

July 28, 2015

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. ER15-402____
Independent Assessment – Department of Market Monitoring
Report on Energy Imbalance Market Issues and Performance**

Dear Secretary Bose:

The Department of Market Monitoring hereby submits its independent assessment on the causes and solutions identified by the California Independent System Operator Corporation in its report on the performance of the Energy Imbalance Market for the month of May, 2015.¹

Please contact the undersigned with any questions.

Respectfully submitted,

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¹ The CAISO submits this report pursuant to *California Independent System Operator Corp.*, 149 FERC ¶ 61,194 (2014).

California ISO

Report on energy imbalance market issues and performance

July 28, 2015

Department of Market Monitoring

Executive Summary

Pursuant to the Commission's March 16, 2015, Order on the ISO's Energy Imbalance Market (EIM), the ISO filed a report on July 14, 2015 covering the period from May 1-31, 2015 (July 14 Report).¹ This report provides a review by the Department of Market Monitoring (DMM) of the information and period covered in the ISO's July 14 Report. Key findings include the following:

- Performance of the EIM improved during May, particularly in the PacifiCorp East. During most intervals, prices in the EIM have continued to be highly competitive and have been set by bids closely reflective of the marginal operating cost of the highest cost resource dispatched to balance loads and generation. However, during a relatively small portion of intervals, energy or flexible ramping constraints have still had to be relaxed for the market software to balance modeled supply and demand.
- In PacifiCorp East, the frequency of intervals in which the power balance constraints have been relaxed in the 15-minute market dropped from about 1.5 percent during April to and about 0.2 percent in May. In the 5-minute market, the frequency of power balance constraint relaxation dropped from about 2.5 percent in April to about 2.1 percent in May.
- In PacifiCorp West, the frequency of intervals in which the power balance constraints have been relaxed in the 15-minute market dropped from about 0.2 percent during April to and about 0.1 percent in May. In the 5-minute market, however, the frequency of power balance constraint relaxation increased from about 0.8 percent in April to about 1.9 percent in May.
- With price discovery provisions currently in place, EIM prices during May in both PacifiCorp areas have been kept equal to or lower than the bilateral market price indices that were used to set prices prior to EIM implementation.
- In PacifiCorp East, without price discovery provisions in place, EIM prices in the 15-minute market during May would have been about 5 percent lower than these bilateral market price indices, while prices in the 5-minute market would have been about 32 percent higher than bilateral prices.
- In PacifiCorp West, without price these discovery provisions, 15-minute prices during May would have been about 3 percent higher than these bilateral market price indices, while prices in the 5-minute market would have been about 28 percent higher than bilateral prices.
- Bidding in the EIM continues to be highly competitive, with bids for most capacity slightly below or above default energy bids used in market power mitigation. When bids are mitigated due to market power mitigation provisions, these procedures generally result in modest reductions in bid prices.

¹ *Energy Imbalance Market Pricing Waiver Report, May 1 – May 31, 2015*, ISO Market Quality and Renewable Integration, July 14, 2015. http://www.caiso.com/Documents/Jul14_2015_May2015_EIM_PriceWaiverReport_ER15-402.pdf

This report is organized as follows. This summary section highlights key findings and trends occurring in May 2015. Section 1 provides background on the ISO filings and FERC orders leading to this report. Sections 2 through 4 provide updated charts and tables which have been included in prior reports. Additional information on special issues are provided in Section 5. In this report, Section 5 provides additional information on the flexible ramping sufficiency test. As discussed in Section 5:

- During May, the number of hours when the hourly test for flexible ramping sufficiency increased significantly, totaling about 7 percent of hours in PacifiCorp East and about 22 percent of hours in PacifiCorp West.²
- When an EIM area fails this test, transfers in from other EIM areas cannot be increased, and price discovery provisions are triggered. However, the relatively high frequency of flexible ramping sufficiency test failures in May did not have a major impact on market results, since the frequency of power balance constraint relaxation during hours when the flexible ramping sufficiency test was not met was very low.
- Although the cause of this increase in May is unclear, the frequency of flexible ramping sufficiency test failures dropped in June after the ISO implemented a new formula for calculating the hourly flexible ramping requirements used in this hourly test. DMM has requested that the ISO provide a detailed written description of the new approach for calculating the hourly flexible ramping requirements used in this test in the EIM Business Practice Manual.

Since the ISO's monthly reports are composed primarily of information included in prior reports, DMM has recommended that the ISO provide a summary of key additional information in each report or and/or a redlined version of each report so that this new information is more readily apparent.³ Prior ISO reports have often included significant new pieces of information or clarifications which have often been hard to identify without such a summary. The ISO's July 14 report does not include any such summary, and DMM continues to recommend this information be included in the ISO's future monthly reports.⁴

² It is important to note that this test is performed based on schedules and bids submitted 40 minutes prior to the start each operating hour (t-40), and adjustments can be made to schedules prior to the time when the 15-minute market is run for many of the 15-minute intervals in that operating hour.

³ *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, June 12, 2015, p.2, footnote 2. http://www.caiso.com/Documents/Jun12_2015_DMM_Report_Performance_Issues_EIM_April2015_ER15-402.pdf.

⁴ For example, DMM's June 12 report provided a summary of key pieces of new information included in the ISO's June 2 report (see page 2, http://www.caiso.com/Documents/Jun12_2015_DMM_Report_Performance_Issues_EIM_April2015_ER15-402.pdf). Beyond the updated charts in the ISO's July 14 report, the ISO's July report included only one significant update. Specifically, the July 14 report includes a modified discussion of the list of undersupply infeasibilities provided in Table 1 of Attachment C (see Attachment C, second paragraph, page 33-34). No modifications were made to the discussion of Remedial Actions in Attachment B.

1 Background

On November 13, 2014, the ISO requested a 90-day waiver of two tariff provisions for establishing the price of energy in the Energy Imbalance Market (EIM) during intervals when, due to a lack of sufficient supply from capacity bid into the market, the ISO's market software must resort to relaxing transmission or system energy balance constraints in order to reach a market solution.⁵

Under these conditions, the waiver would allow prices to be set by a special *price discovery* process designed to let prices reflect the highest cost supply dispatched to meet demand, rather than based on penalty pricing parameters such as the \$1,000/MW price otherwise applied to the amount by which the power balance constraint relaxed. To effectuate this price discovery feature, the ISO has also set the penalty price for the flexible ramping constraint to \$0 in the pricing run of the EIM software. This allows energy prices to be set based on the highest cost supply needed to meet demand when the price discovery mechanism is triggered without any additional impact from the penalty price assigned to the flexible ramping constraint in the scheduling run.⁶

The ISO's November 13 waiver request was submitted as a means of mitigating high prices that the ISO believes resulted from a variety of factors which prevented the market software from producing prices reflective of actual supply and demand conditions. The ISO explained that these high prices are not always indicative of actual physical conditions on the system, and instead reflect factors such as (1) challenges in providing timely and complete data to ensure system visibility under the new procedures, (2) limitations on the resources available to PacifiCorp for use in the EIM, and (3) several forced outages of large EIM participating resources.

On December 1, the Federal Energy Regulatory Commission (FERC) issued an order granting the ISO's petition for waiver of these provisions for 90 days, effective November 14, 2014, as requested.⁷ The Commission also directed the ISO to file detailed informational reports at 30-day intervals, providing detailed supporting data demonstrating progress towards identifying and eliminating the problems giving rise to the waiver petition. FERC indicated that these reports should include independent assessments from the Department of Market Monitoring on the causes and the solutions identified by the ISO. The Commission indicated that the first report be filed 30 days from the effective date of the tariff waiver, December 15, 2014.

On March 16, 2015, FERC extended the waiver for an additional 90 days and, in addition, extended the reporting requirements. The ISO filed a report pursuant to the March 16 Order covering EIM performance in May on July 14, 2015.⁸ This represents DMM's report corresponding to the information and period covered in the ISO's July 14 Report.

⁵ http://www.aiso.com/Documents/Nov13_2014_PetitionWaiver_EIM_ER15-402.pdf

⁶ The penalty price for the flexible ramping constraint was \$247/MW until January 14, 2015. As of January 15, 2015, the ISO tariff specifies that the parameter for the flexible ramping constraint will be set to \$60.

⁷ http://www.aiso.com/Documents/Dec1_2014_OrderGrantingWaiver_EIM PricingParameters_ER15-402.pdf

⁸ *Energy Imbalance Market Pricing Waiver Report, May 1 – May 31, 2015*, ISO Market Quality and Renewable Integration, July 14, 2015: http://www.aiso.com/Documents/Jul14_2015_May2015_EIM_PriceWaiverReport_ER15-402.pdf.

2 Energy imbalance market prices

Figure 2.1 and Figure 2.3 show the average daily frequency of constraint relaxations in the 15-minute market by month in PacifiCorp East and PacifiCorp West, respectively. Figure 2.5 and Figure 2.7 provide a similar summary for the 5-minute market in these two areas. A detailed description of various types of constraint relaxation in these figures has been provided in prior reports.⁹

Figure 2.2 and Figure 2.4 show average monthly prices in the 15-minute market *with* and *without* the special price discovery mechanism being applied to mitigate prices in PacifiCorp East and PacifiCorp West, respectively. Figure 2.6 and Figure 2.8 provide the same monthly price summary for the 5-minute market. These figures also include monthly average bilateral market prices that were used to determine balancing energy charges prior to EIM implementation in PacifiCorp East and PacifiCorp West, respectively. Table 2.1 shows results of this analysis for the month of May.

A detailed description of the methodology used to calculate these counterfactual prices that would result without price discovery has been provided in prior reports.¹⁰ The ISO's June 3 Report notes that the ISO implemented the load bias limiter feature for EIM on March 20, so that data in the ISO's report now exclude intervals since March 20 when the power balance constraint was relaxed in the scheduling run, but this software feature would have been triggered if price discovery was not in effect. DMM has also adjusted its analysis to be consistent with the data in the ISO report.¹¹ However, Section 4 of this report provides additional detail on the impact of the load bias limiter feature on prices if price discovery was not in effect.

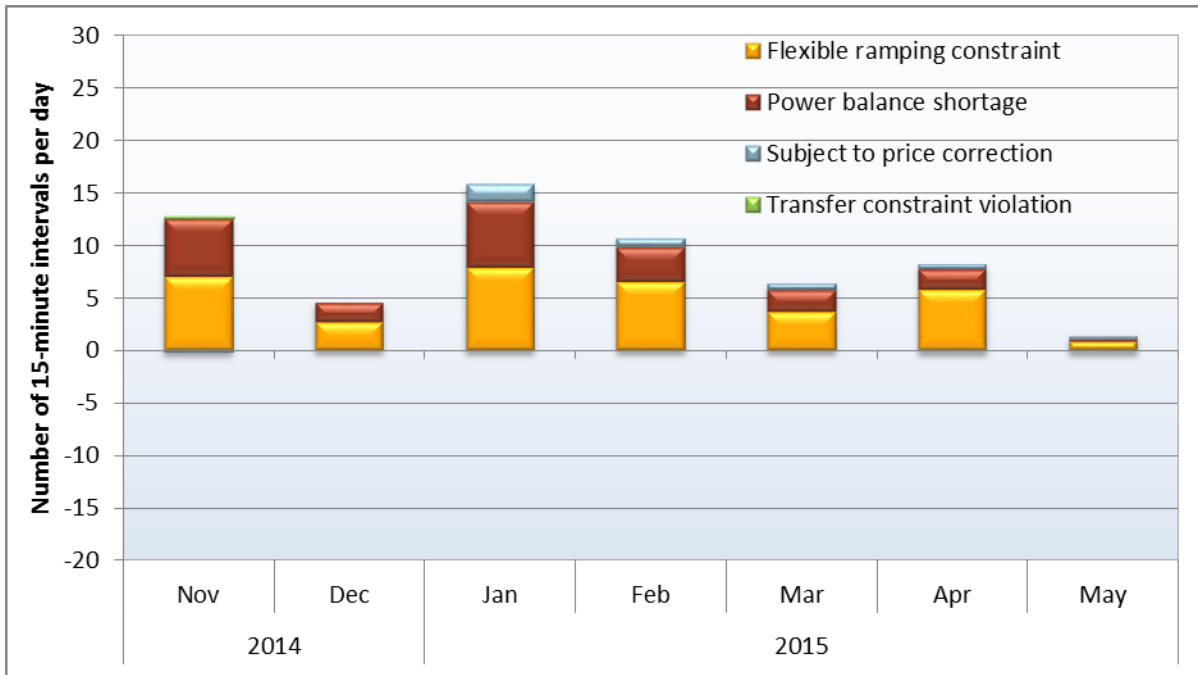
As shown in these figures, the price discovery mechanism approved under the Commission's December 1, 2014 order has effectively mitigated the impact of constraint relaxation on market prices. As shown in Table 2.1. Without price discovery, prices in PacifiCorp East during May would be 5 percent lower in the 15-minute market and 32 percent higher in the 5-minute market than bilateral prices. In PacifiCorp West, prices in April would have been 3 percent higher than bilateral market prices in the 15-minute market and 28 percent higher in the 5-minute markets. In previous months, the effects of price discovery were consistently higher on PacifiCorp East prices and lower on PacifiCorp West prices.

⁹ *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, April 2, 2015, p.5. http://www.caiso.com/Documents/Apr2_2015_DMM_AssessmentPerformance_EIM-Feb13-Mar16_2015_ER15-402.pdf.

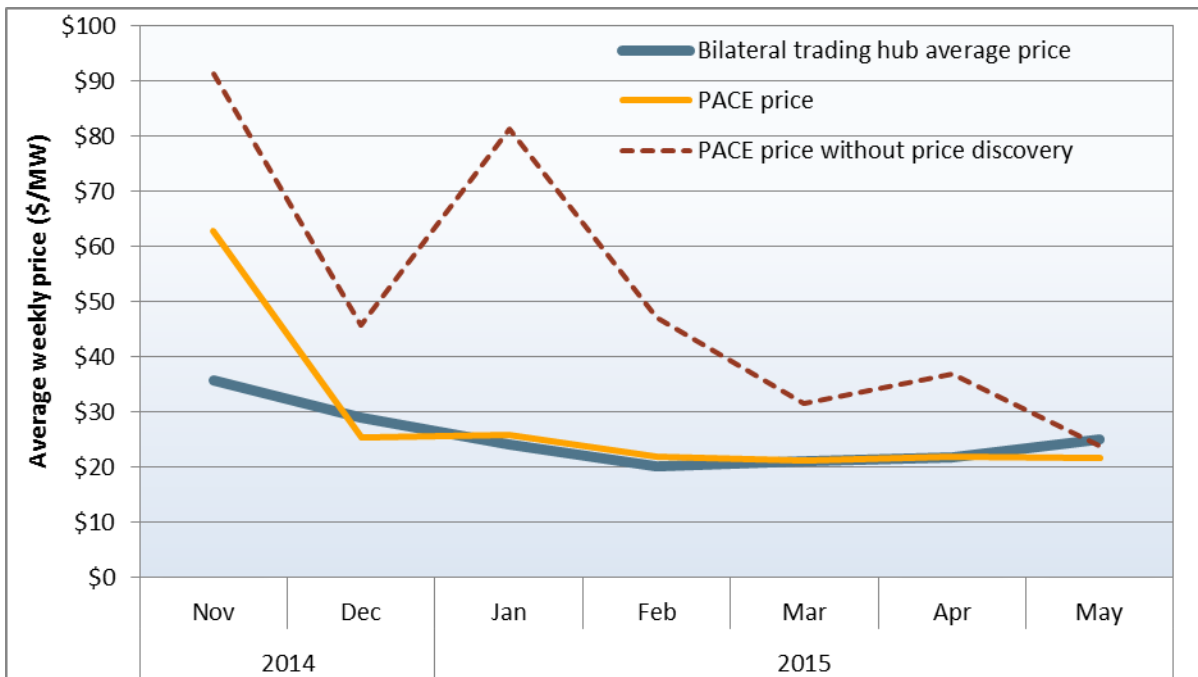
¹⁰ *Report on Energy Imbalance Market Issues and Performance*, Department of Market Monitoring, April 2, 2015, p.6. http://www.caiso.com/Documents/Apr2_2015_DMM_AssessmentPerformance_EIM-Feb13-Mar16_2015_ER15-402.pdf.

¹¹ As in the ISO report, data on the frequency of constraint relaxation exclude intervals since March 20 when the power balance constraint was relaxed in the scheduling run, but this software feature would have been triggered if price discovery was not in effect. Also, when estimating prices without price discovery, it is assumed that when the load bias limited would have been triggered, the resulting price would have been equal to the actual price that resulted with price discovery in effect.

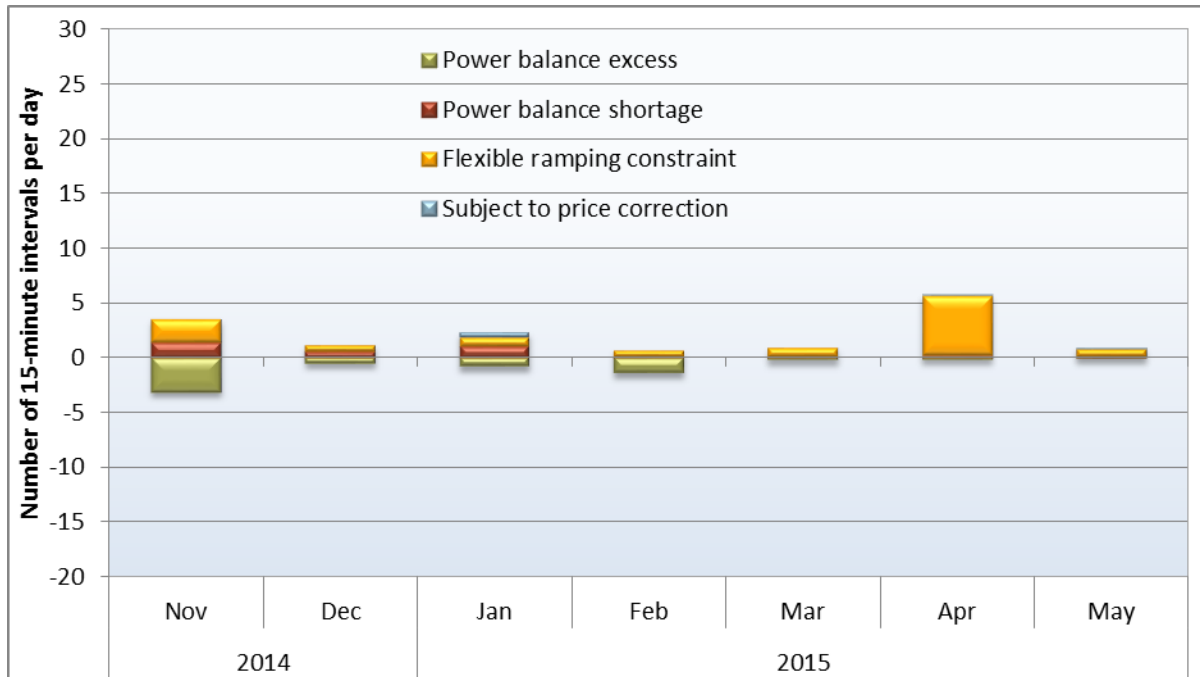
**Figure 2.1 Frequency of constraint relaxation
PacifiCorp East - 15-minute market**



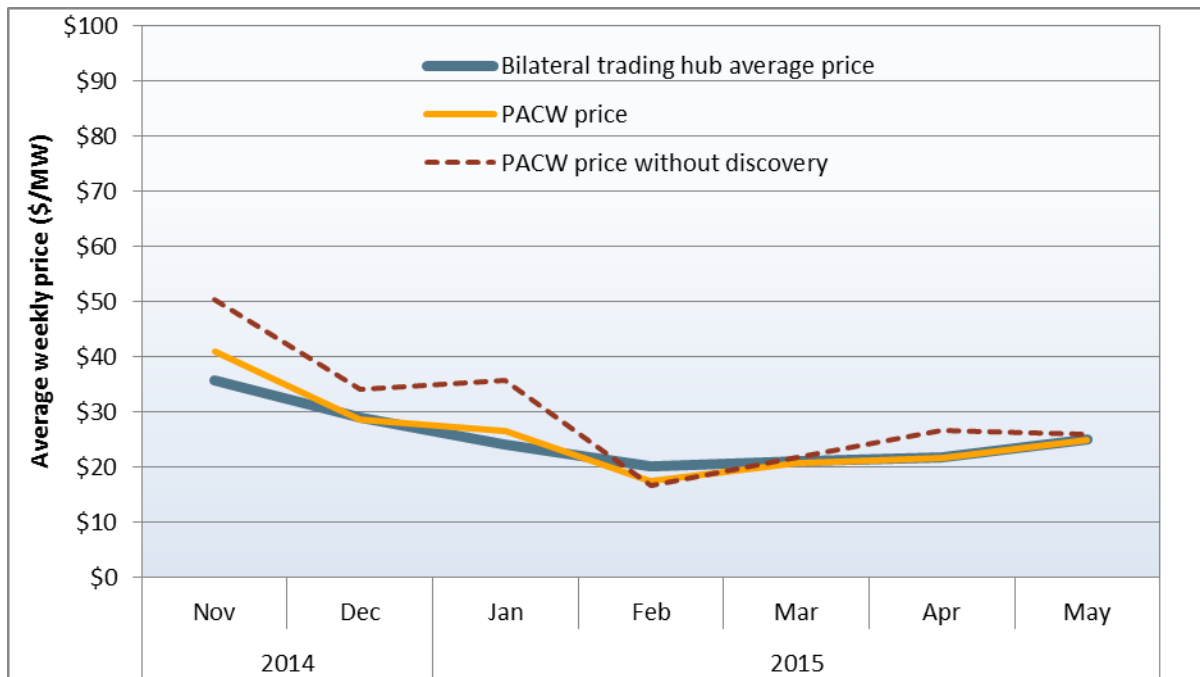
**Figure 2.2 Average daily prices with and without price discovery
PacifiCorp East - 15-minute market**



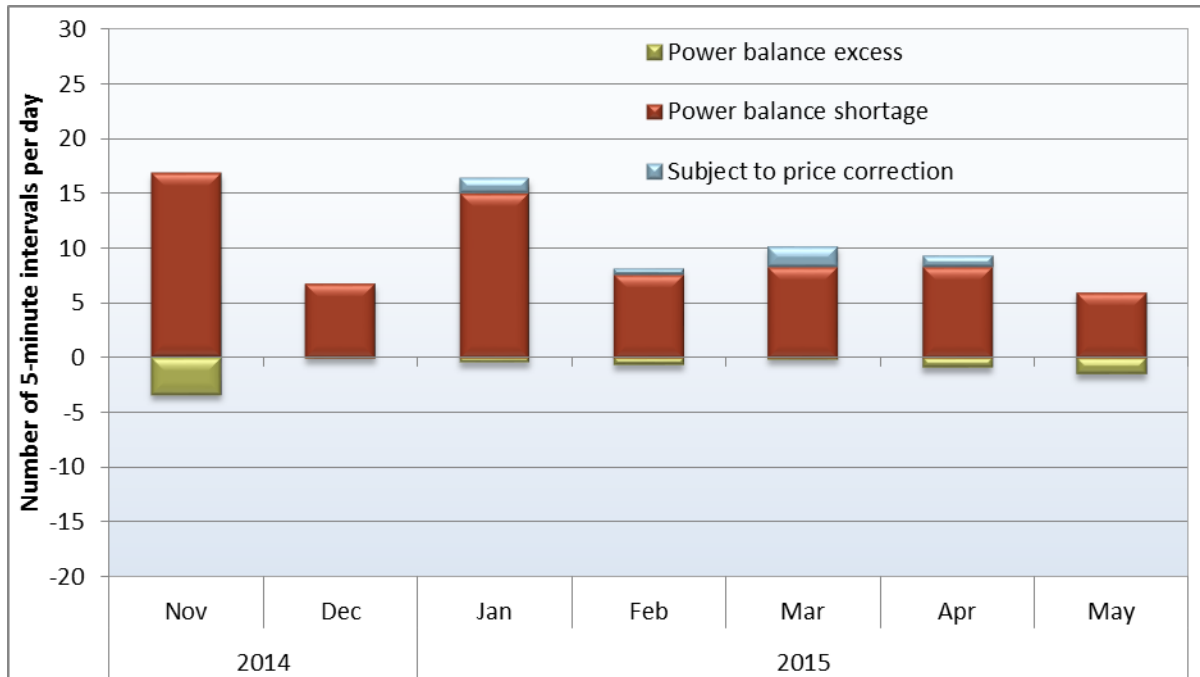
**Figure 2.3 Frequency of constraint relaxation
PacifiCorp West - 15-minute market**



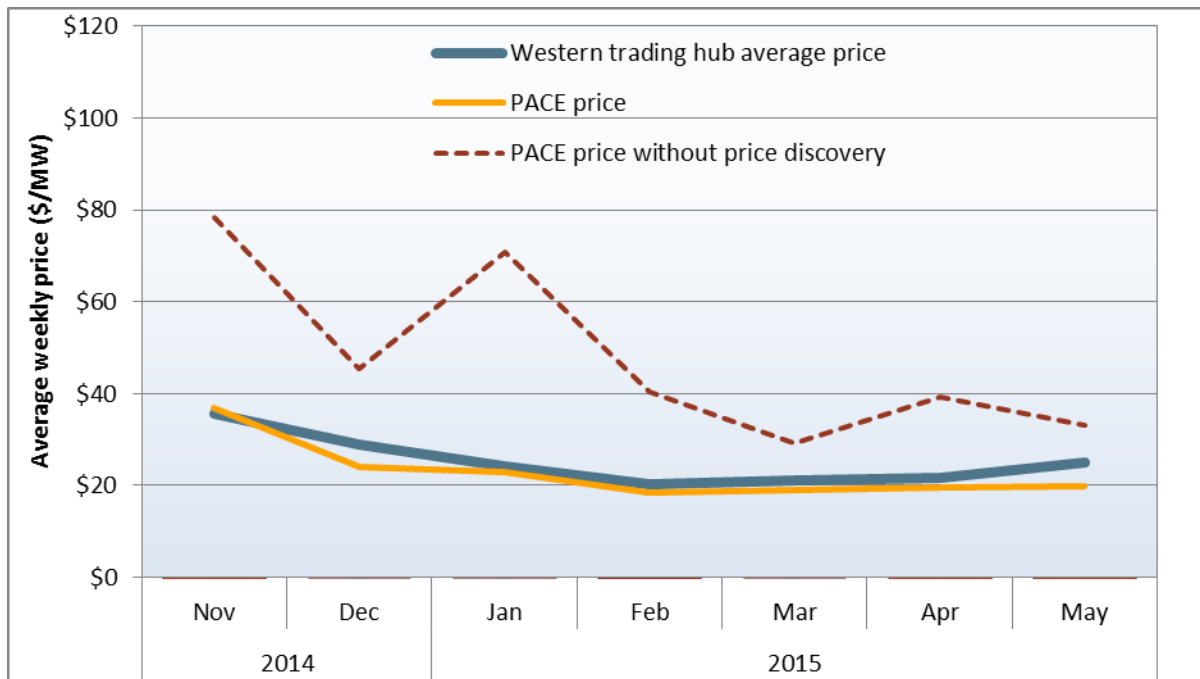
**Figure 2.4 Average daily prices with and without price discovery
PacifiCorp West - 15-minute market**



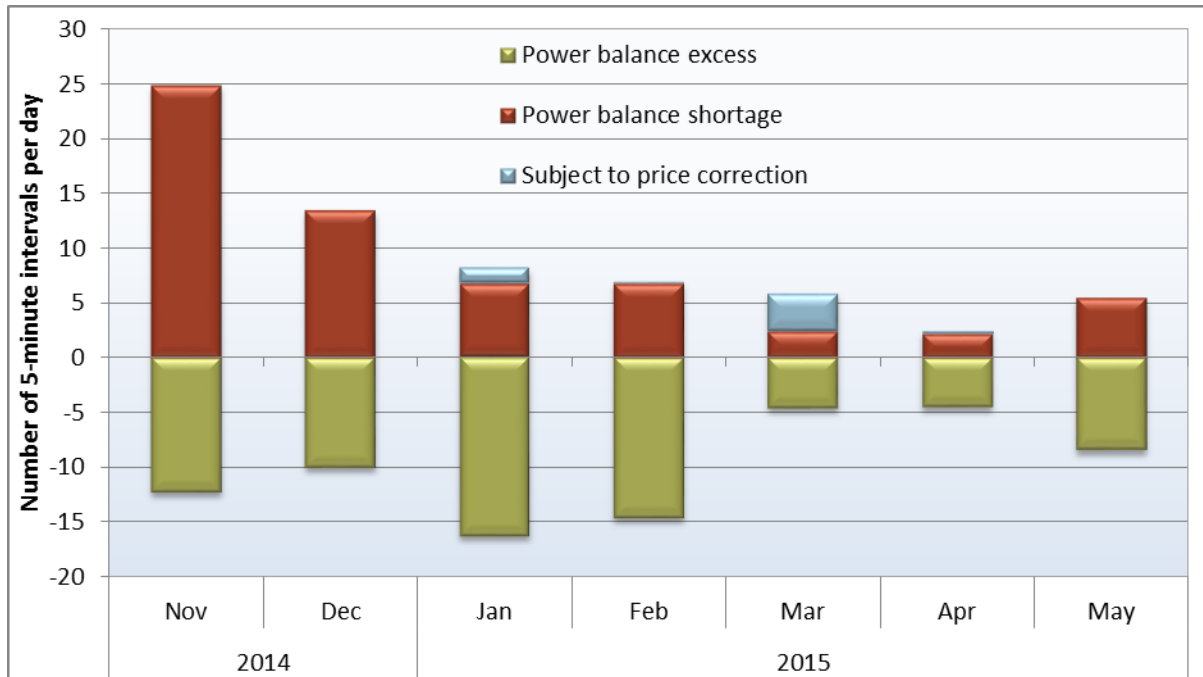
**Figure 2.5 Frequency of constraint relaxation
PacifiCorp East – 5-minute market**



**Figure 2.6 Average daily prices with and without price discovery
PacifiCorp East – 5-minute market**



**Figure 2.7 Frequency of constraint relaxation
PacifiCorp West 5-minute market**



**Figure 2.8 Average daily prices with and without price discovery
PacifiCorp West – 5-minute market**

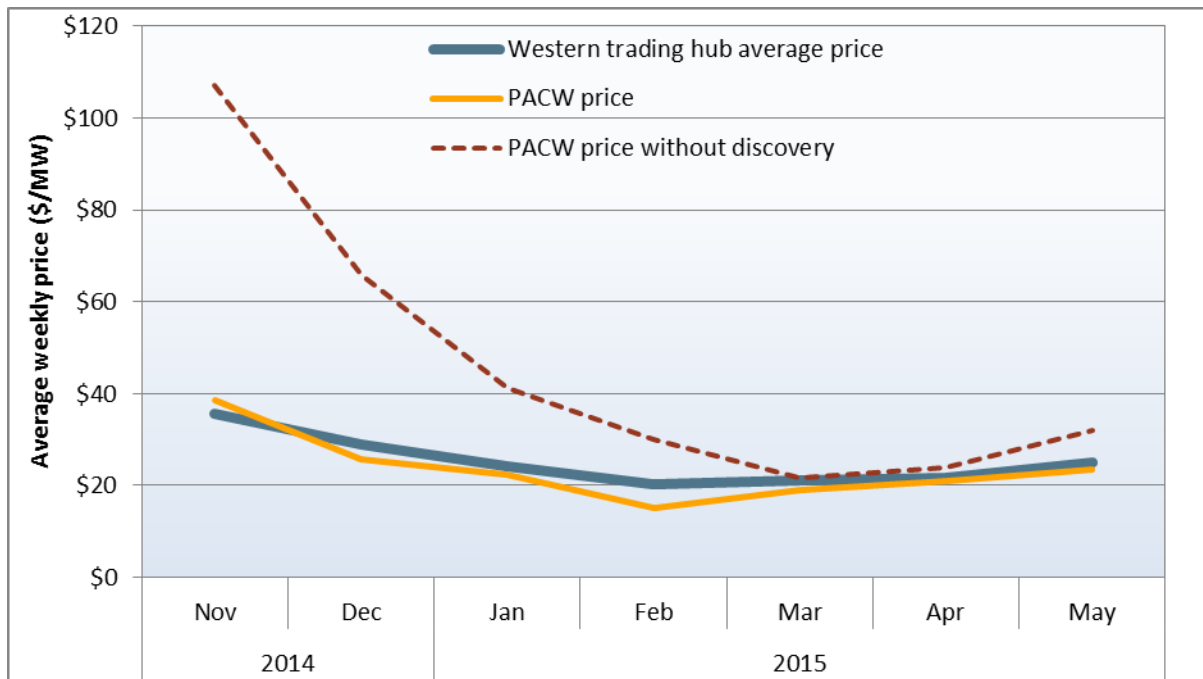


Table 2.1 Average prices in EIM and bilateral markets (May 2015)

	Western trading hub average price	Average EIM price	EIM price without price discovery
<i>PacifiCorp East</i>			
15-minute market (FMM)	\$25.05	\$21.70	\$23.83
5-minute market (RTD)	\$25.05	\$19.99	\$33.05
<i>PacifiCorp West</i>			
15-minute market (FMM)	\$25.05	\$25.02	\$25.87
5-minute market (RTD)	\$25.05	\$23.52	\$32.10

3 Market software constraint relaxation

EIM performance has been driven primarily by the need to periodically relax several key constraints in the EIM market model. This section provides summary information on the frequency of the constraint violations in the EIM by calendar month for each market. Figure 3.1 and Figure 3.2 summarize the percent of intervals in which the power balance and flexible ramping constraints have been relaxed by month in PacifiCorp East and PacifiCorp West, respectively.¹²

As shown in Figure 3.1, in PacifiCorp East the frequency of intervals in which the power balance constraint have been relaxed in the 15-minute market fell from about 1.5 percent in April to about 0.2 percent of intervals in May, while the frequency of power balance constraint relaxation in the 5-minute market dropped from about 2.5 percent to about 2.1 percent of intervals.

As shown in Figure 3.2, in PacifiCorp West the frequency of intervals in which the power balance constraint has been relaxed in the 15-minute market fell slightly in May to at about 0.1 percent of intervals, while the frequency of power balance constraint relaxation in the 5-minute market increased from about 0.8 percent in April to about 1.9 percent of intervals in May.

As shown in Figure 3.1 and Figure 3.2, the frequency that the flexible ramping constraint was relaxed in the 15-minute market decreased significantly in May, falling below 1 percent in both PacifiCorp areas. This decrease may be attributable to reductions in the upper limits used by the new automated tool that set the flexible ramping constraint requirement in the PacifiCorp balancing areas that was implemented in late March.

DMM has analyzed the performance of the new approach to setting flexible ramping constraint requirements and is recommending further modifications in how flexible ramping constraint requirements are set in both the ISO and EIM areas. We will provide updated information this issue in future reports.

¹² These charts have changed slightly from previous versions in earlier reports as they now exclude relaxations during intervals where prices were corrected.

Figure 3.1 Frequency of constraint relaxation by month – PacifiCorp East (PACE)

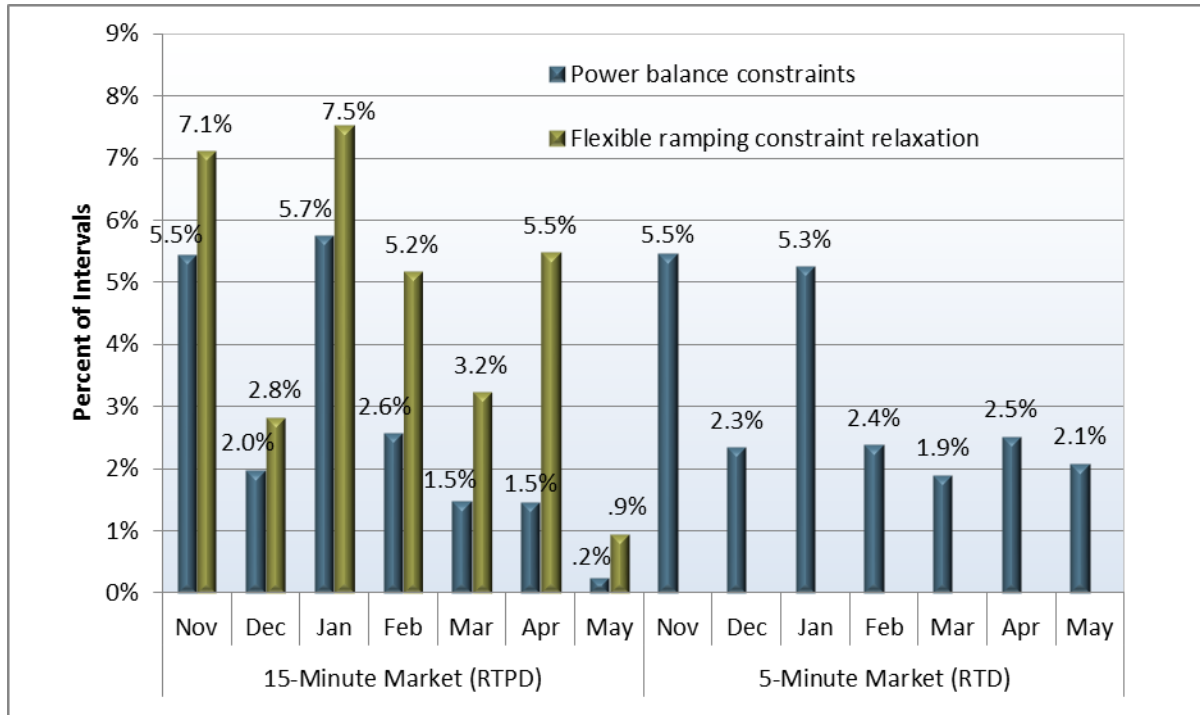
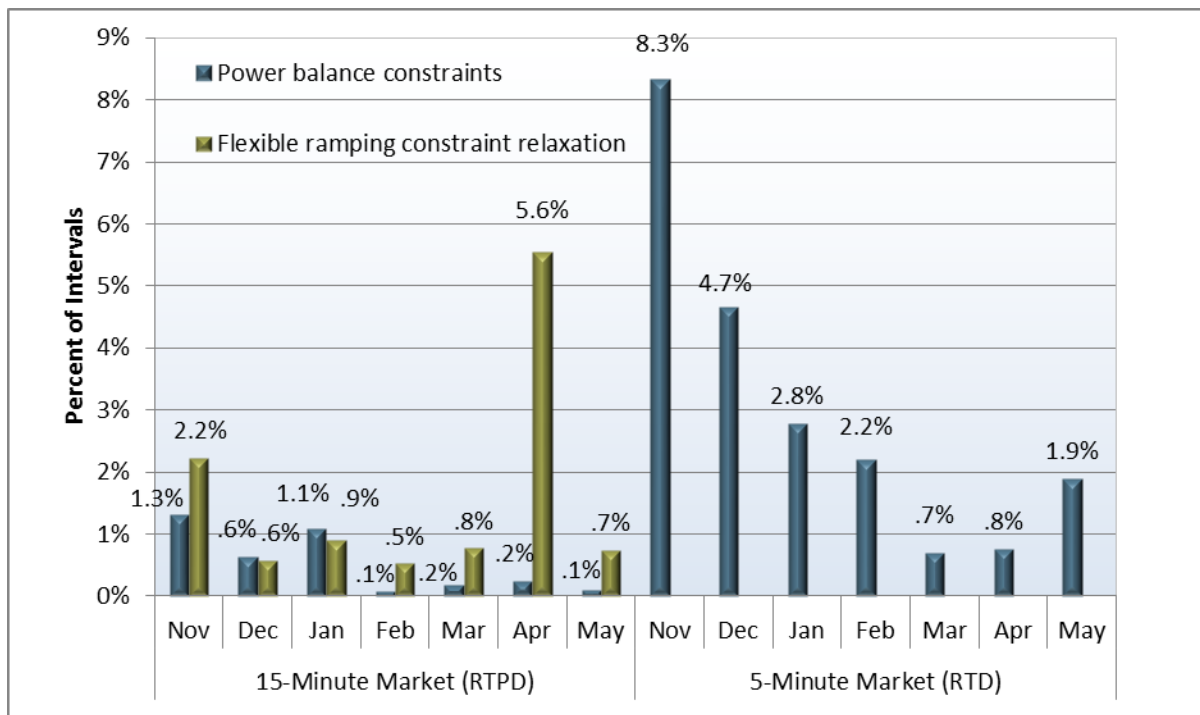


Figure 3.2 Frequency of constraint relaxation by month – PacifiCorp West (PACW)



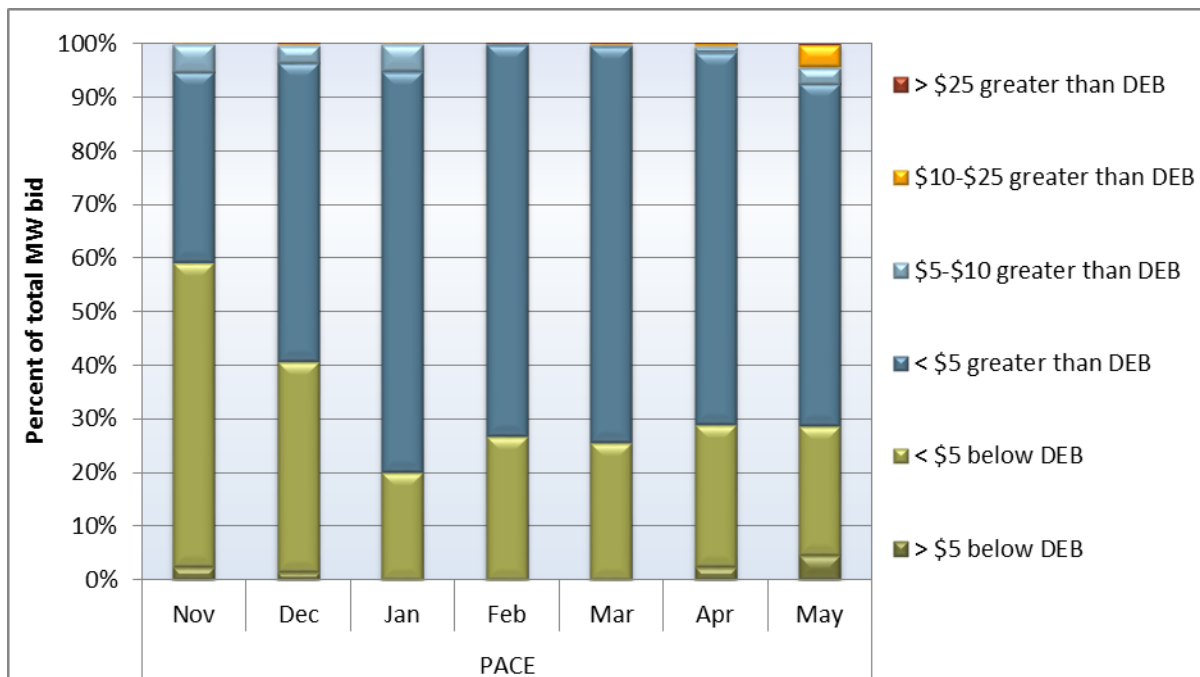
4 Market bidding and mitigation

Bidding in the EIM has been highly competitive, with bids for most capacity slightly below or above default energy bids (DEBs) used in market power mitigation. Thus, when relatively high EIM prices have occurred, these prices reflect penalty prices for software constraints rather than bid prices. In addition, when bids are mitigated due to market power mitigation provisions, these procedures generally result in modest reductions in bid prices.

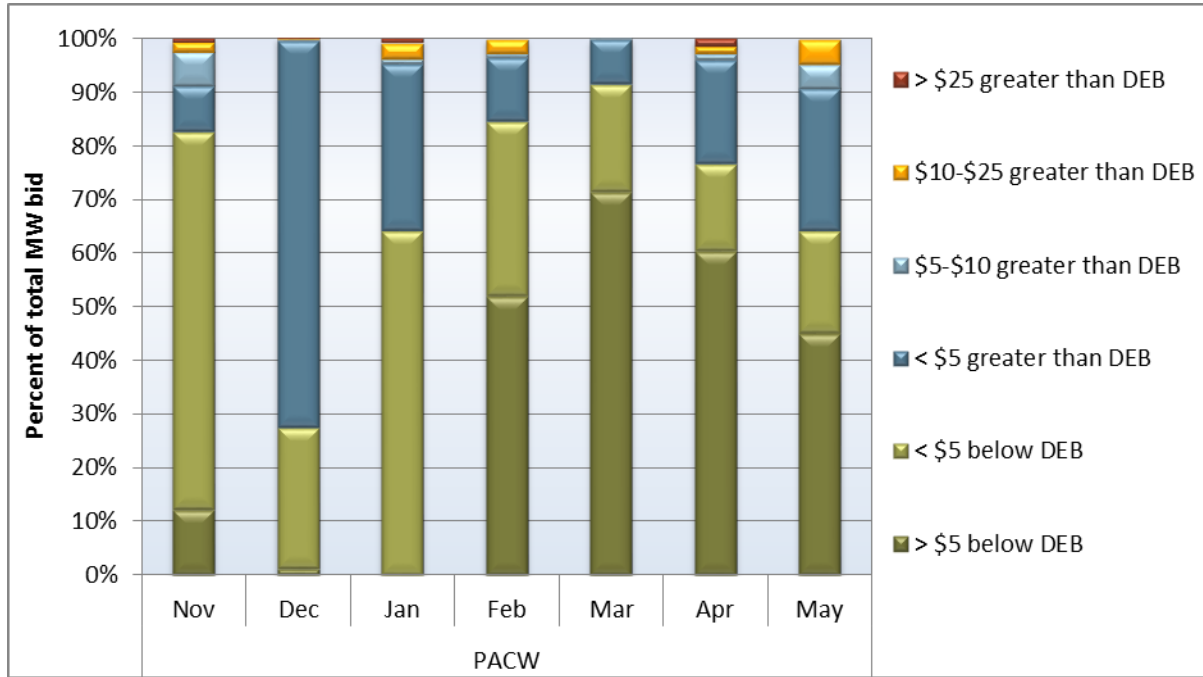
Figure 4.1 summarizes a comparison of bid prices in PacifiCorp East for thermal and hydro units compared to default energy bids used in market power mitigation. Figure 4.2 shows the same information for PacifiCorp West. These default energy bids are based on the marginal operating costs of thermal resources or opportunity cost for hydro resources with limited energy and energy storage capabilities.

Figure 4.1 shows that the bidding pattern in PacifiCorp East in May was similar to April. However, there was a continued increase in the volume of bids less than \$5/MWh above the default energy bids in PacifiCorp West and a continued decrease in the volume of bids more than \$5/MWh below the default energy bid, as shown in Figure 4.2. Most of the bids more than \$5/MWh below the default energy bid in PacifiCorp West were between \$5 and \$10/MWh below the default energy bid.

**Figure 4.1 Comparison of market bids to default energy bids
PacifiCorp East**



**Figure 4.2 Comparison of market bids to default energy bids
PacifiCorp West**



5 Special issues

Flexible ramping sufficiency test

This section provides additional information on the flexible ramping sufficiency test. As shown in Figures 5.1 and 5.2, during May the number of hours when the hourly test for flexible ramping sufficiency increased significantly during, totaling about 7 percent of hours in PacifiCorp East and about 22 percent of hours in PacifiCorp West. This test is performed based on schedules and bids submitted prior to each operating hour (with the final test being performed at t-40). Adjustment to schedules can be made prior to the time when the 15-minute market is run for the 15-minute intervals in the later portion of the operating hour.

When an EIM area fails this test, transfers in from other EIM areas cannot be increased,¹³ and price discovery provisions are triggered.¹⁴ However, the relatively high frequency of flexible ramping sufficiency test failures in May did not have a major impact on market results, since the frequency of power balance constraint relaxation during hours when the flexible ramping sufficiency test was not met was very low.

As described in the EIM business practice manual, the test for meeting flexible ramp requirements is cumulative for each 15-minute interval of the hour and the test fails if any of the four cumulative tests fail.¹⁵ For example, the requirement for the fourth interval in each hour is based on summing up the 15-minute flexible ramping requirement for each of the four 15-minute intervals in that hour. This approach over estimates likely ramping requirements since it assumes that the full requirement for each prior 15-minute interval is actually needed every interval.

To avoid this over estimation of ramping requirements used in the hourly sufficiency test, the ISO implemented a modification to this formula in early June 2015. Although the cause of this increase in May is unclear, the frequency of flexible ramping sufficiency test failures dropped in June after the ISO implemented a new formula for calculating the hourly flexible ramping requirements used in this hourly test. DMM has requested that the ISO provide a detailed written description of the new for calculating the hourly flexible ramping requirements used in this test in the EIM Business Practice Manual.

¹³ See section 29.34(n) of the CAISO tariff and section 10.3.2.1 of the Business Practice Manual for the Energy Imbalance Market.

¹⁴ See section 10.3.2.1 of the Business Practice Manual for the Energy Imbalance Market.

¹⁵ See section 10.3.2.1 of the Business Practice Manual for the Energy Imbalance Market.

Figure 5.1 Failures of hourly flexible ramping sufficiency test and constraint relaxation in subsequent 15-minute intervals (PacifiCorp East)

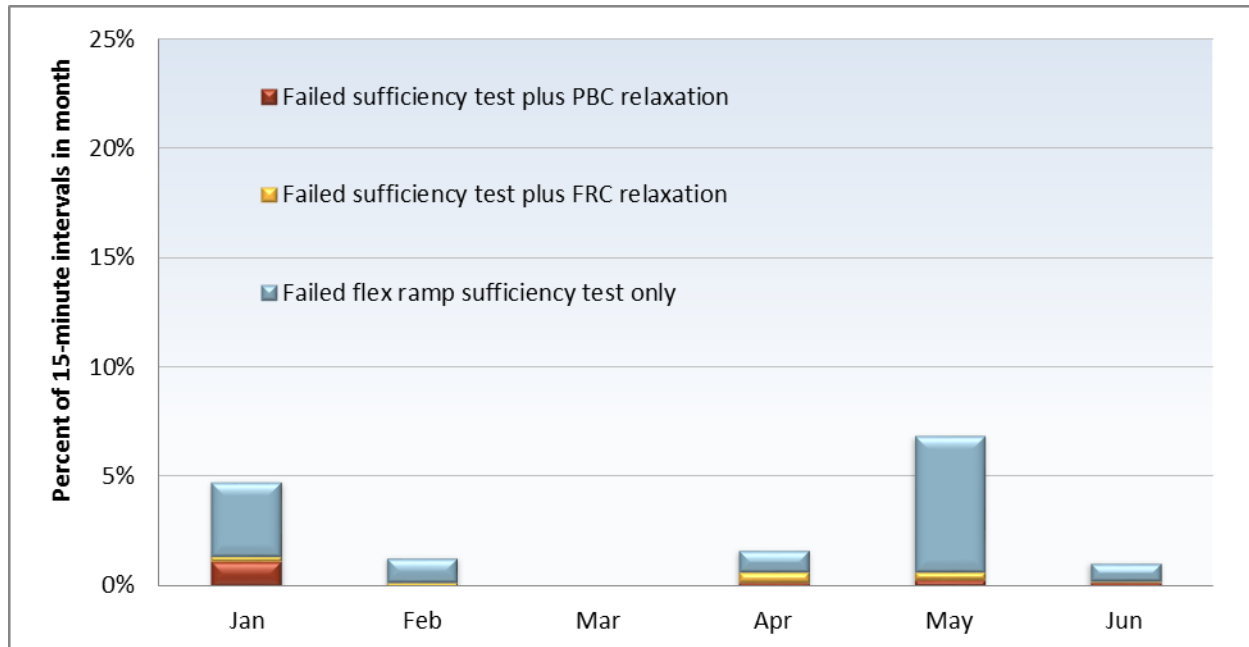


Figure 5.2 Failures of hourly flexible ramping sufficiency test and constraint relaxation in subsequent 15-minute intervals (PacifiCorp West)

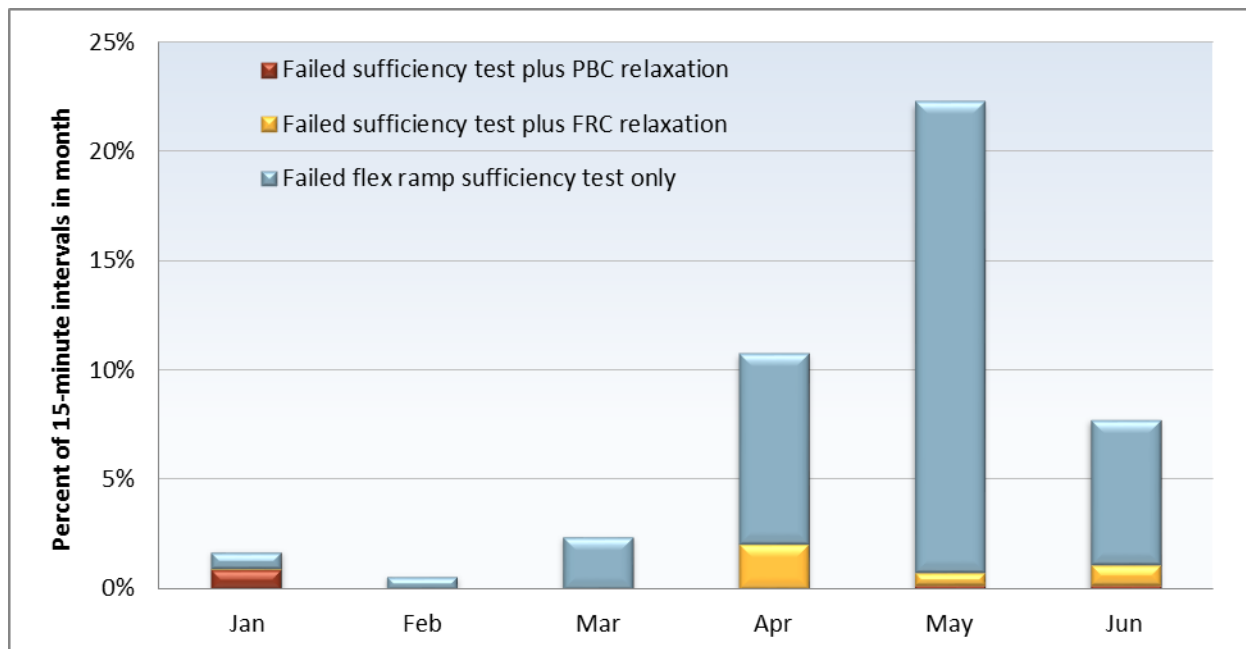


Figure 5.3 Hourly flexible ramping sufficiency test failures and subsequent constraint relaxation in 15-minute market (PacifiCorp East)

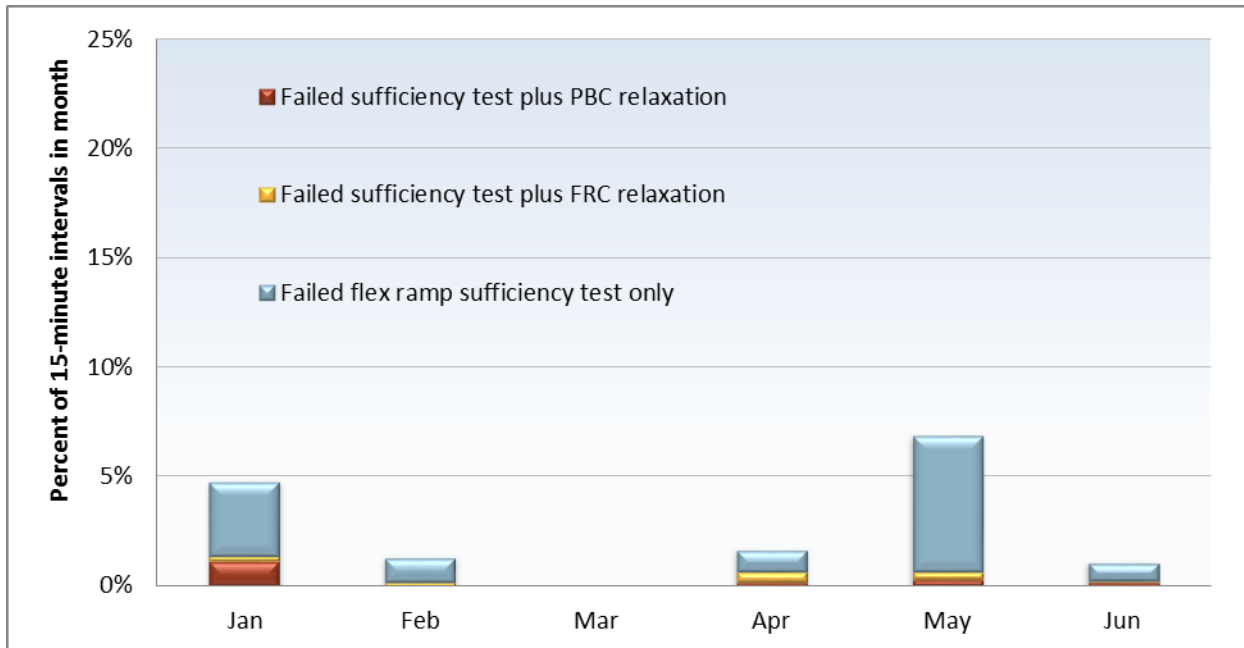
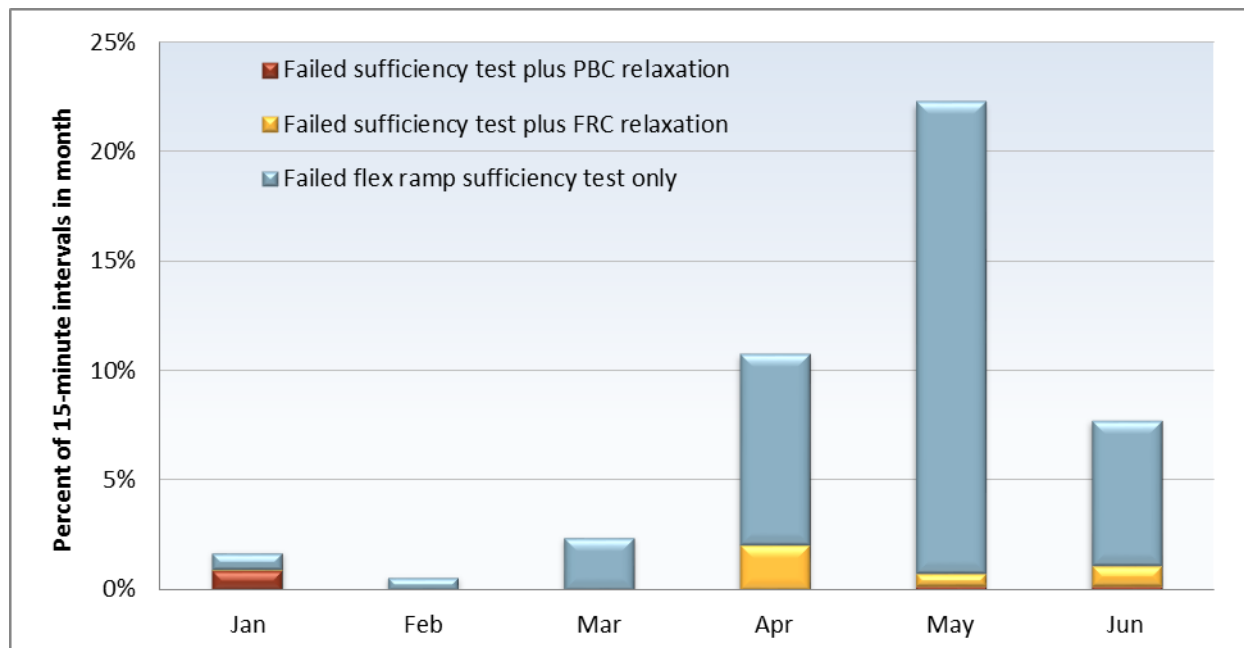


Figure 5.4 Hourly flexible ramping sufficiency test failures and subsequent constraint relaxation in 15-minute market (PacifiCorp West)



CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon the parties listed on the official service list in the captioned proceedings, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated at Folsom, California this 28th day of July, 2015.

Is/ Anna Pascuzzo
Anna Pascuzzo