their bid

prices and inflate the congestion price component of the LMP. The resource LMP without a non-competitive congestion component is a competitive LMP free of market power. The ISO will mitigate each resource with an LMP that includes a non-competitive congestion component down to the higher of its default energy bid or the competitive LMP from the market mitigation run. The mitigated energy bids are then used to clear the integrated forward market.

## Partial LMPM Failure

From December 13, 2012 to February 20, 2013, the RSI for constraints managed with flowgates[1] in the day-ahead market were calculated incorrectly due to a software failure that was not detected until February. Specifically, the shift factors for flowgates, which are a critical input for determining congestion, were not provided to the DCPA calculation process. It was later determined that the software failure began when a software patch for an entirely different purpose was applied on December 13, 2012. During this period, the counter flow supply was calculated at zero because of the missing shift factors, which caused the RSI to be undefined. As a result, all binding flowgate constraints were deemed competitive in the day-ahead market. The RSI calculation for constraints managed by nomograms was not affected by the issue, and was calculated correctly. The problem affecting flowgates was fixed by another patch, which was applied to production on February 21, 2013.

## Market Impact Analysis

The ISO performed a market impact assessment consisting of the following steps:

1. An offline RSI calculation was performed, to identify the non-competitive constraints except for January 11, 2013. Because the offline RSI calculation could not be executed for January 11, 2013 due to market model errors, the ISO reran the market power mitigation and IFM from savecase for that day.

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[1] Because the partial LMPM failure did not affect constraints managed by nomograms, the problem was not readily observable. The ISO has implemented monitoring measures to monitor flowgates and nomograms separately to identify problems affecting only one type of constraint immediately..

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2. The ISO then performed spot checks and reruns for days with congestion on major paths including path 26 and path 15 to validate the robustness of the offline RSI results. In addition, the ISO's Department of Market Monitoring (DMM) developed the offline RSI calculation tool for validation and monitoring purposes. Based on historical observations, DMM has concluded that the offline RSI calculation benchmarks were well withinthe production RSI calculation. Accordingly, the ISO has confidence in the validity of the results using the offline RSI tool.

3. For each resource, the ISO calculated non-competitive congestion component and the competitive LMP based on the offline RSI results.

4. The ISO then identified resources that

   • had a positive non-competitive congestion component, and

   • submitted bids higher than the competitive LMP for at least one segment.

5. For each day that has at least one resource that met the criteria in step 4, the ISO reran the market, including the LMPM process, from the savecase, and compared the mitigation and IFM results with the original savecase.

The ISO provides the following additional detail concerning the steps summarized above. The first step of the market impact assessment was to run the offline RSI calculation to identify the non-competitive flowgates in the 67 day period. However, the offline RSI calculation could not be applied to January 11, 2013 because the market model was changed subsequently as a result of the need for price corrections for an unrelated input error.[2] As a result, the data source for the offline RSI calculation is not available because it does not capture price corrections. Therefore, the ISO reran the market power mitigation process and IFM in order to determine the market impact for January 11, 2013 and concluded that mitigation should have occured. For the rest of the 66 days, the ISO listed the non-competitive constraints and the number of binding hours based on the offline RSI calculation in Table 1.

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[2] Price corrections on this day were due to the wrong constraint limit for path 26 being enforced in the market. The RSI issue was not fixed when the price corrections were made, so the corrected prices were still based on incorrect RSI results.

| Non-competitive flowgates | Hours |
|---|---|
| 22192_DOUBLTTP_138_22300_FRIARS_138_BR_1_1 | 18 |
| 22356_IMPRLVLY_230_22360_IMPRLVLY_500_XF_80 | 7 |
| 22569_NCMTGTAP_138_22264_ESCNDO50_138_BR_1_1 | 6 |
| 22768_SOUTHBAY_69.0_22352_IMPRLBCH_69.0_BR_1_1 | 5 |
| 24137_SERRANO_230_24154_VILLAPK_230_BR_1_1 | 8 |
| 24804_DEVERS_230_24806_MIRAGE_230_BR_1_1 | 1 |
| 25406_J.HINDS_230_24806_MIRAGE_230_BR_1_1 | 37 |
| 30550_MORAGA_230_30554_CASTROVL_230_BR_1_1 | 20 |
| 30630_NEWARK_230_30703_RAVENSWD_230_BR_1_1 | 1 |
| 31336_HPLNDJT_60.0_31206_HPLNDJT_115_XF_2 | 8 |
| 33020_MORAGA_115_30550_MORAGA_230_XF_1A_P | 10 |
| 33310_SANMATEO_115_33315_RAVENSWD_115_BR_1_1 | 11 |
| 33378_WTRSHTPA_60.0_33380_JEFFERSN_60.0_BR_1_1 | 10 |
| IVALLYBANK_XFBG | 9 |
| SOUTHLUGO_RV_BG | 3 |

Table 1: non-competitive flowgates based on offline RSI calculation

To minimize possible false negatives of the offline RSI calculation, the ISO spot-checked nine days that involved congestion on major flowgate constraints including path 26 and path 15 against the production RSI. The offline RSI deemed these major flowgate constraints to be competitive, but the ISO re-executed the production DCPA function on the selected nine savecases to validate the offline RSI results. The results are shown in Table 2. For these nine days, the offline RSI correctly deemed these major flowgates as competitive. This validates the quality of the offline RSI calculation. Given the quality of the offline RSI calculation, the ISO believes the offline DCPA results can be relied on to assess the market impact of the software failure for the 67 day period.

| Rerun date | Major flowgate | Offline RSI | Production RSI |
|---|---|---|---|
| 01/08/2013 | PATH15_BG | Competitive | Competitive |
| | SCE_PCT_IMP_BG | Competitive | Competitive |
| 01/09/2013 | SCE_PCT_IMP_BG | Competitive | Competitive |
| 01/12/2013 | PATH15_BG | Competitive | Competitive |
| | SCE_PCT_IMP_BG | Competitive | Competitive |
| 01/13/2013 | SCE_PCT_IMP_BG | Competitive | Competitive |
| 01/14/2013 | PATH26_BG | Competitive | Competitive |
| | SCE_PCT_IMP_BG | Competitive | Competitive |
| 01/15/2013 | PATH15_BG | Competitive | Competitive |
| | PATH26_BG | Competitive | Competitive |
| | SCE_PCT_IMP_BG | Competitive | Competitive |
| 01/19/2013 | SCE_PCT_IMP_BG | Competitive | Competitive |
| 01/31/2013 | SCE_PCT_IMP_BG | Competitive | Competitive |
| 02/13/2013 | SCE_PCT_IMP_BG | Competitive | Competitive |

Table 2: RSI spot checking

Among the 67 days of RSI failure, the offline RSI assessment tool resulted in at least one non-competitive flowgate constraint for 25 days where the constraints were binding. For each of the 25 days, the ISO decomposed each resource's LMP into four components:

$$LMP = LMP^{EN} + LMP^{CC} + LMP^{NC} + LMP^{LS}$$

where

$LMP^{EN}$ is the energy component,

LMP$^{CC}$ is the competitive congestion component,

LMP$^{NC}$ is the non-competitive congestion component,

LMP$^{LS}$ is the loss component.

Note that for market power mitigation purpose, the reference bus for LMP decomposition is the Midway 500 KV bus if the path 26 flow is from north to south, or the Vincent 500 KV bus if the path 26 flow is from south to north. The LMP non-competitive congestion component is the sum of the shift factor times the constraint shadow price over all non-competitive constraints. All resources with positive non-competitive constraints are subject to mitigation. After the resources subject to mitigation were identified, the ISO calculated each resource's competitive LMP as

LMP$^{COMP}$ = LMP$^{EN}$ + LMP$^{CC}$ + LMP$^{LS}$. A resource subject to mitigation was mitigated (i.e. bids being modified) if the resource's bids are higher than both the competitive LMP and its default energy bid (DEB). In other words, a resource subject to mitigation will not trigger mitigation if the resource's bids are below the competitive LMP. Among the 25 days with non-competitive constraints, there was one day that resources had bids above the competitive LMP, which was December 14, 2012. Bid mitigation should have been triggered for this day but no bid mitigation occurred. The ISO then reran the market power mitigation process and IFM from savecases for December 14, 2012 to determine the market impact.

The entire market impact assessment process is illustrated in Figure 1. In summary, there are only two days where mitigation should have occurred:
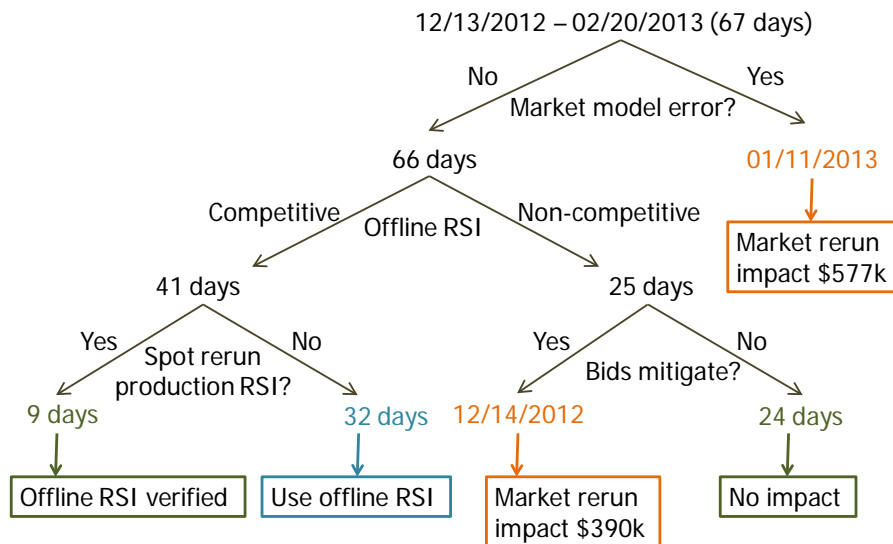
- December 14, 2012

- January 11, 2013

Figure 1: Market impact assessment decision tree.

The rerun results are shown in Table 3.  Failing to mitigate market power due to RSI failure resulted in load paying more than it would have if mitigation had occurred. Payment by load to suppliers would have been $390,000 less for December 14, 2012 and $577,000 less for January 11, 2013.  Accordingly, the total market impact on load payment resulting from the partial LMPM failure due to incorrect RSI calculation in the day-ahead markets from December 13, 2012 to February 20, 2013 is estimated to be $967,000.

| Date | Non-competitive flowgates | Delta load payment (load*LMP) |
|------|---------------------------|-------------------------------|
| 12/14/2012 | SOUTHLUGO_RV_BG  IVALLYBANK_XFBG | −$390,000 |
| 01/11/2013 | PATH15_BG | −$577,000 |

Table 3: Missed mitigation

## Monitoring Metrics

After the issue was identified, the ISO developed additional metrics to closely monitor abnormal RSI values.  If a similar issue happens in the future, the monitoring metrics will be able to identify and resolve it in a timely manner.