



April 4, 2017

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. ER15-2565-____
December 2016 Informational Report
Energy Imbalance Market – Transition Period Report – Arizona
Public Service**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its report on the transition period of Arizona Public Service during its first six (6) months of participation in the Energy Imbalance Market (EIM) for December 2016. The Commission also directed the Department of Market Monitoring (DMM) to submit an independent assessment of the CAISO's report, which the DMM will seek to file within approximately 15 business days.

The CAISO will continue filing such reports, consistent with the Commission's order, through the six (6) month reporting period.

Please contact the undersigned with any questions.

Respectfully submitted

By: /s/ Anna A. McKenna

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California ISO

Energy Imbalance Market
December 1 – December 31, 2016

Transition Period Report
Arizona Public Service Entity

April 4, 2017

I. Introduction and Background

On October 29, 2015, the Federal Energy Regulatory Commission (Commission) approved the California Independent System Operator Corporation's (CAISO) proposed tariff amendments to allow a transition period for new Energy Imbalance Market (EIM) entities during the first six months of EIM participation, effective November 1, 2015.¹ Arizona Public Service Company (APS) entered the EIM on October 1, 2016, and the transition period will apply to its balancing authority area until April 1, 2017.

During the six-month transition period, the pricing of energy in the balancing authority area of a new EIM entity is not subject to the pricing parameters that normally apply when the market optimization relaxes a transmission constraint or the power balance constraint. Instead, during the six-month transition period, the CAISO will clear the market based on the marginal economic energy bid (referred to as "transition period pricing"). In addition, during the six-month transition period, the CAISO sets the flexible ramping constraint relaxation parameter for the new EIM entity's balancing authority area between \$0 and \$0.01, but only when the power balance or transmission constraints are relaxed in the EIM balancing authority area. This is necessary to allow the market software to determine the marginal energy bid price.

Consistent with the Commission's October 29 order, the CAISO and the Department of Market Monitoring (DMM) will file informational reports at 30-day intervals during the six-month transition period for any new EIM entity. The CAISO provides this report for APS to comply with the requirements in the Commission's October 29 order. The CAISO will continue to file the monthly reports until the expiration of the transition period for the APS balancing authority area. The timing of the monthly reports may vary according to availability of data and coordination with the EIM entity to whom the report pertains. Because the DMM must review the CAISO's report before completing its own independent assessment, the DMM will file its report approximately 15 business days after the CAISO files its report.

¹ *California Indep. Sys. Operator Corp.*, 153 FERC ¶ 61,104 (2015) (October 29 order).

II. Highlights

- In December, the APS balancing authority area observed average prices of \$27.79/MWh and \$29.23/MWh in the fifteen-minute market (FMM) and real-time dispatch (RTD).
- The APS balancing authority area passed over 92.2 percent of its balancing tests in December.
- The APS balancing authority area passed in 98.42 percent and 82.69 percent of its flexible ramping sufficiency tests for upward and downward capacity, respectively, in December.
- The APS balancing authority area observed no valid power balance constraint infeasibilities in the FMM. The APS balancing authority area observed valid power balance constraint infeasibilities in 0.06 percent of the intervals in the RTD.
- The APS balancing authority area observed flexible ramping constraint infeasibilities in 0.8 and 9.85 percent of the intervals in the FMM for upward and downward capacity, respectively. The average flexible ramping price for upward capacity in December was \$3.87/MWh.

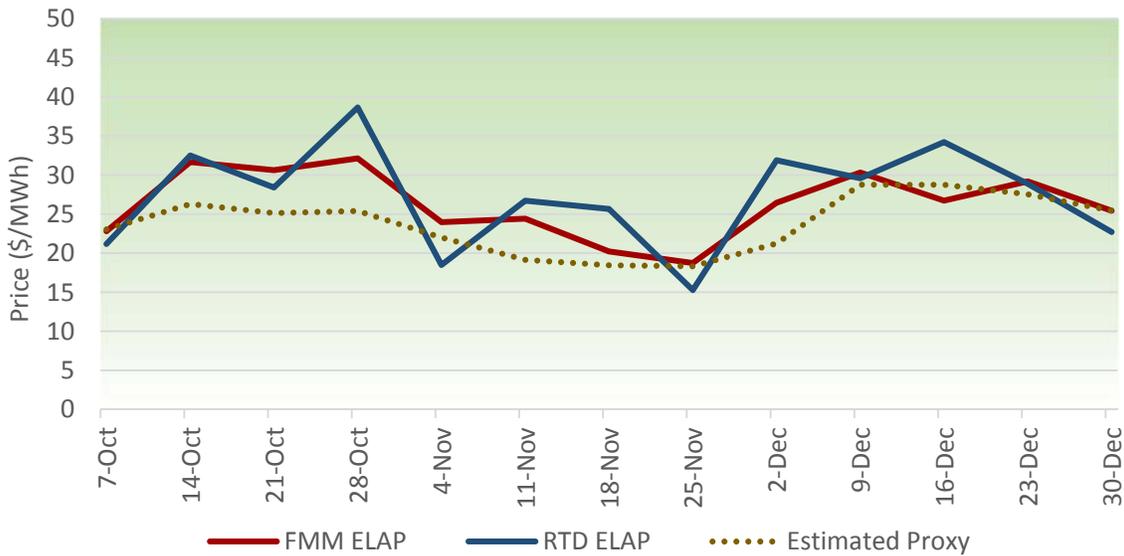
III. Report

a. Prices

Figure 1 shows that average prices in the APS EIM Load Aggregation Point (APS ELAP)² were \$27.79/MWh in the FMM and \$29.23/MWh in the RTD. These prices were higher than the \$24.84/MWh and \$21.98/MWh average prices observed in November in the FMM and RTD, respectively.

² The ELAP provides aggregate prices that are representative of pricing in the overall APS balancing authority area.

Figure 1: Daily average prices for the APS balancing authority area.



Under the CAISO’s price correction authority in Section 35 of the CAISO tariff, the CAISO may correct prices posted on its Open Access Same-time Information System (OASIS) if it finds: (1) that the prices were the product of an invalid market solution; (2) the market solution produced an invalid price due to data input failures, hardware or software failures; or (3) a result inconsistent with the CAISO tariff. The prices in Figure 1 include all prices produced by the CAISO consistent with the CAISO tariff requirements.³ The trends below represent: (1) prices as produced in the market that the CAISO deemed valid; (2) prices that the CAISO could, and did, correct under Section 35 of the CAISO tariff; and (3) any prices the CAISO adjusted under transition period pricing reflected in Section 29.27 of the CAISO tariff. In December, there were two instances in the FMM and 45 instances in the RTD that required a price correction for the APS balancing authority area under Section 35 of the CAISO tariff.

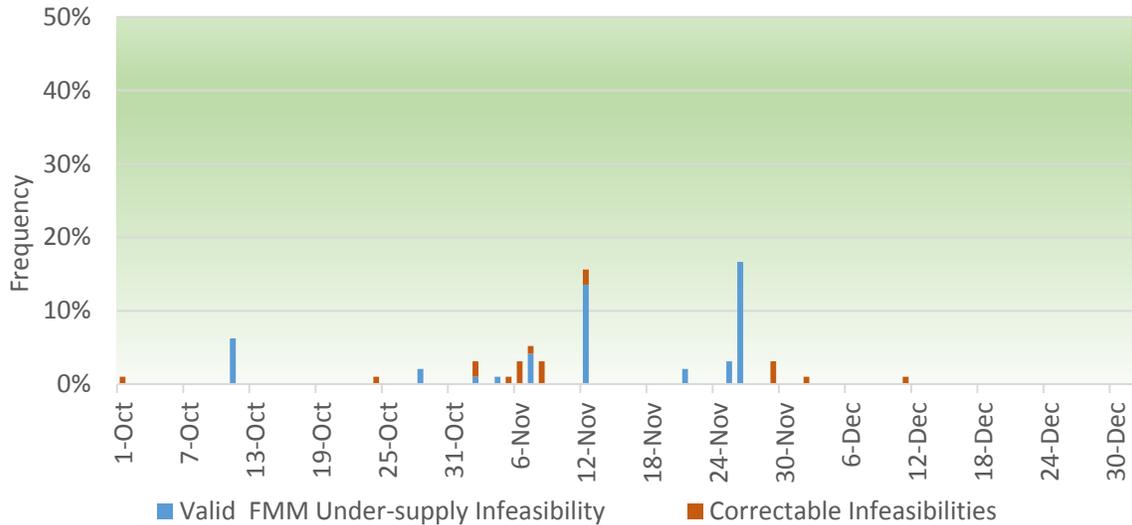
b. Frequency of Power Balance Constraint Infeasibilities

Figures 2 and 3 show the frequency of intervals that the power balance constraint was relaxed for under-supply conditions in the APS balancing authority area for the FMM and RTD, respectively. The under-supply infeasibilities are grouped into “valid” and “correctable” instances. Prices for the intervals that fell in the “valid” category are instances with under-supply infeasibilities not in error

³ Figure 1 also provides an estimated proxy price, which for the APS balancing authority area is the weighted average the day-ahead price for the PaloVerde, Four Corners, and Mead hubs from the Intercontinental Exchange (ICE).

and that are subject to the transitional period pricing. Whereas the CAISO corrected under-supply infeasibilities that fell in the “correctable” category, that were due to either a software error or data error under Section 35 of the CAISO tariff.

Figure 2: Frequency of FMM under-supply power balance infeasibilities in the APS balancing authority area.



In the APS balancing authority area, there was no under-supply infeasibility in the FMM. However, the RTD market observed 4 (0.04 percent of the time) valid under-supply infeasibilities. The reasons for these under-supply infeasibilities are:

- i) December 2 and December 6, RTD. Limited supply capacity in the market driven by net imports changes.
- ii) December 3, RTD. Redispatch of resources in the CAISO-APS area.
- iii) December 11, RTD. Deviations of renewable generation.

There was one valid RTD infeasibility in the APS balancing authority area that coincided with load conformance. The CAISO uses a load conformance limiter in the CAISO balancing authority area and in each of the EIM balancing authority areas to prevent over-adjustments through load conformance, and prevent an artificial infeasibility – one that does not reflect actual scarcity. When the quantity of the infeasibility is less than the operator’s adjustment, and the infeasibility is in the same direction as the adjustment, the load conformance limiter automatically limits the operator’s adjustments to at least the level of the infeasibility. In the pricing run, the limiter will remove an infeasibility that is less than or equal to the operator’s adjustment, *i.e.*, the load conformance. The limiter will not apply to infeasibilities greater than or in the opposite direction of

the load conformance. Use of the load conformance limiter in the CAISO balancing authority area has avoided invalid constraints that arise through operational adjustments that do not reflect supply issues. During the transition period, the CAISO does not apply the load conformance limiter because it applies the transition period pricing, which obviates the need for the load conformance limiter. Therefore, Figure 3 illustrates the infeasibilities avoided by the load conformance limiter were it in effect during the transition period in the APS balancing authority area.

Figure 3: Frequency of RTD under-supply power balance in feasibility in the APS balancing authority area.

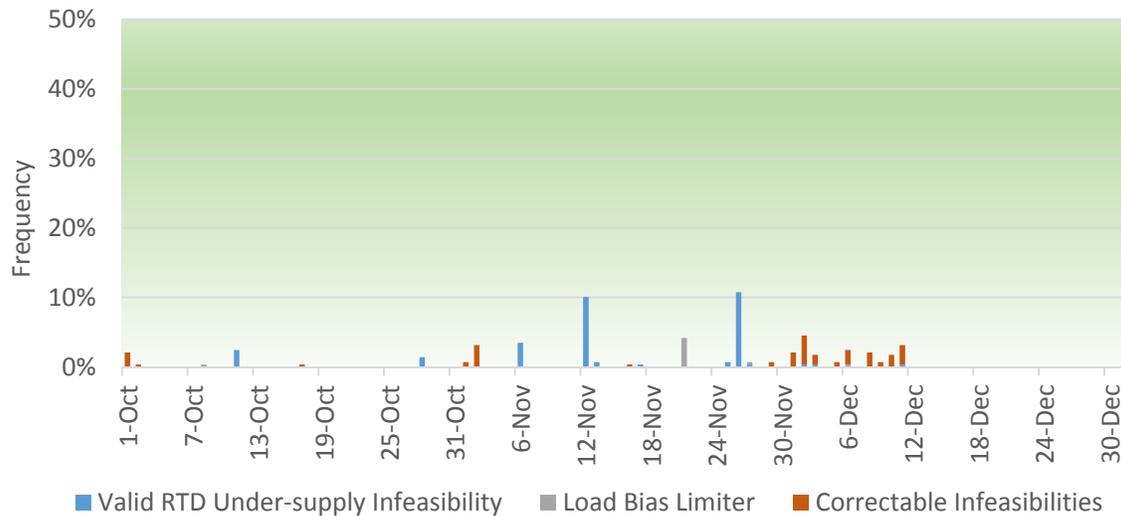


Table 1 lists the RTD intervals with infeasibilities observed in December, including the load conformance to reflect the instances that the load conformance limiter would have triggered and offset the infeasibility. There were no instances of under-supply infeasibilities in the FMM.

Table 1: List of valid RTD under-supply infeasibilities in the APS balancing authority area.

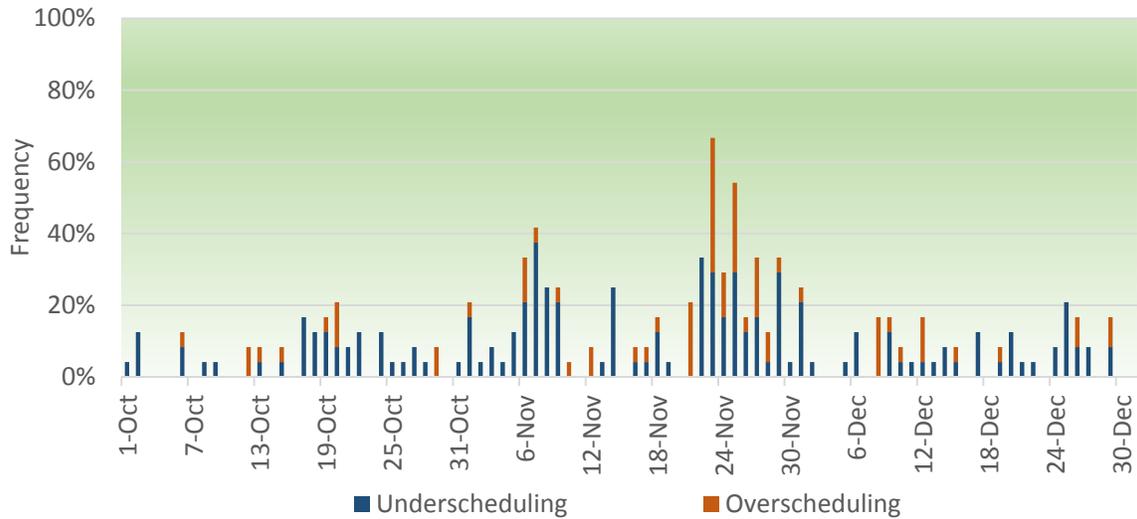
Trade Date	Trade Hour	Trade Interval	MW Infeasibility	Load Conformance
02Dec2016	1	3	9.72	0
03Dec2016	6	12	63.52	0
06Dec2016	18	1	6.51	100
11Dec2016	8	1	24.29	0

c. Balancing and Sufficiency Test Failures

Figure 4 shows the trend of balancing test outcomes for December, which the CAISO performs under Section 29.34(k) of the CAISO tariff. The APS balancing authority area passed the balancing test in 92.2 percent of the intervals in December, 5.64 percent of the failures were for under-scheduling, while 2.15

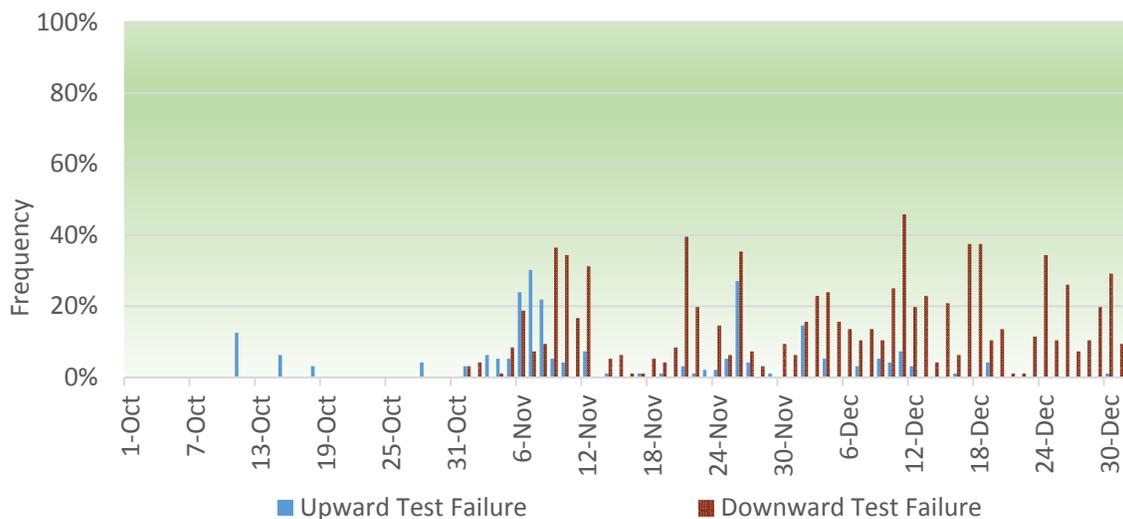
percent were for over-scheduling. The frequency of these failures is within historical ranges.

Figure 4: Frequency of balancing test failures in the APS balancing authority area.



The CAISO also performs the flexible ramping sufficiency test as specified in Section 29.34(m) of the CAISO tariff. Figure 5 shows the trend of the test failures for flexible ramping for December. The APS balancing authority area passed the test in 98.42 percent for the upward capacity and 82.69 percent downward capacity in December. With implementing the flexible ramping product on November 1, 2016, the CAISO conducts the test separately for each direction.

Figure 5: Frequency of flexible ramping sufficiency test failures in the APS balancing authority area.



The APS balancing authority area experienced a high frequency of intervals that the APS EIM entity failed the flexible ramping test, predominantly in the downward direction. Several were driven by incomplete rules or wrong accounting for the APS balancing authority area's resources flexible capability in within the flexible ramping sufficiency test calculations. The market software introduced several enhancements and fixes to calculate the flexible capability more accurately. These enhancements and fixes are summarized below.

1. Prior to December 21, 2016, the market software had limited ability to consider commitment instructions (start-ups, shut-downs, MSG transitions, etc.) in the calculation of capability uses in the flexible ramping test. The calculation would account for ramping capacity based only on the resource status and configuration at 7.5 minutes before the trading interval and it would disregard resource status or binding instructions after that time. After the enhancement on December 21, the logic would primarily use the resource status within the hour to calculate upward capacity.
2. Limited ability to account more accurately for upward and downward flexible capacity for multi-stage generator units in calculating the flexible ramping test. The software issue was corrected on December 21. After the market software issue was corrected, the software could better account the available flexible capacity under different scenarios, such as when the unit had self-schedules, when the unit is with initial status of offline, if the unit has base schedules, if the unit only has economic bids, or whether the unit can be started up in less than an hour.
3. When an EIM balancing authority area fails the capacity test, it also fails the flexible ramping test by default/design. Therefore, some of the flexible ramping test failures were due to failures in the capacity (range) test. The calculation of the capacity test requirement uses historical data. However, given that the APS balancing authority area was a new EIM entity, the APS balancing authority area capacity requirement calculation is very sensitive to even the smallest of changes in data due to a limited set of similar day-type data for a corresponding hour in days. There was not sufficient historical data to calculate the requirements accurately and mitigate volatility of the calculation.
4. The APS balancing authority area has many units, particularly multi-stage generators, with large PMin MW for the 1x1 configuration. When a large PMin unit is starting up or coming online, the increase in generation leads to increases in the flexible ramping down requirement to levels where the APS balancing authority area would fail the test. The CAISO is working on an

enhancement of the flexible ramping test calculation to simulate startup profile and expects to deploy the enhancement into production by end of the first quarter of 2017.

5. For jointly owned units (JOUs) with dynamic non-EIM export share, the test calculation was looking for export schedule based on the enhancement mentioned in item 2, above. However, these JOUs do not have the updated real-time interchange schedule within the hour, which causes the flexible ramping sufficiency calculation to use zero MW instead of base schedule values. The market optimization uses telemetry as an indication for updated information within the hour and otherwise uses base schedule values. The CAISO is working on an enhancement flexible ramping test and expects to deploy it into production by end of the first quarter of 2017.
6. The current flexible ramping uncertainty requirements calculations are based on separate historical data histograms for imports and exports. Therefore, the requirements increase whenever there are changes in the imports or exports relative to their base schedules within the hour. This separation of import and export histograms is not practical and it unnecessarily increases the balancing authority area uncertainty requirements. The CAISO believes that it can enhance this business practice and is working on a business practice manual (BPM) change to describe the enhanced treatment of net imports and exports changes into one histogram for the flexible ramping uncertainty requirements calculations. The CAISO intends to complete the BPM change and implement the enhancement before end of the second quarter of 2017.

Finally, there were some other issues in the APS balancing authority area that contributed to some of the flexible ramping test failures, which includes:

1. For a specific resource, the initial forecast values provided by the APS balancing authority area were sometimes inaccurate. One was related to the data sent to the CAISO for the horizon past T-40. This forecast rarely included changes from the current hour's schedule. This led to inaccurate amounts of sufficiency capacity calculation for the shoulder hours of the renewable forecast. This issue was resolved around December 5.
2. The generation the APS balancing authority area has online affects flexible ramping capability. Having a couple larger units online instead of several smaller units limits the APS balancing authority area's flexible ramping down capability. The APS balancing authority area has experienced flexible ramping down failures due

to keeping units online that cannot support adequate downward movement.

3. Large load forecast changes have contributed to flexible ramping failures. The APS balancing authority area makes a generation plan to support a higher load forecast at T-55. When the load forecast drops at T-40, the plan does not support adequate room to move down.

d. Flexible Ramping Product Infeasibilities

In this section, the CAISO discusses the frequency with which and the reasons the flexible ramping product constraint was binding in the APS balancing authority area.

In December, the flexible ramping constraint in the APS balancing authority area was infeasible on a daily average in 0.81 percent and 9.85 percent of the FMM intervals for upward and downward capacity, respectively. With implementing the flexible ramping product, the connotation of infeasibility or relaxation for flexible ramping has changed. The term of infeasibility refers to the market outcome where the clearing of the flexible ramping product lies on a point of the price-responsive demand curve for flexible ramping rather than a traditional relaxation of the constraint. These infeasibilities were mainly driven by the economics of the flexible ramping constraint and the opportunity costs regarding energy. The CAISO market co-optimizes the procurement of energy and flexible ramping capacity and the flexible ramping product relies on a demand curve. Therefore, the optimization process may find that based on the overall economics of the system for energy and flexible ramping capacity, it is more economical to relax the flexible ramping requirement by clearing at a price-responsive segment of the flexible ramping demand curve instead of procuring more flexible ramping capacity at a higher cost.

Figure 6: Frequency of flexible ramp constraint infeasibilities in the APS balancing authority area.

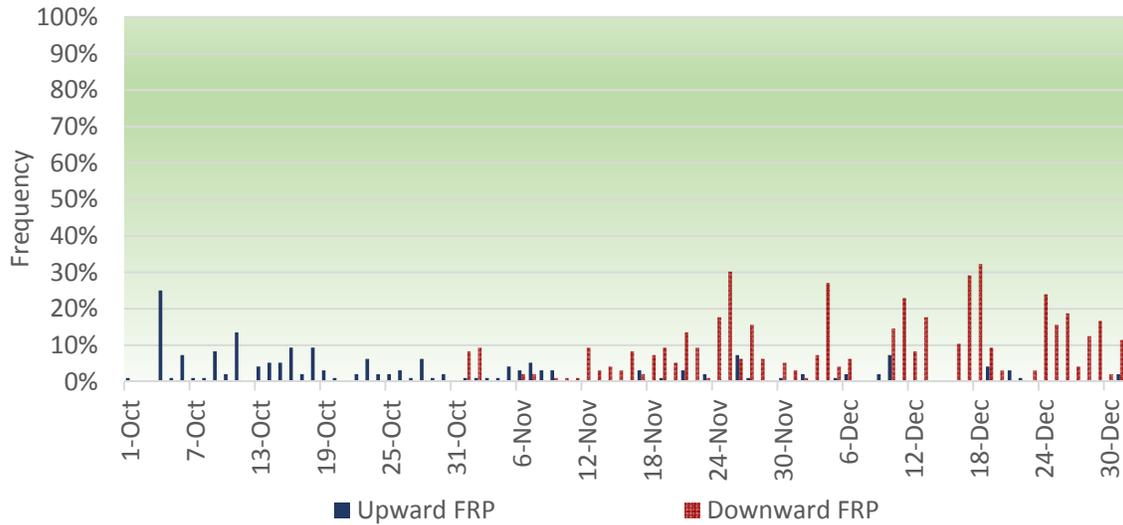
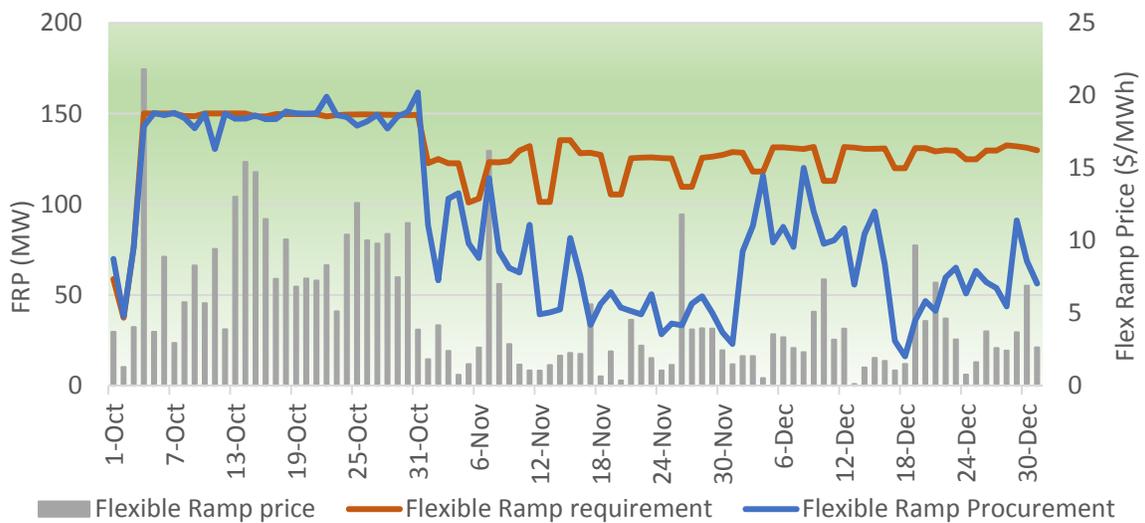


Figure 7 shows the daily average of the flexible ramping constraint requirement and procurement in the APS balancing authority area. In the vast majority of the hours, both the CAISO and the APS balancing authority areas were meeting their flexible ramping requirement. This plot also shows the daily average of the shadow price for the flexible ramping constraint in the APS balancing authority area. On average, the flexible upward ramp price was \$3.27/MWh in December, slightly lower than the \$3.87/MWh observed in November.

Figure 7: Average requirement and procurement of flexible ramping in the FMM in the APS balancing authority area.



CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon the parties listed on the official service list in the above-referenced proceeding, 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 4th day of April 2017.

/s/ Grace Clark
Grace Clark