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## TECHNICAL BULLETIN

# Flexible Ramping Constraint Penalty Price In the Fifteen Minute Market

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## Revision History

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## Executive Summary

This technical bulletin provides the background and analyses that lead to the ISO's setting of the flexible ramping constraint penalty price in the Fifteen Minute Market (FMM). The FMM will be in production starting May 01, 2014 as part of the FERC Order No. 764 market design changes. One significant change from the current market design is that the energy award difference between the Integrated Forward Market (IFM) and the FMM will be settled at the FMM price. The ISO has observed price divergence between the Real-Time Unit Commitment (RTUC) and the Real-Time Dispatch (RTD). The price divergence is largely correlated with the flexible ramping constraint (FRC) shadow price. The FRC is a constraint implemented in the RTUC to procure 15-minute ramping capability to handle real-time net load variability and uncertainties. The FRC may either commit units, or redispatch resources to make room for 15-minute ramping capability. When the FRC redispatches, the opportunity cost from the out of merit dispatch will manifest itself in the shadow price of the FRC. Unit commitment, as opposed to RTUC redispatch, has been most effective to improve dispatch flexibility.

Under today's market, the RTUC energy price is only advisory and does not have an economic consequence. Under the FERC Order No. 764 market design the FMM price is financially binding and therefore the price divergence between the FMM and RTD should be addressed. The ISO performed analyses to tune the FRC penalty price setting to minimize the price divergence. The FRC penalty price will allow the FRC to be relaxed if the redispatch cost exceeds the penalty price, and the FRC shadow price is set at the FRC penalty price should any relaxation occur. Based on analyses of FRC effectiveness in reducing power balance violations and in committing units, the ISO plans to reduce the FRC penalty price from its current value of \$247 to \$60 starting May 01, 2014. The ISO will continue to monitor the FRC performance, and its impacts on the FMM, and make adjustments accordingly if the need arises in the future. In addition, the ISO will start soon the stakeholder process of the flexible ramping product, which is a superior design to permanently replace the FRC.

## Background

On December 13, 2011, the ISO implemented a new flexible ramping constraint in the market optimization to address certain observed reliability and operational issues. The ISO has observed that the unit commitments and dispatch levels in real-time lack sufficient ramping capability and flexibility to meet system conditions in the five minute market when the system conditions have changed from the assumptions made in RTUC. To address this issue, the ISO enforces the FRC in the fifteen minute RTUC process to ensure ramping capability is available to be used by the five minute real-time dispatch. If the FRC requirement is not already met, there are two way to satisfy the FRC requirement in RTUC: by committing more units, or by redispatching resources out of merit so that more economic fast resources are held back from their economic dispatch level to free up ramping capability. When the FRC redispatches, the opportunity cost from the out of merit dispatch will manifest itself in the shadow price of the FRC.

The unit commitments driven by the FRC are binding and passed to RTD for 5-minute granularity dispatch, so the unit commitment portion of the FRC is effective in addressing RTD ramping needs. In contrast, the out of economic merit order pre-dispatches driven by the FRC are not operationally binding in RTUC and may be partially unwound in RTD, because RTD does not model the FRC in the binding interval but FRC is increasingly enforced in subsequent advisory intervals of RTD. Therefore, the redispatch portion of FRC is less effective than additional unit commitment to RTD. This ineffective redispatch has been referred to as “phantom” ramp by the Market Surveillance Committee<sup>1</sup>.

Resources which resolve the flexible ramping constraint are compensated based upon the formula agreed to through the FERC settlement process which is capped at \$800 and based upon the maximum of the resource’s spinning reserve price or the shadow price of the constraint.

## Need for Adjustment of Shadow Price

The ISO has recognized the existence of “phantom” ramp in the context of the current market, which is not currently an issue because the RTUC is not a financially binding energy market. With the introduction of the FMM on May 1, 2014, the energy award difference between the IFM and the FMM will be settled at the FMM price. RTUC performs a multi-

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<sup>1</sup> [http://www.caiso.com/Documents/Order764Implementation-MS\\_C\\_Presentation.pdf](http://www.caiso.com/Documents/Order764Implementation-MS_C_Presentation.pdf)

interval optimization extending between 4 and 7 fifteen minute intervals. The FMM is created by calculating financially binding energy schedules in the second RTUC interval which is 37.5 minutes prior to flow. This allows the market results to align with WECC e-Tag submission deadlines for schedules changes of imports and exports. In the Department of Market Monitoring's Q3 2013 Report on Market Issues and Performance, the DMM identified divergence between the RTUC price and the RTD price.<sup>2</sup> Under the new market design, the price divergence is a concern because the RTUC price will become financially binding in the FMM. The DMM recommended that the ISO place a high priority on addressing the issue prior to implementation of the FERC Order No. 764 market design changes in Spring 2014.

The ISO has observed that the price difference between the RTUC and the RTD is strongly correlated with the FRC shadow price. Figure 1 and Figure 2 plot the hourly average RTUC and RTD system wide energy prices against the FRC shadow price using September 2012 to August 2013 market data. Figure 1 includes all real-time intervals, while Figure 2 only includes intervals when the FRC has positive shadow prices. As shown in Figure 1 and Figure 2, the RTUC and RTD price divergence moves in the same direction with the FRC shadow price, and is about the same magnitude. This suggests that the FRC might be a main driver for the RTUC and RTD price divergence, and the costly but potentially ineffective pre-dispatch in RTUC may have resulted in higher RTUC prices.

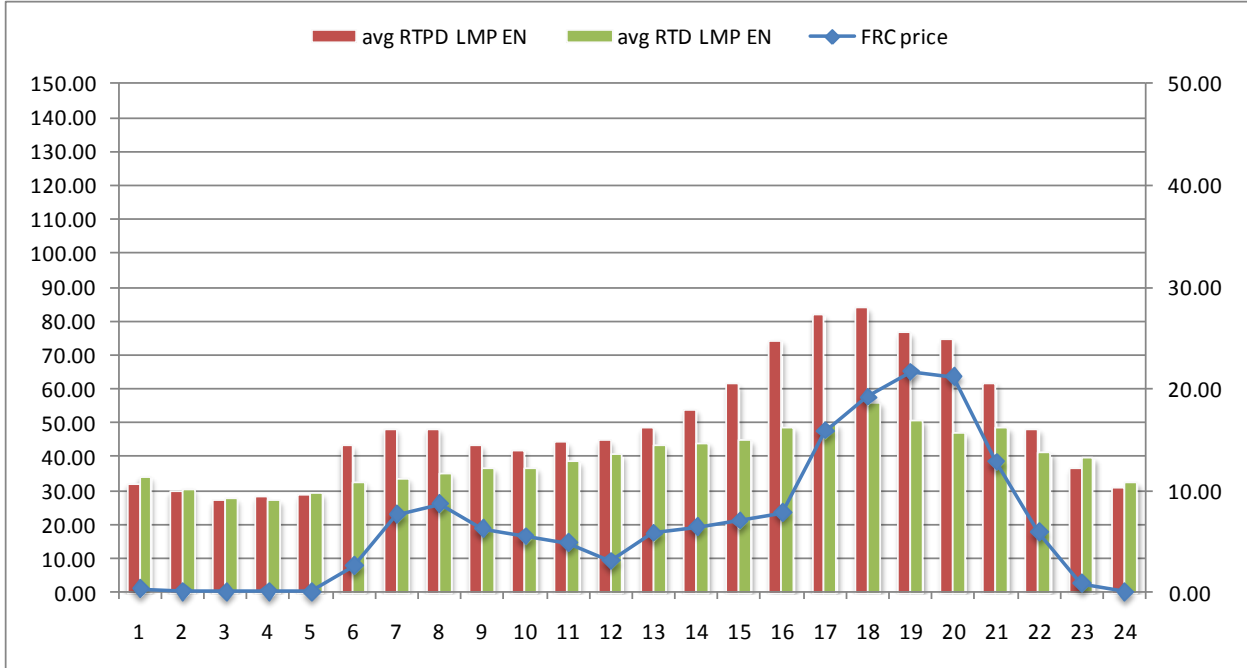
The ISO has discussed the flexible ramping constraint implementation with the Market Surveillance Committee. The ISO presented its findings at the March 11, 2014 MSC meeting and outlined steps to address "phantom" ramp<sup>3</sup>. To address this issue, the ISO strives to tune the penalty price of the FRC to reduce the out of merit dispatches, but still maintain the beneficial unit commitments.

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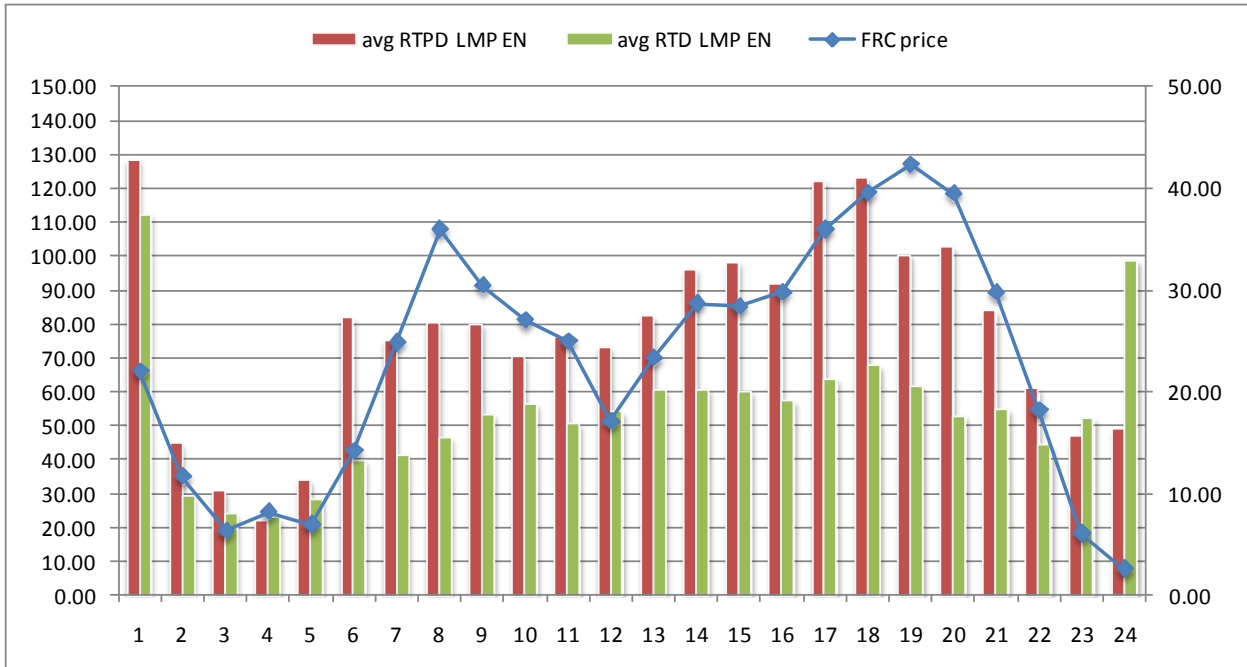
<sup>2</sup> See page 23 of the report which is available at

[http://www.caiso.com/Documents/2013ThirdQuarterReport-MarketIssues\\_Performance-Nov2013.pdf](http://www.caiso.com/Documents/2013ThirdQuarterReport-MarketIssues_Performance-Nov2013.pdf)

<sup>3</sup> <http://www.caiso.com/informed/Pages/BoardCommittees/MarketSurveillanceCommittee/Default.aspx>



**Figure 1: RTUC price vs RTD price and FRC price**



**Figure 2: RTUC price vs RTD price and FRC price when FRC is binding**

## Analyses

The ISO analyzed the correlation between the FRC shadow price and the power balance violations in 2013, and summarized the results in Table 1. The ISO divide the FRC shadow prices into four ranges: below \$20, \$20 to \$60, \$60 to \$240, and \$240 to \$250. The size of the price ranges are chosen such that there are a significant number (at least 300) of observations in each of the price range. Table 1 lists the number of instances of positive power balance violation, i.e. under generation, and the average amount of the violation per price range. The average amount of positive power balance violations when the FRC shadow price is less than \$20 is 3.87 MW, and it is reduced to 3.27 MW when the FRC shadow price range is between \$20 and \$60. This indicates that the FRC is effective at a higher price in reducing the amount of positive power balance violations.

However, when the FRC shadow price increases, we observe that the amount of positive power balance violations starts to increase rather than decrease. For example, when the FRC shadow price is between \$60 and \$240, the average amount of positive power balance violations is 8.2 MW. When the FRC shadow price is between \$240 and \$250, the average amount of positive power balance violations increases to 9.9 MW. This means that the FRC is less effective in reducing the amount of positive power balance violations even though the cost has increased in the RTUC.

The reason that the FRC is effective when the shadow price is below \$60 is that in this price range, units likely have been committed to resolve the FRC, which will help RTD mitigate power balance violations. The FRC is less effective when the shadow price is above \$60, because when the FRC shadow price is high, the FRC relies on more out of merit order redispatches than unit commitments. The ISO validated this by examining the FRC shadow price when there are unit startups driven by the FRC. The criteria that is used to determine if a unit startup is driven by the FRC is whether an online unit providing flexible ramping is offline in the previous interval. It is then assumed that the resource is started up in the current interval to provide flexible ramping. It turns out that for intervals that have these FRC driven unit startups in 2013, the FRC shadow prices are always below \$60. As discussed earlier, out of merit order redispatches inflate the RTUC price without being helpful to RTD. So the FRC is less effective when the shadow price is above \$60 than when the shadow price is blow \$60.

Based on the analysis, the ISO will reduce the FRC penalty price from its current \$247 setting to \$60 starting May 1, 2014. The FRC penalty price will allow the FRC to be relaxed if



the redispatch cost exceeds the penalty price, and the FRC shadow price is set at the FRC penalty price should any relaxation occur. The \$60 penalty price is expected to reduce the out of merit dispatches driven by FRC, but maintain the beneficial unit commitments.

**Table 1: FRC shadow price and power balance violation in 2013**

FRC shadow price range	Average power balance violation MWs	Number of instances
<20	3.87	3141
[20, 60)	3.27	691
[60, 240)	8.20	364
[240, 250]	9.90	473

## Next Steps

The ISO will continue to monitor the FRC performance, and its impacts of the FMM, and make adjustments accordingly if the need arises in the future. The ISO will start soon the stakeholder process of the flexible ramping product, which is a superior design to permanently replace the FRC. The planned implementation date of the flexible ramping product is Fall 2015.