

November 16, 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. ER15-861  
Energy Imbalance Market – Fourth Quarter 2016  
Available Balancing Capacity Report**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) hereby submits its quarterly informational report for the fourth quarter of 2016 (October 1 to December 31, 2016) on the Available Balancing Capacity (ABC) enhancement for the Energy Imbalance Market (EIM). The quarterly informational report is to provide the Commission with information on the performance of the ABC enhancement and to provide the same information the CAISO provides in its monthly informational reports submitted during an EIM entity's first six-month transition period.

Consistent with the Commission's directive in the December 17, 2015 order, the CAISO will continue to file such quarterly reports for at least the first year after implementation of the ABC enhancement, until the Commission finds the quarterly informational reports are no longer needed.

Please contact the undersigned with any questions.

Respectfully submitted

**By: /s/ Anna A. McKenna**

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# California ISO

**Energy Imbalance Market**  
**October 1 – December 31, 2016**  
**Available Balancing Capacity Report**

November 16, 2017

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## I. Background

On December 17, 2015, the Federal Energy Regulatory Commission (Commission) approved the California Independent System Operator Corporation's (CAISO) proposed tariff revisions to comply with the Commission's July 20, 2015 order in FERC Docket No. ER15-861-006.<sup>1</sup> The CAISO's proposed tariff provisions to enhance the Energy Imbalance Market (EIM) functionality so that the market systems automatically recognize and account for capacity an EIM entity has available to maintain reliable operations in its own balancing authority area (BAA), but has not been bid into the EIM.<sup>2</sup> This enhancement is referred to as the Available Balancing Capacity (ABC) enhancement. The CAISO implemented the ABC enhancement on March 23, 2016.

Consistent with the CAISO's commitments made in this proceeding, the Commission directed the CAISO to prepare and file with the Commission quarterly informational reports for the first year after implementation of the ABC enhancement.<sup>3</sup> The quarterly informational reports are to provide information on the performance of the ABC enhancement and provide the same information the CAISO provides in its monthly informational reports submitted during an EIM entity's first six-month transition period.<sup>4</sup>

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<sup>1</sup> *Cal. Indep. Sys. Operator Corp.*, 152 FERC ¶ 61,060 (2015); and *Cal. Indep. Sys. Operator Corp.*, 153 FERC ¶ 61,305 (2015) (December 17 Order).

<sup>2</sup> *Id.* at P 1.

<sup>3</sup> *Id.* at P 99.

<sup>4</sup> *Id.* at P 39.

**II. Highlights**

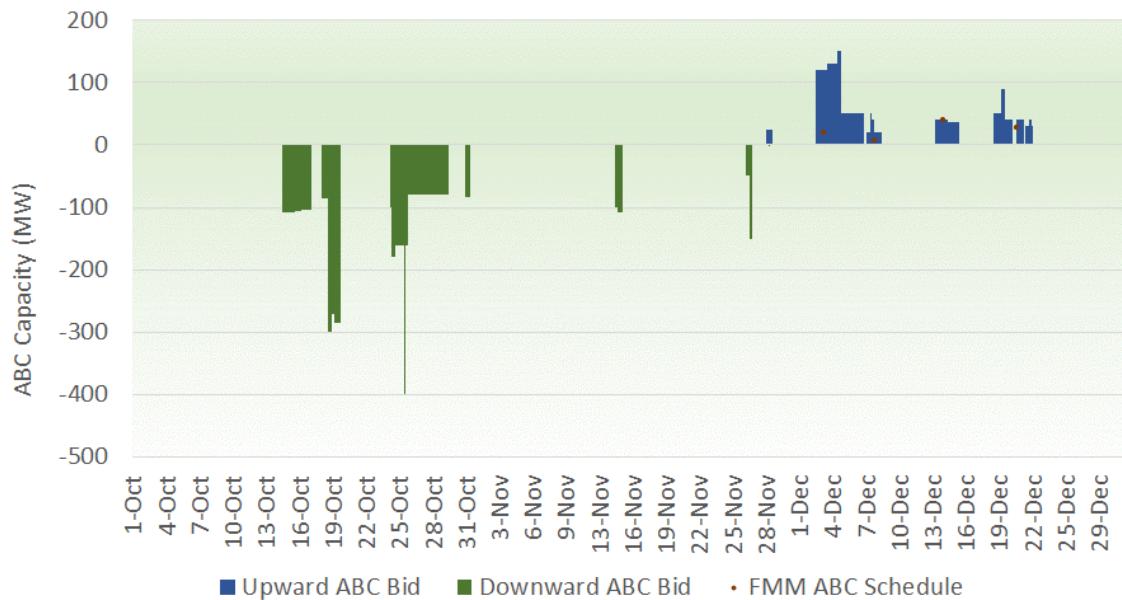
- The CAISO implemented the ABC enhancement on March 23, 2016. The price discovery mechanism for the PacifiCorp West and PacifiCorp East BAAs ended with the activation of the ABC enhancement.
- In the fourth quarter of 2016, ABC submitted for the PAC West and East balancing authority areas, for both upward and downward capacity, was very limited with less than 12 percent of the time.
- Overall, NV Energy, Puget Sound Energy, and Arizona Public Service Company submitted ABC for upward capacity in over 70 percent of the time.
- Generally, the CAISO real-time market continued to dispatch ABC in either upward or downward directions in less than three percent of the market intervals.
- The number of resources supporting the submitted ABC during the fourth quarter continue to be low, with as few as one resource in the PacifiCorp West BAA and as many as 10 resources in the Arizona Public Service Company BAA.

### III. Available Balancing Capacity

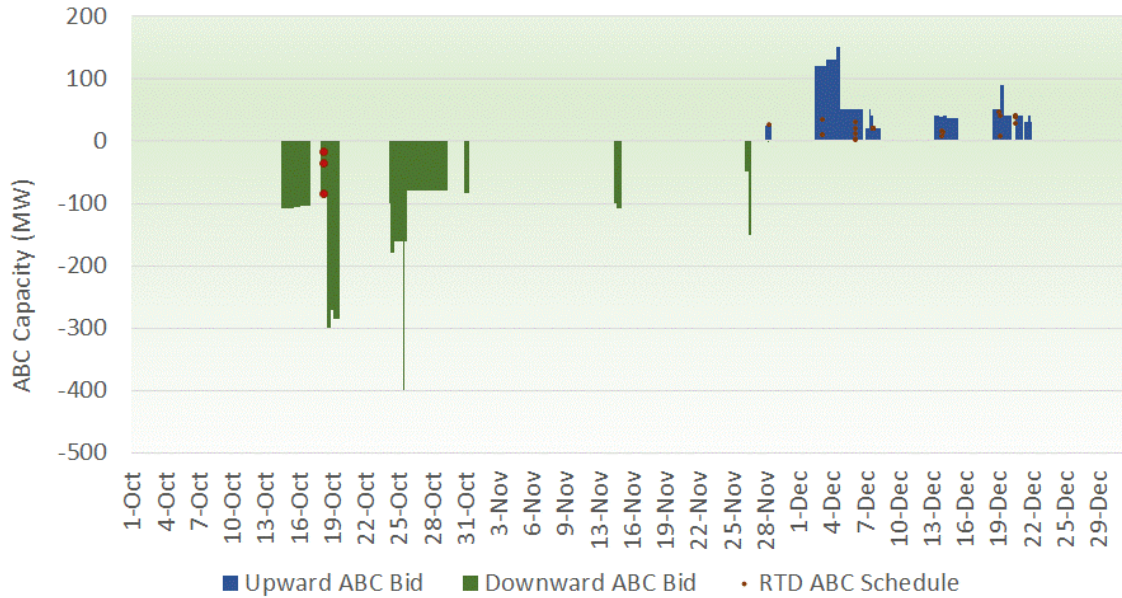
#### A. ABC submitted to the market

Each EIM entity can identify and set the amount of ABC they will make available to the CAISO and the resources supporting this capacity through its EIM entities resource plan. The EIM Entity submits this capacity to the CAISO on an hourly basis, and it is available for both the fifteen-minute market (FMM) and the five-minute real-time dispatch (RTD). Figures 1 through 10 show the ABC made available in each of the EIM BAA: PacifiCorp West (PAC West), PacifiCorp East (PAC East), NV Energy, Puget Sound Energy (PSE) and Arizona Public Service (APS). For each BAA, there are two plots to show the ABC dispatched in the FMM and RTD, separately. The blue bars and positive values illustrate the ABC upward capacity made available by the EIM entity, and the green bars and negative values illustrate the downward ABC made available.

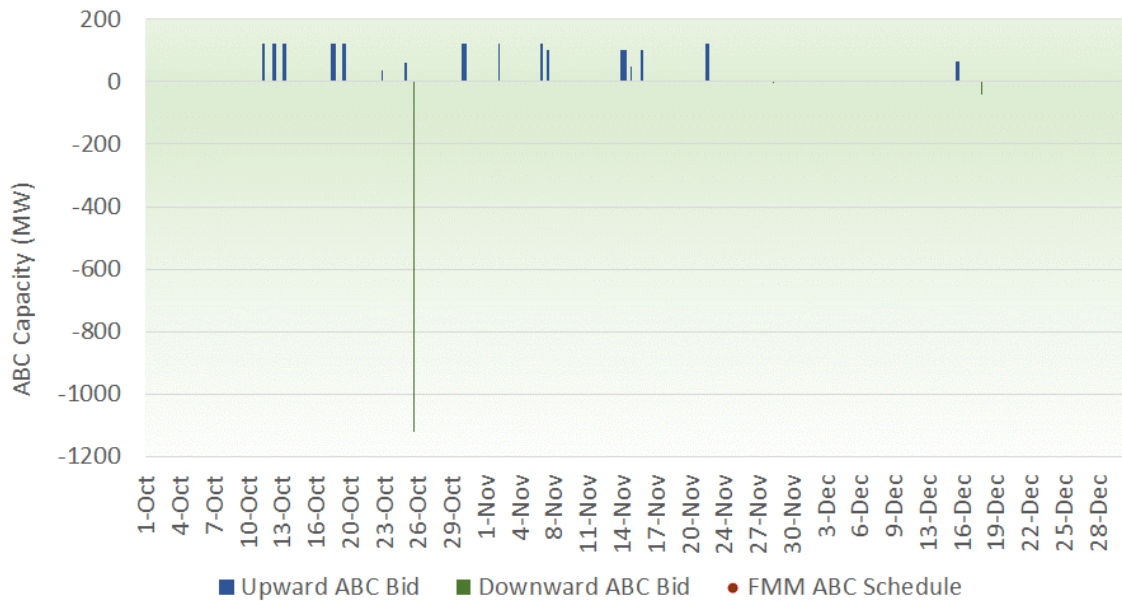
**Figure 1: Submitted and Scheduled ABC in the PAC West BAA – FMM**



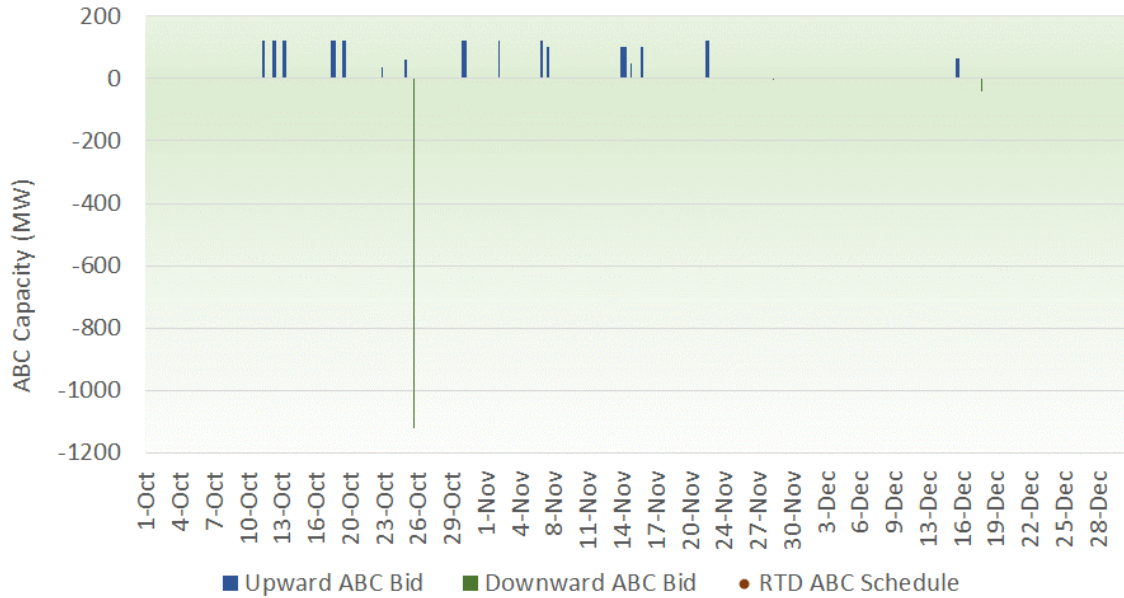
**Figure 2: Submitted and Scheduled ABC in the PAC West BAA – RTD**



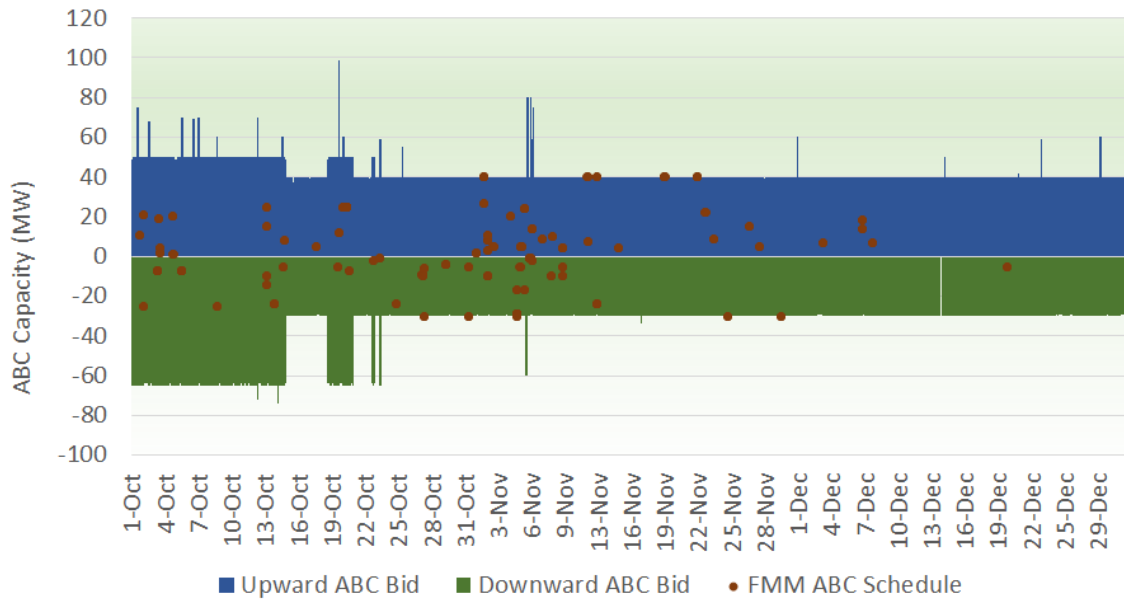
**Figure 3: Submitted and Scheduled ABC in the PAC East BAA – FMM**



**Figure 4: Submitted and Scheduled ABC in the PAC East BAA – RTD**

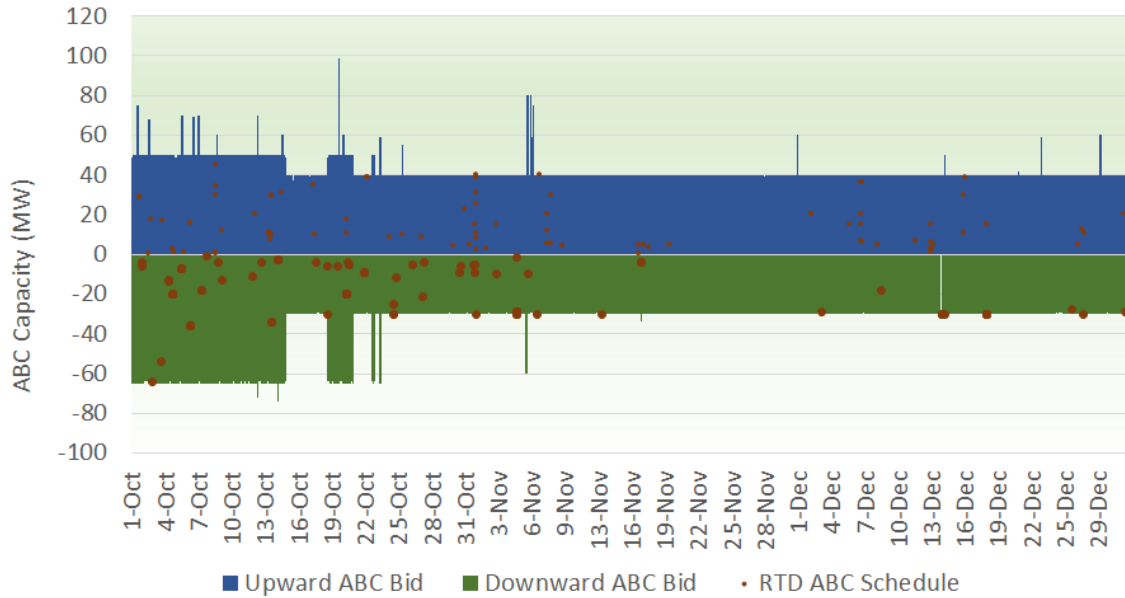


**Figure 5: Submitted and Scheduled ABC in the NV Energy BAA – FMM**

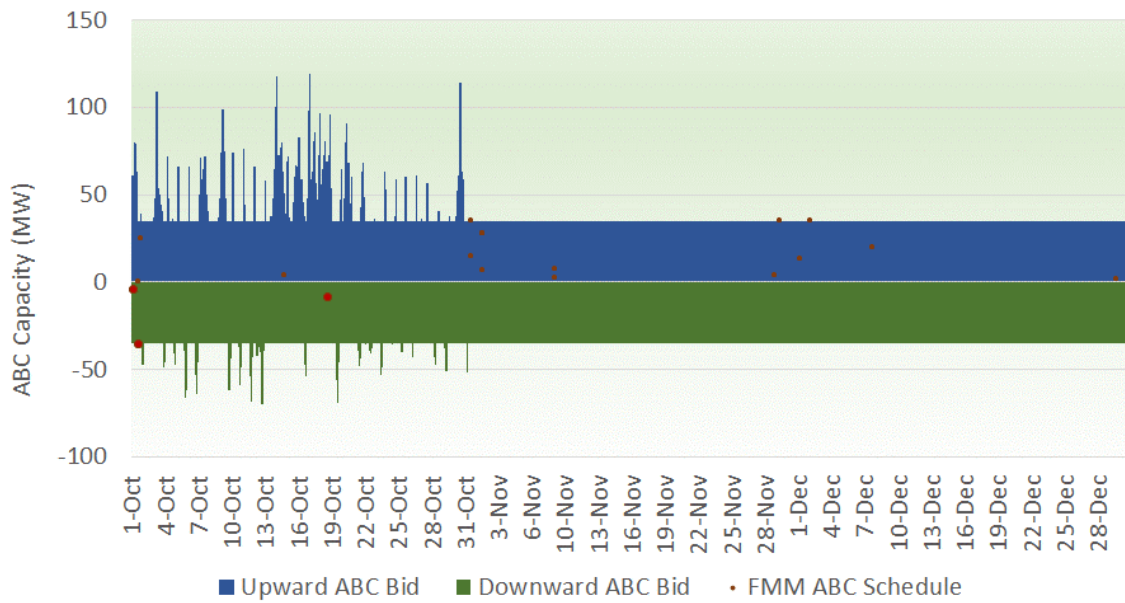




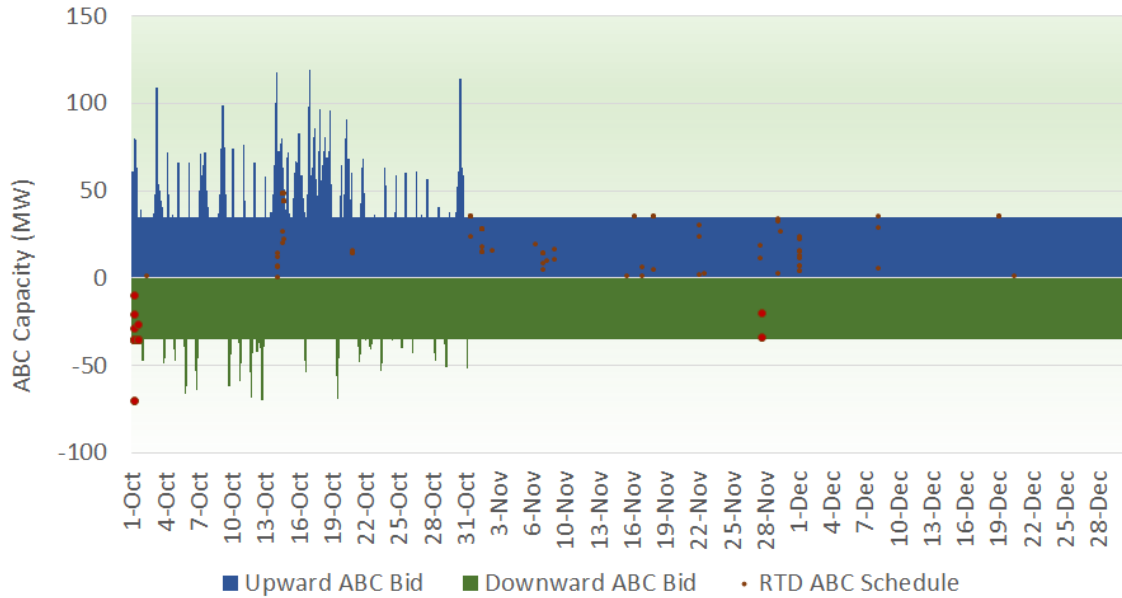
**Figure 6: Submitted and Scheduled ABC in the NV Energy BAA – RTD**



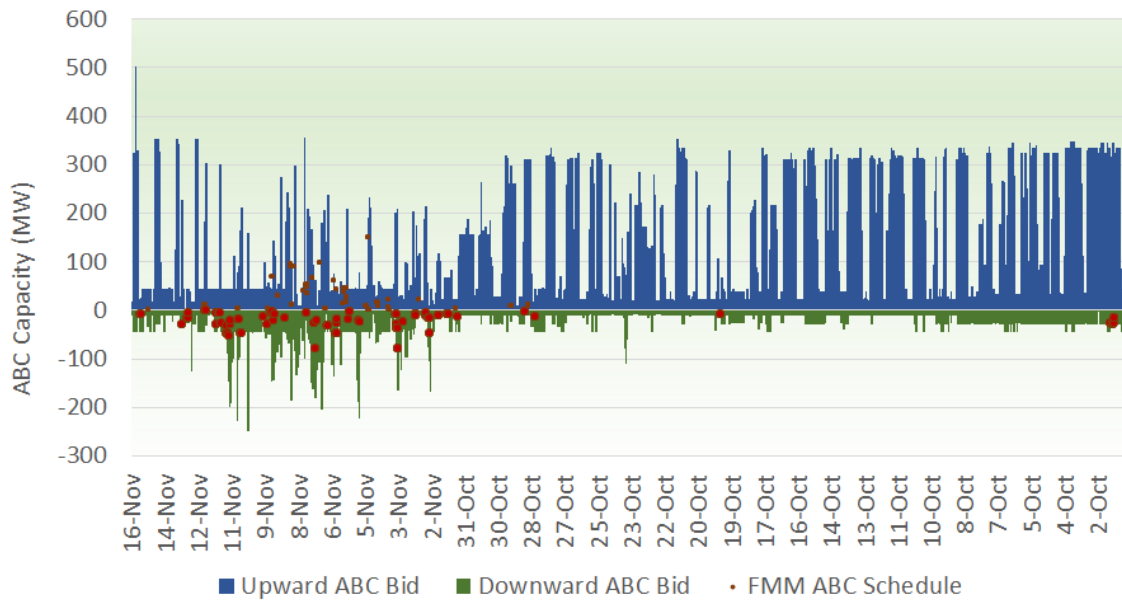
**Figure 7: Submitted and Scheduled ABC in the PSE BAA – FMM**



**Figure 8: Submitted and Scheduled ABC in the PSE BAA – RTD**



**Figure 9: Submitted and Scheduled ABC in the APS BAA – FMM**



**Figure 10: Submitted and Scheduled ABC in the APS BAA – RTD**

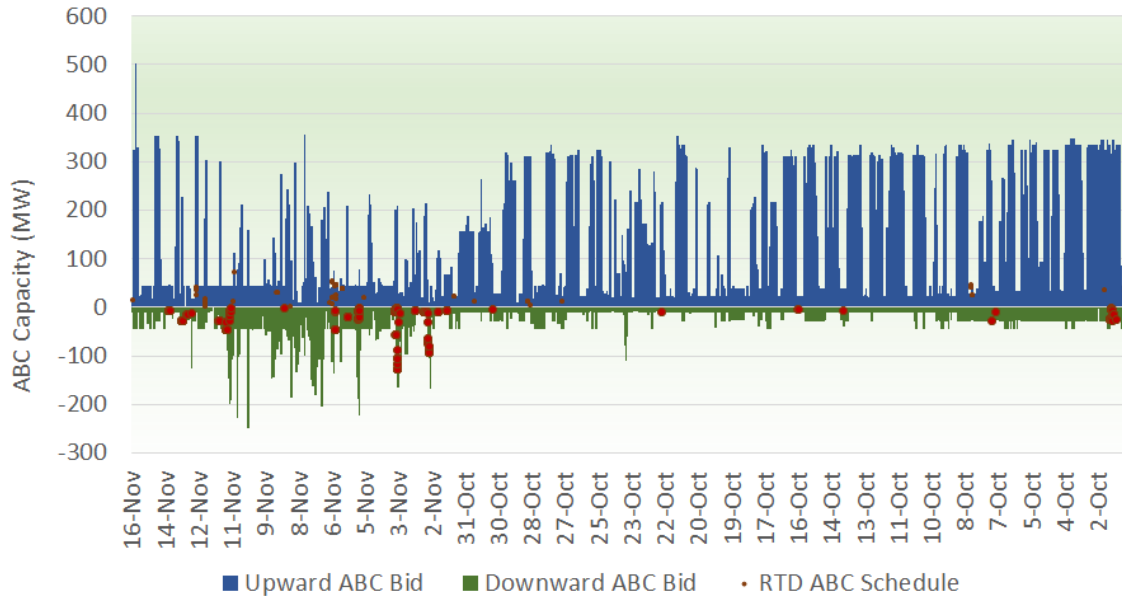


Table 1 summarizes the percentage of intervals in which each of the EIM Entities submitted ABC.

**Table 1: Frequency of ABC submitted to market**

BAA	Upward Capacity	Downward Capacity
PAC West	10.9%	11.9%
PAC East	2.8%	0.14%
NV Energy	99.8%	99.4%
APS	100%	100%
PSE	75%	73%

PAC West infrequently submitted ABC through the fourth quarter of 2016. PAC East submitted even less frequently, as it submitted ABC downward capacity throughout the reported period, and intermittently submitted ABC upward capacity. In contrast, the NV Energy, APS, and PSE submitted ABC, both upward and downward capacity, for the majority of the intervals.

Table 2 shows the frequency with which the CAISO market dispatched ABC when ABC was made available, which was very infrequent for both the FMM and RTD for all five of the BAAs.

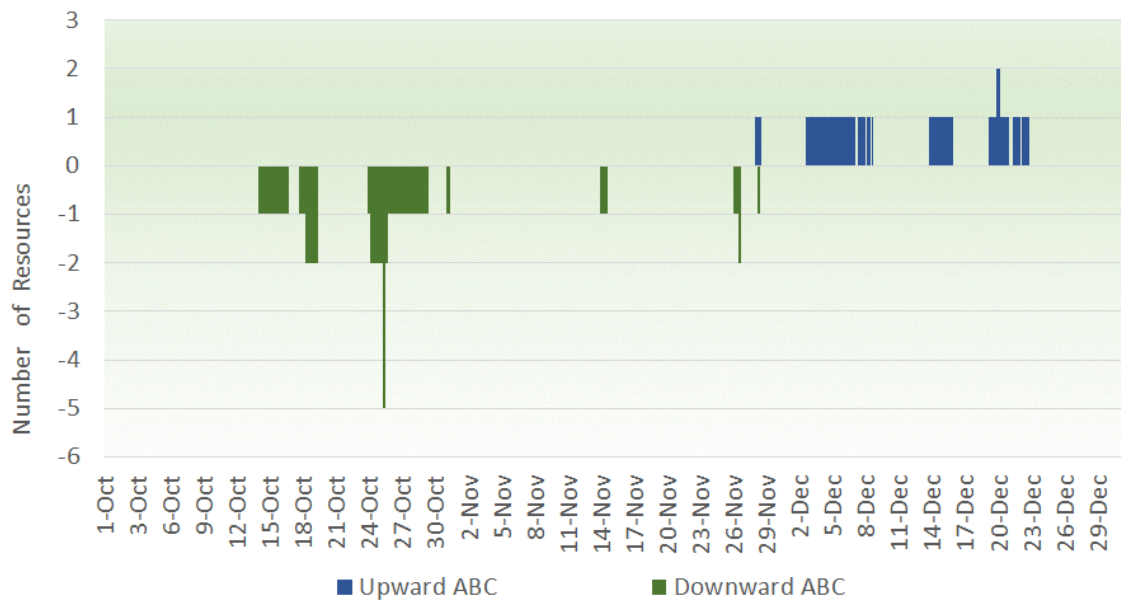
**Table 2: Frequency of ABC dispatched in the market**

Balancing Authority Area	Upward Capacity		Downward Capacity	
	FMM	RTD	FMM	RTD
PAC West	0.45%	1.15%	0%	0.13%
PAC East	0.0%	0.0%	0.0%	0.0%
NE Energy	0.92%	0.37%	0.6%	0.5%
APS	1.34%	0.45%	2.2%	1.8%
PSE	0.2%	0.35%	0.03%	0.07%

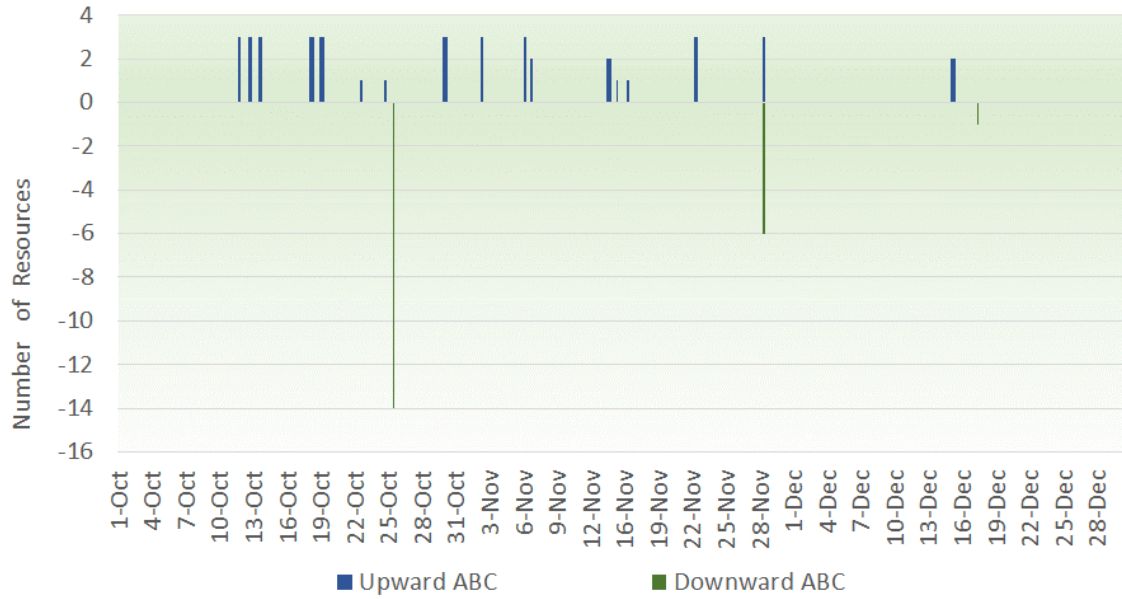
**B. Resources supporting Available Balancing Capacity**

Figures 11 through 15 show the number of different resources supporting the ABC the EIM entities submitted to the FMM and RTD. NV Energy, APS, and PSE had multiple resources supporting the submitted ABC.

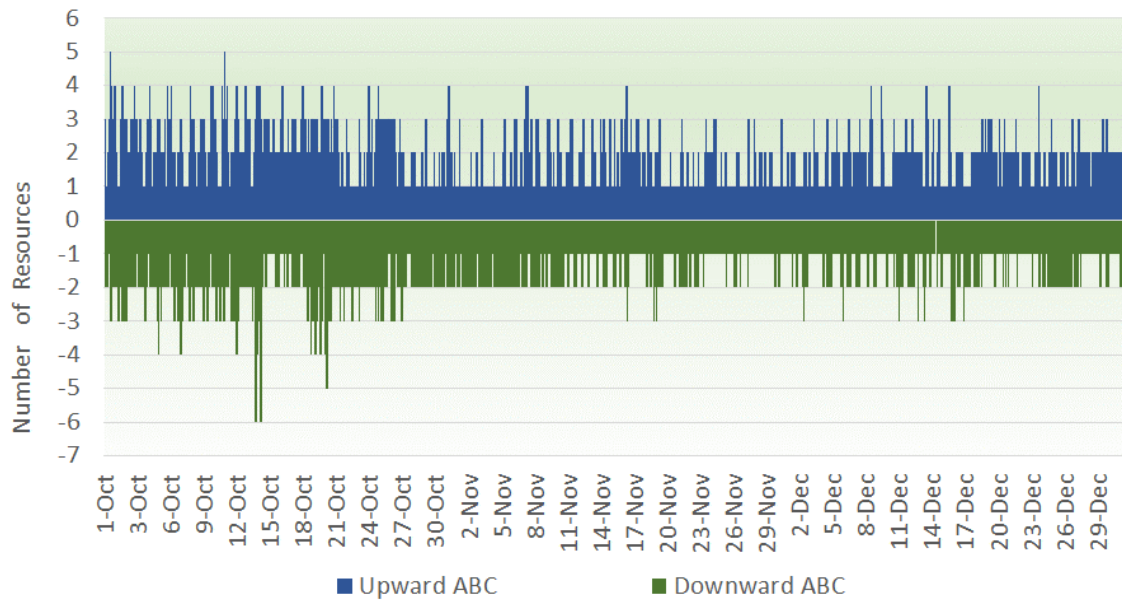
**Figure 11: Number of Resources Supporting the Submitted ABC in the PAC West BAA**



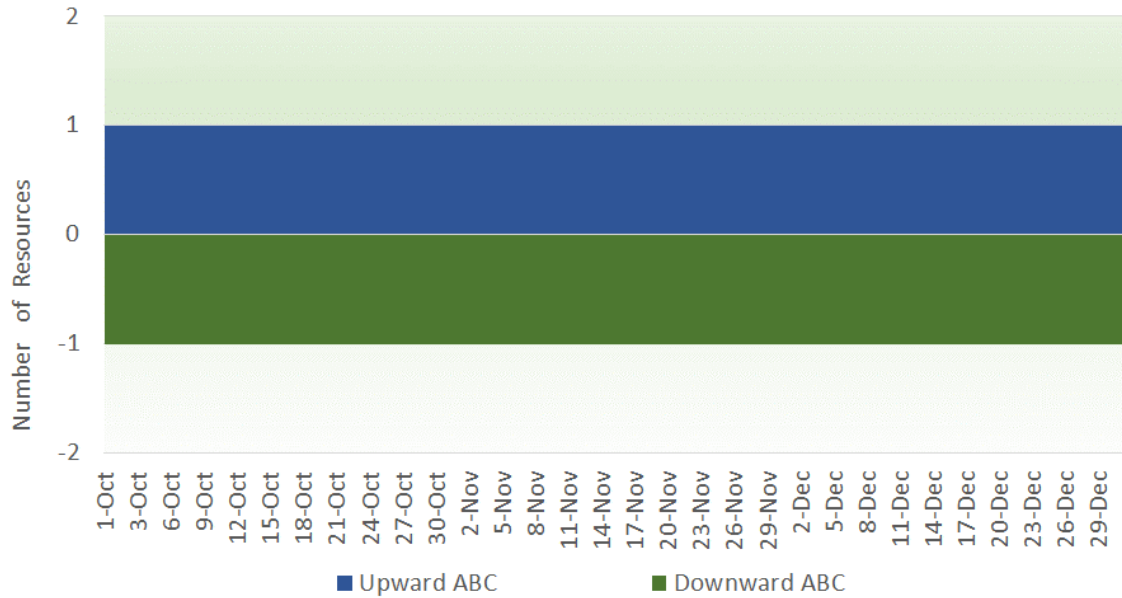
**Figure 12: Number of Resources Supporting the Submitted ABC in the PAC East BAA**



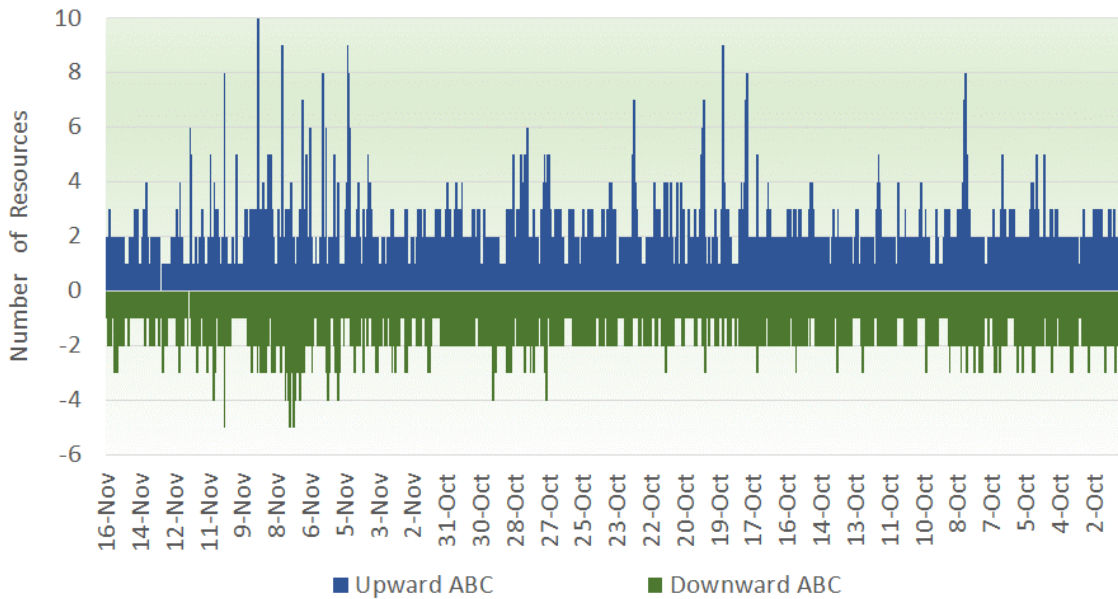
**Figure 13: Number of Resources Supporting the Submitted ABC in the NV Energy BAA**



**Figure 14: Number of Resources Supporting the Submitted ABC in the PSE BAA**



**Figure 15: Number of Resources Supporting the Submitted ABC in the APS BAA**



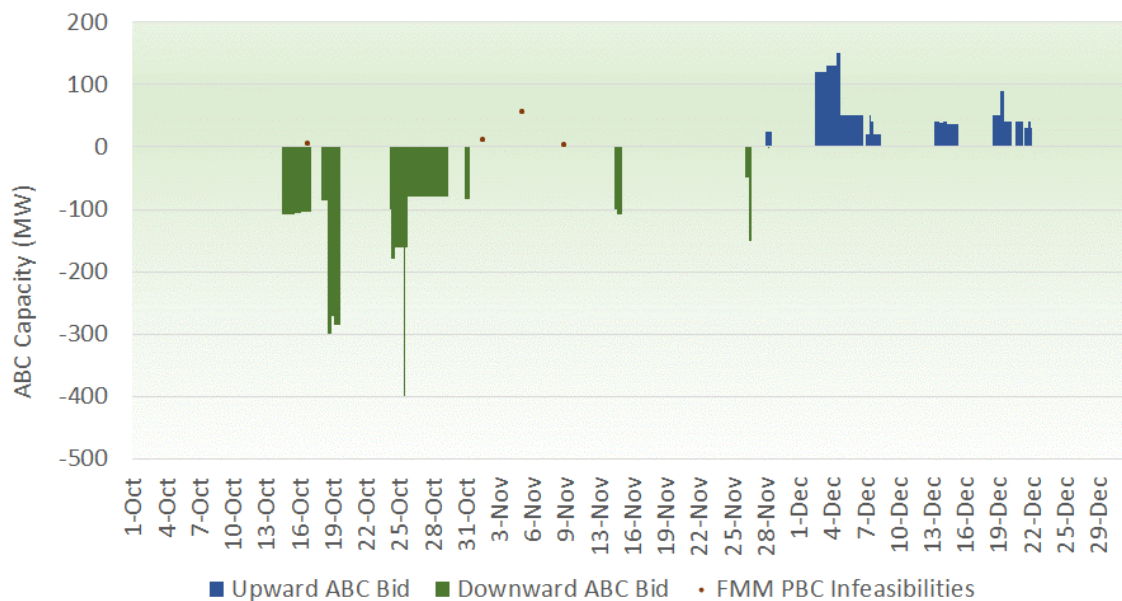


**C. ABC and Power Balance Constraint Infeasibilities**

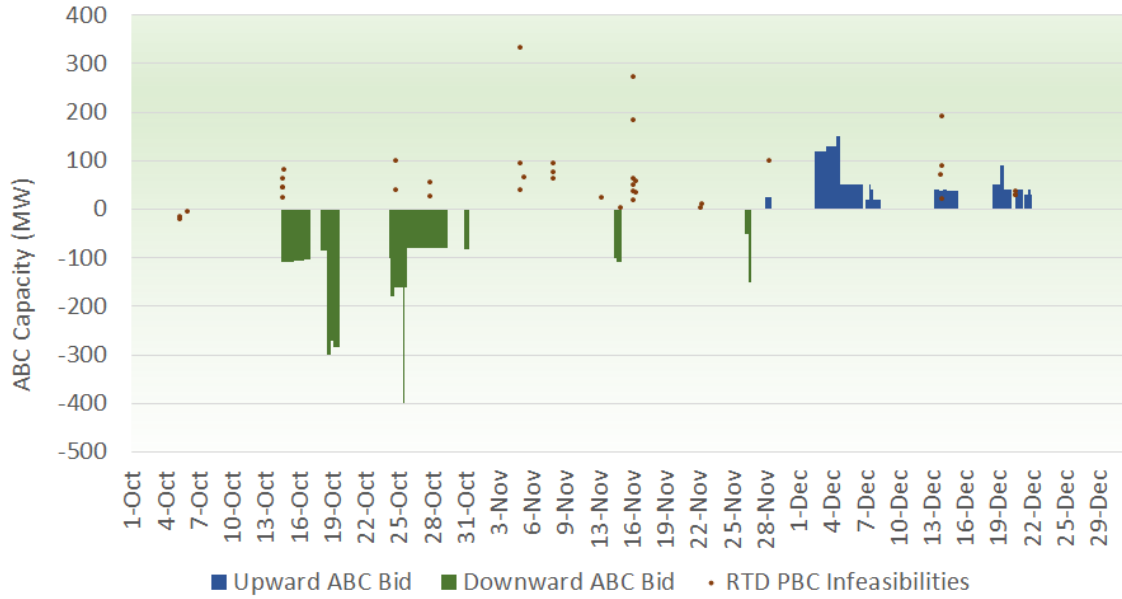
The purpose of the ABC enhancement is to make capacity available to the market that otherwise would not be visible. The primary objective in making such capacity available is that the market can recognize and access that capacity when the conditions warrant its use, namely when the market is running out of capacity made available through economic bids. The ABC is capacity stacked above economic bids, but is below the power balance constraint relaxation penalty price. When the market is tight in supply and it has exhausted all effective economic bids, the market clearing process will go through the bid stack in economic order. The market clearing process will access the ABC. If there is sufficient ABC, the market will relax the power balance constraint to clear. As such, the market clearing process uses the ABC to resolve the power balance infeasibility. If instead the ABC identified is not sufficient to cure the infeasibility, the ABC may be exhausted and there still may be a need to relax the power balance constraint in order to clear the market.

Figures 16 through 25 show the comparison between ABC submitted in the FMM and RTD, along with the power balance constraint infeasibilities, separately. In the PAC West BAA, there were a few power balance constraints infeasibilities during intervals with no ABC available in the FMM. However, in the RTD, the majority of power balance constraint infeasibilities were for under-supply conditions, but the ABC available was primarily to cover over-supply infeasibilities (ABC downward capacity).

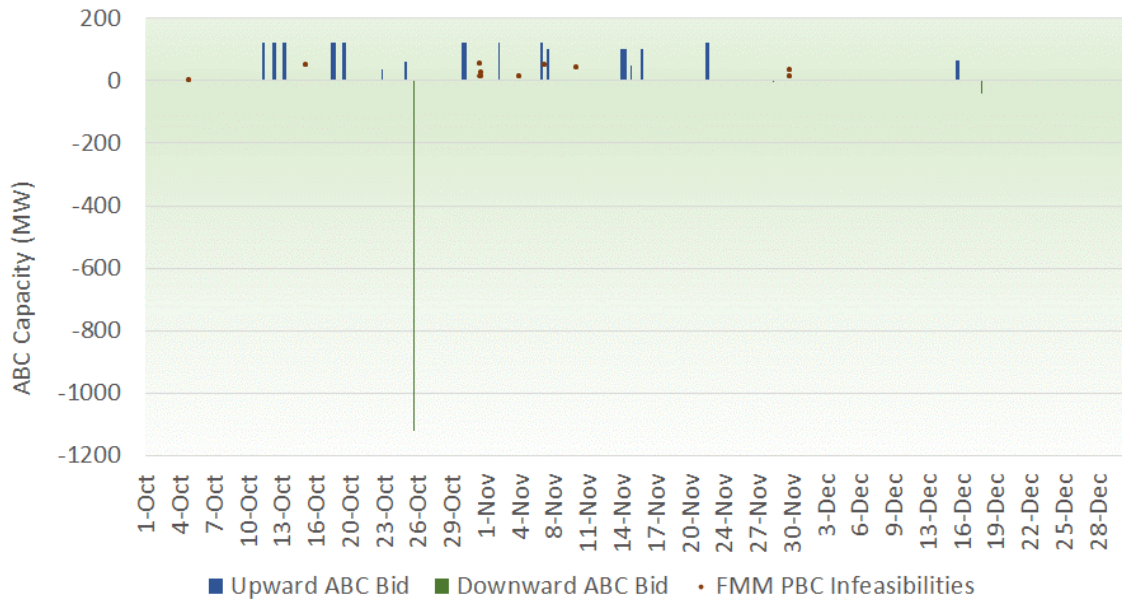
**Figure 16: Submitted ABC and Power Balance Constraint Infeasibilities in the PAC West BAA – FMM**



**Figure 17: Submitted ABC and Power Balance Constraint Infeasibilities in the PAC West BAA – RTD**

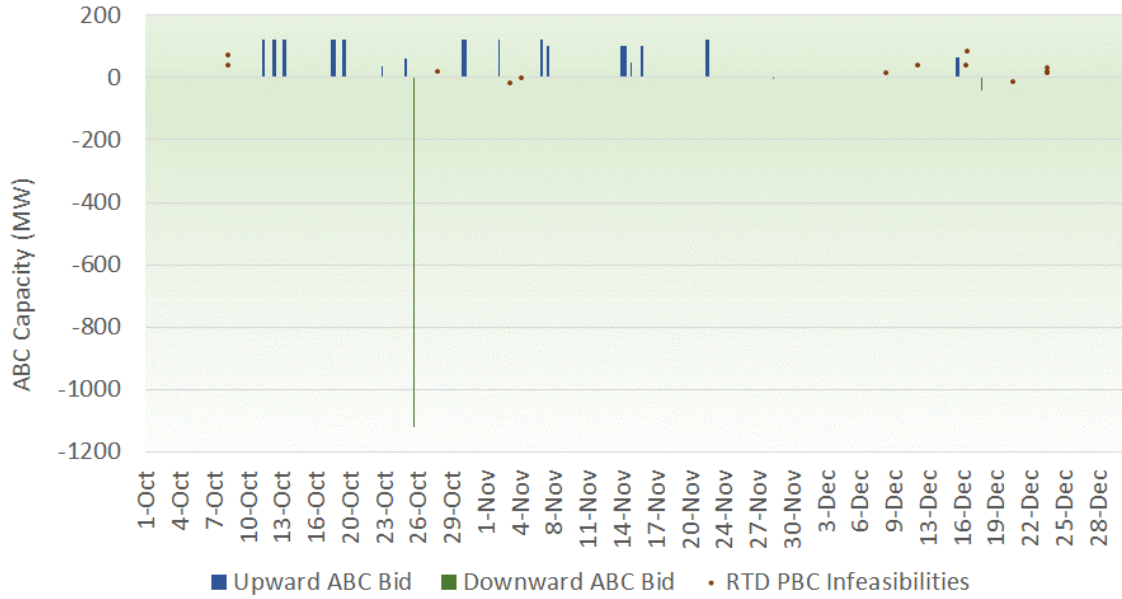


**Figure 18: Submitted ABC and Power Balance Constraint Infeasibilities in the PAC East BAA – FMM**

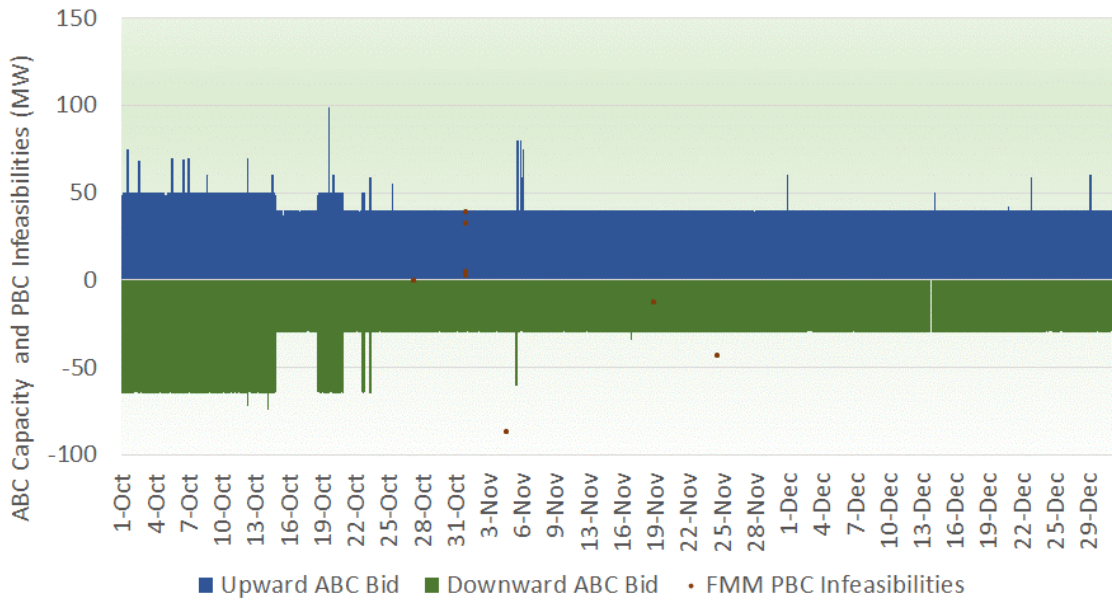




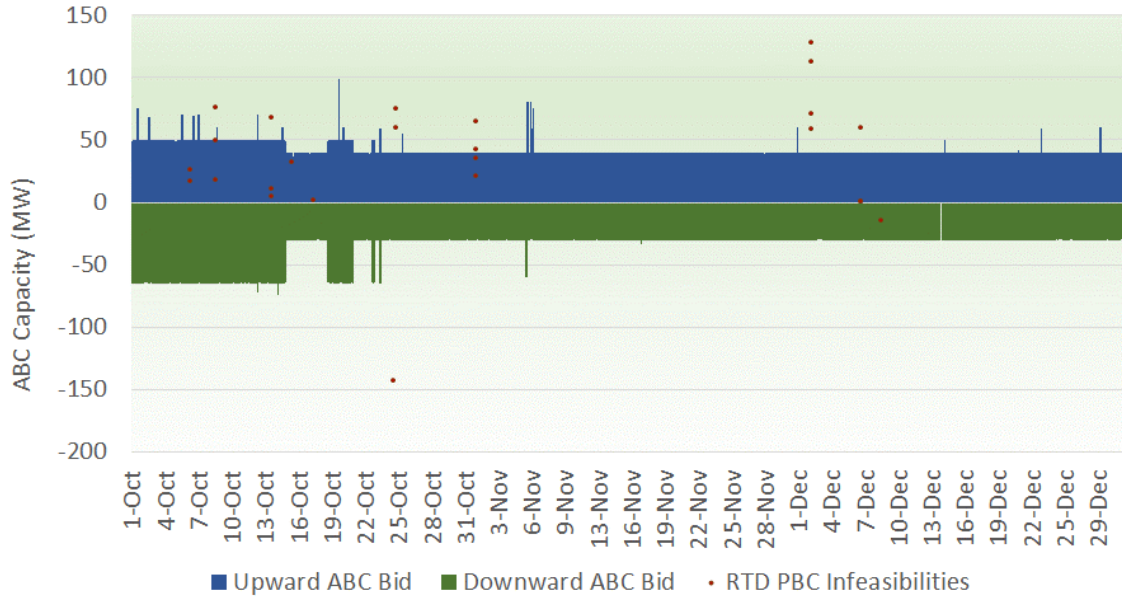
**Figure 19: Submitted ABC and Power Balance Constraint Infeasibilities in the PAC East BAA – RTD**



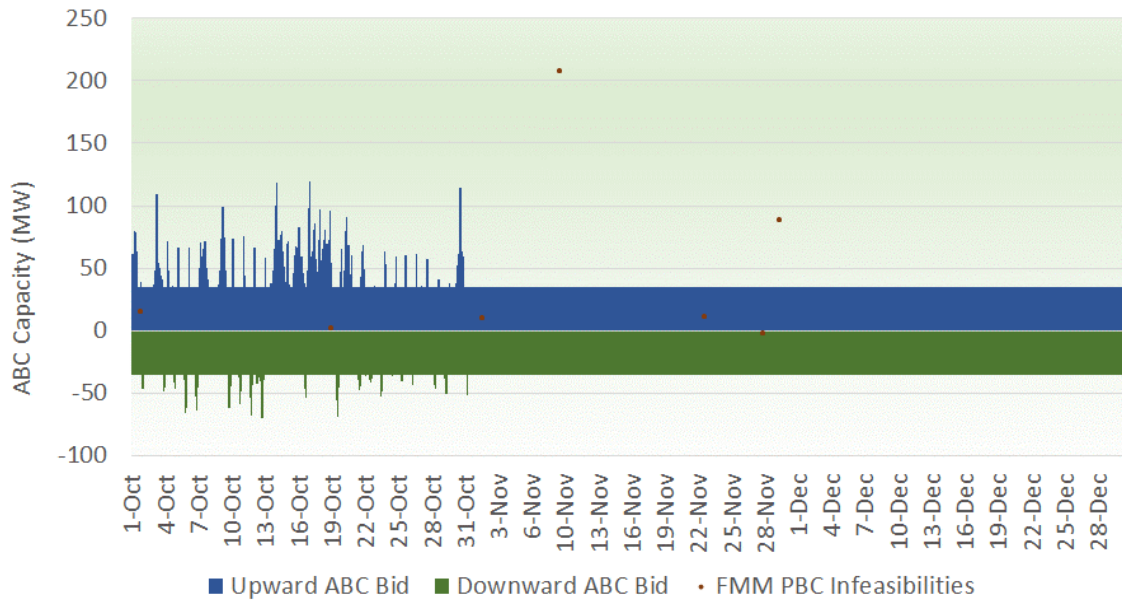
**Figure 20: Submitted ABC and Power Balance Constraint Infeasibilities in the NV Energy BAA – FMM**



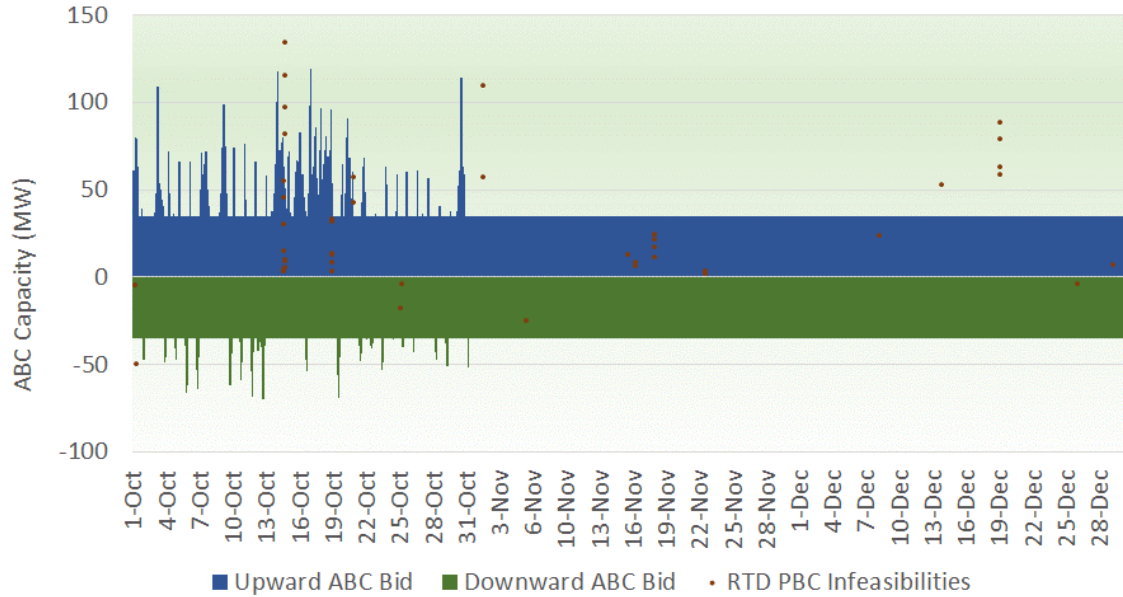
**Figure 21: Submitted ABC and Power Balance Constraint Infeasibilities in the NV EnergyBAA – RTD**



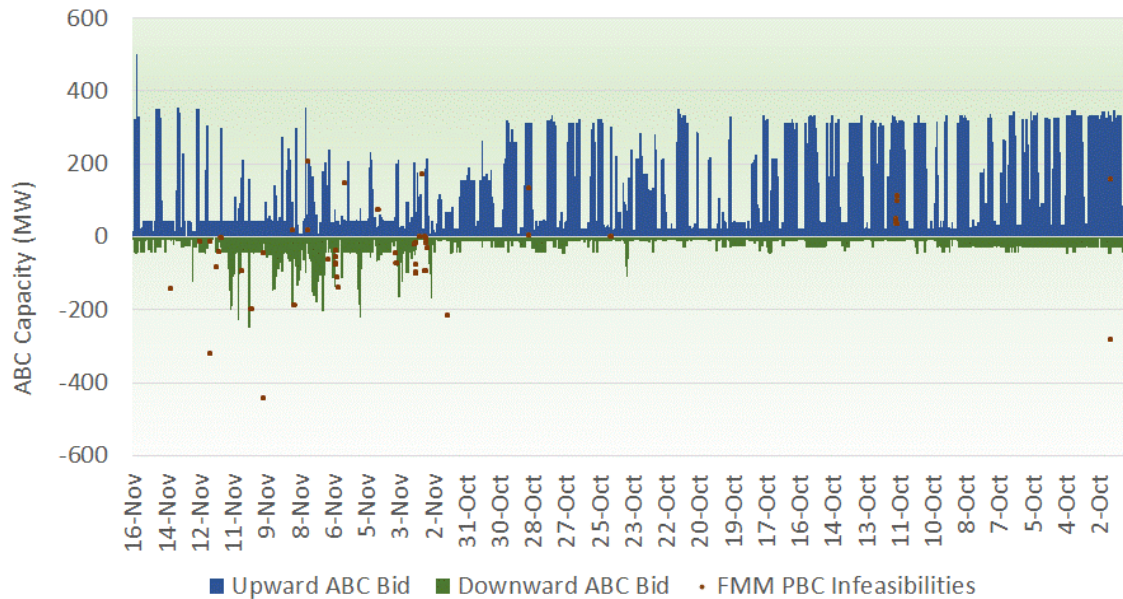
**Figure 22: Submitted ABC and Power Balance Constraint Infeasibilities in the PSE BAA – FMM**



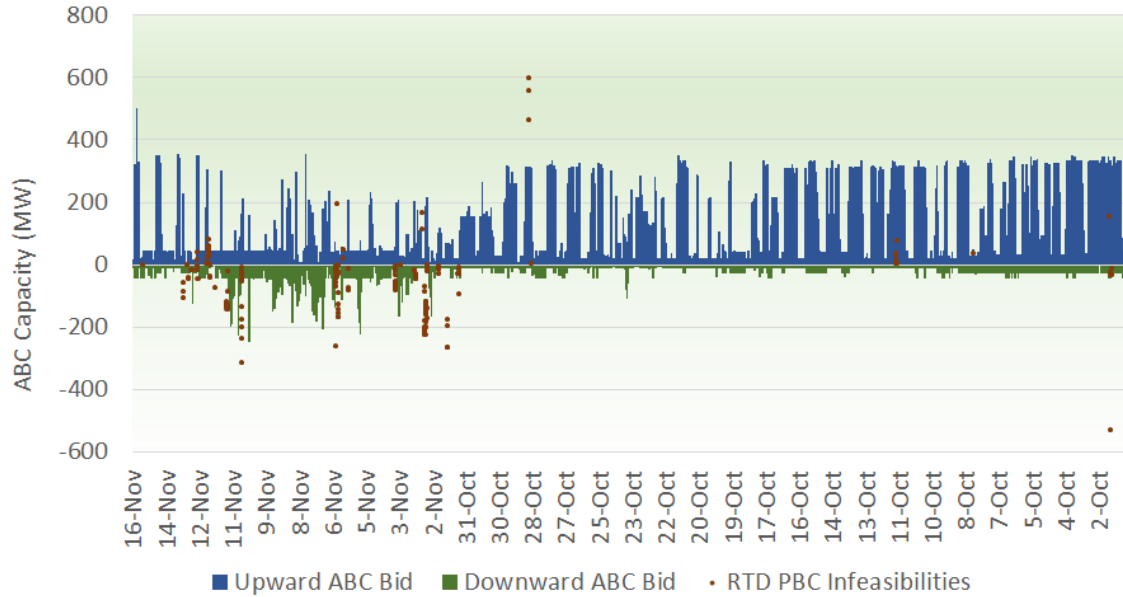
**Figure 23: Submitted ABC and Power Balance Constraint Infeasibilities in the PSE BAA – RTD**



**Figure 24: Submitted ABC and Power Balance Constraint Infeasibilities in the APS BAA – FMM**



**Figure 25: Submitted ABC and Power Balance Constraint Infeasibilities in the APS BAA – RTD**



Based on the data provided in the figures above, Table 3 shows the frequency of intervals in which there was no ABC made available in the market when the power balance constraint was relaxed. The data in Table 3 illustrates over-supply infeasibilities where ABC downward capacity is needed and for under-supply infeasibilities where ABC upward capacity is needed. For instance, for the NV Energy BAA, both the FMM and RTD are a 100% for under-supply infeasibilities, indicating that in every interval when an under-supply infeasibility was observed, there was no ABC upward capacity made available to the market.

**Table 3: Frequency of power balance infeasibilities when no ABC was available in the market**

BAA	Over-supply		Under-supply	
	FMM	RTD	FMM	RTD
PAC West	100%	0%	0%	9.9%
PAC East	0%	0%	0%	0%
NV Energy	100%	100%	100%	100%
APS	71.4%	59.9%	51.8	58%
PSE	0%	0%	0%	0%

Through the validation of the ABC performance after implementation, the CAISO has observed three additional scenarios that can occur.

1. **Use of ABC Related to Resource Constraints:** The CAISO market optimization software recognizes the resource constraints and characteristics of capacity identified as ABC, just as it does of any other participating capacity in the market. Therefore, at times the market is constrained from utilizing the identified capacity due to the operational characteristics of the resources identified as such. The CAISO has observed that in several instances when there was a power balance constraint infeasibility, the ABC identified by the EIM entity was not sufficient to resolve the infeasibility because of the operational ramp limitations of the resources. In some cases, the resource's ramp rate may be limited given its current operating point at any given point in time. In other cases, the resource is not available because in that particular interval the resource must cross a forbidden region first in order to access the ABC and that may take several market intervals, thereby preventing the market optimization software from utilizing the identified capacity. In some instances, a resource is required to cross the operational range where the ABC is defined, and given its ramp rate, the only way for the resource to reach an expected operating point is by dispatching it within the operating region with ABC.
2. **Use of ABC Related to Congestion Management:** The CAISO market systems releases the ABC in the scheduling run based on the scheduling run's assessment of system conditions. However, the CAISO schedules and prices resources in the CAISO markets. The ABC is considered as part of the market clearing process in the pricing run. The pricing run will optimize the entire EIM area, which is the combination of all balancing authority areas that participate in the EIM, including the CAISO's BAA. The market software will simultaneously consider the ABC in clearing the least-cost congestion management solution based on resource constraints and system conditions it observes. Consequently, in some instances the ABC in an EIM balancing authority area was released because the market optimization found it necessary to release the capacity to address congestion either in the EIM or elsewhere in the system. The ABC is considered as part of the single market optimization for the entire EIM area, the need to redispatch resources to manage congestion efficiently would have resulted in the re-allocation of resources such that the ABC would need to be



released to ensure the EIM entity could operate its system reliably. However, because the CAISO must ensure the EIM area can operate its system reliably with the use of the ABC it identifies, the CAISO enforces a constraint that ensures that when ABC has cleared, such capacity stays within the EIM entity's BAA. While the CAISO is not able to isolate the electrons, the constraint ensures that the EIM entity's BAA does not export the ABC to another area to the detriment of the EIM entity's BAA. This ensures that the exports from the EIM entity's balancing authority area are net of the ABC released in an EIM entity's balancing authority area.

3. Software defect. There were a few instances impacted by a software defect regarding the reported amount of ABC. In these cases, some MW schedules were incorrectly reported as ABC. This reporting issue was corrected on October 1, 2016.

#### **IV. EIM Performance**

This section presents the information the CAISO submits in its monthly informational reports required during an EIM entity's first six-month transition period. In this report, the CAISO only provides information on the performance for the PAC West, PACE East and NV Energy BAAs because those EIM balancing authority areas are no longer in a transition period. The CAISO has submitted reports related to the performance for the APS and PSE BAAs in their respective monthly EIM transition period reports corresponding to the months covered by this quarterly report.

##### **A. Prices**

Figures 26 through 28 show the ELAP prices<sup>5</sup> for the FMM and RTD in each EIM entity's respective BAA. These trends show only the actual financially binding prices. In the transition period reports, the CAISO compared the actual prices to counter-factual prices in order to show the effect of using the pricing waiver of the price discovery mechanism.

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<sup>5</sup> The ELAP (EIM Load Aggregation Points) provides aggregate prices that are representative of pricing in the overall area of each EIM entity.

This comparison is no longer meaningful because the PAC West and the PAC East tariff waivers ended with the activation of the ABC enhancement on March 23, 2016, and the NV Energy transition period pricing expired by the end of May 2016.<sup>6</sup>

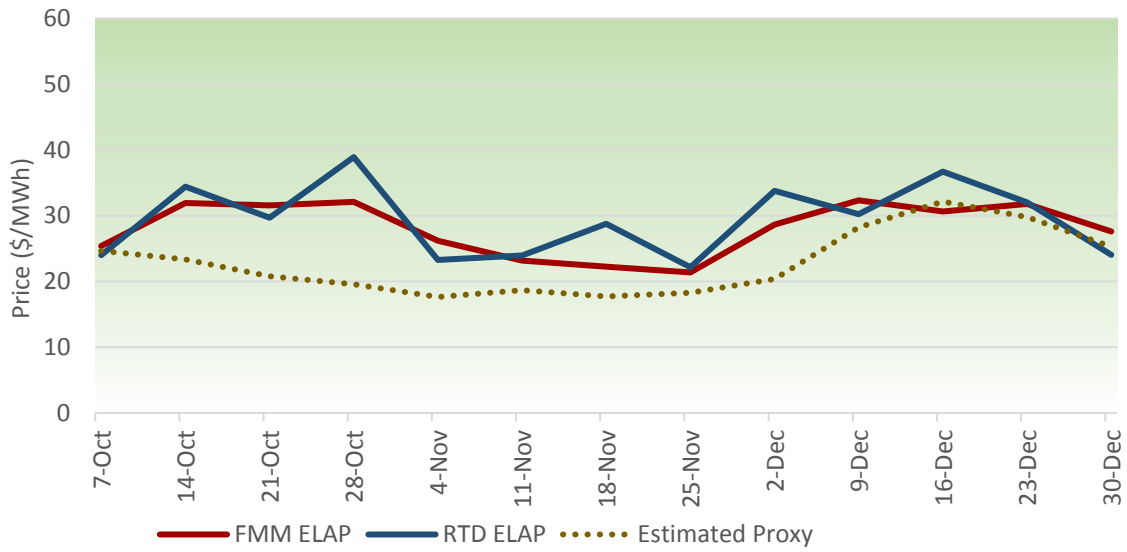
Under the CAISO's price correction authority in section 35 of the CAISO tariff, the CAISO may correct prices posted on its Open Access Same-Time Information System (OASIS) if it finds (1) that the prices were the product of an invalid market solution; (2) the market solution produced an invalid price due to data input failures, hardware or software failures; or (3) a result that is inconsistent with the CAISO Tariff. The prices presented in Figures 26 through 28 include all prices produced by the CAISO consistent with the CAISO tariff requirements. That is, the trends below represent: (1) prices as produced in the market for which the CAISO deemed valid; (2) prices that the CAISO could and did correct pursuant to section 35 of the CAISO tariff; and (3) any prices the CAISO adjusted pursuant to transition period pricing reflected in section 29.27 of the CAISO tariff.

For the period of October 1 through December 31, 2016, ELAP prices in the NV Energy BAA were on average \$28/MWh in the FMM and \$27.24/MWh in the RTD. Prices in the PAC West BAA were on average \$24.6/MWh in the FMM and \$21.24/MWh in the RTD, while prices in the PAC East BAA were on average \$26.92/MWh in the FMM and \$24.84/MWh in the RTD.

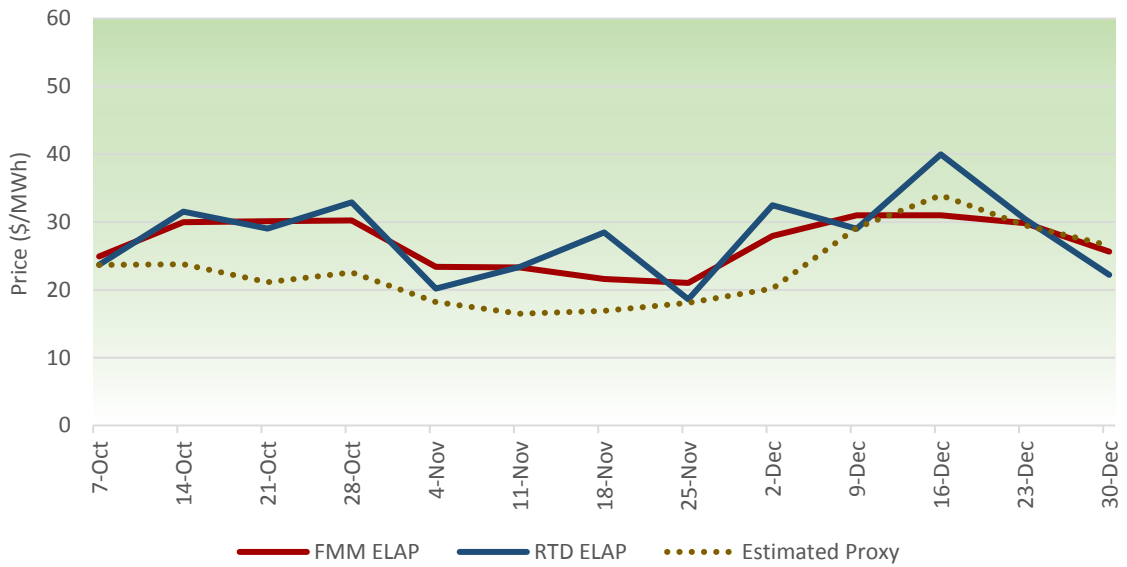
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<sup>6</sup> In Docket ER15-402, the CAISO reported on prices based on the price discovery mechanism in effect during the term of the Commission's waiver granted in that docket and the prices as they would be if the waiver was not in effect, *i.e.*, what prices would have been had they been on the penalty prices in the CAISO tariff. Because pricing under the waiver pricing is based on the last economic bid price signal, these prices are a proxy of what the prices would have been absent the seven category of learning curve type issues experience in that market. The difference between the counterfactual pricing and the price in effect during the term of the reports in that docket illustrated the market impact of the waiver pricing. For the NV Energy BAA, the comparison is still useful for the months of April and May 2016. However, the CAISO has already provided such comparison in the corresponding monthly EIM informational submitted previously to FERC.

**Figure 26: Daily Average Price for the NV Energy BAA ELAP**

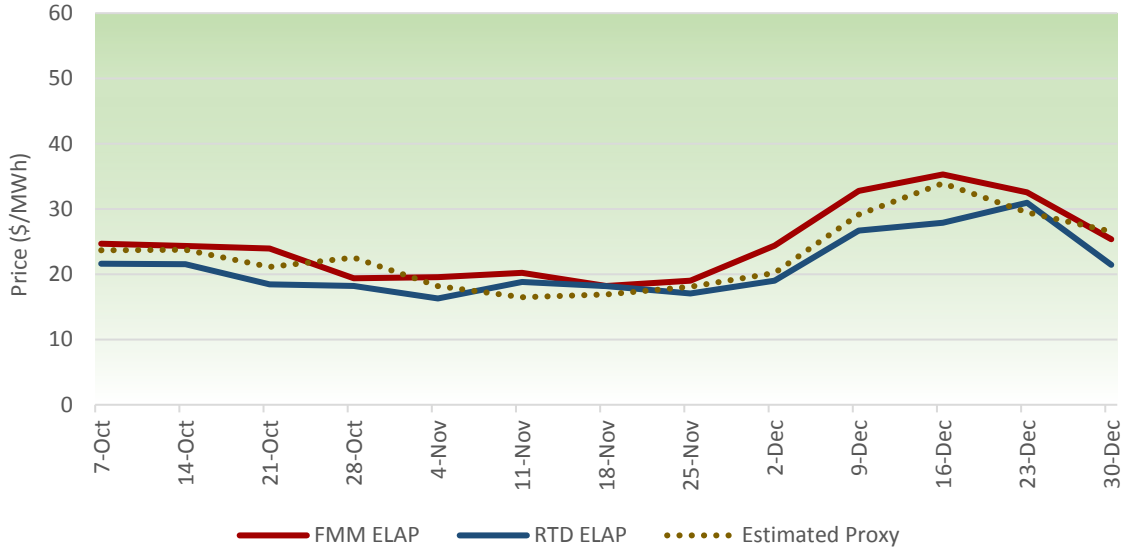


**Figure 27: Daily Average Price for the PAC East BAA ELAP**





**Figure 28: Daily average price for PAC West BAA ELAP**



**B. Frequency of Power Balance Constraint Infeasibilities**

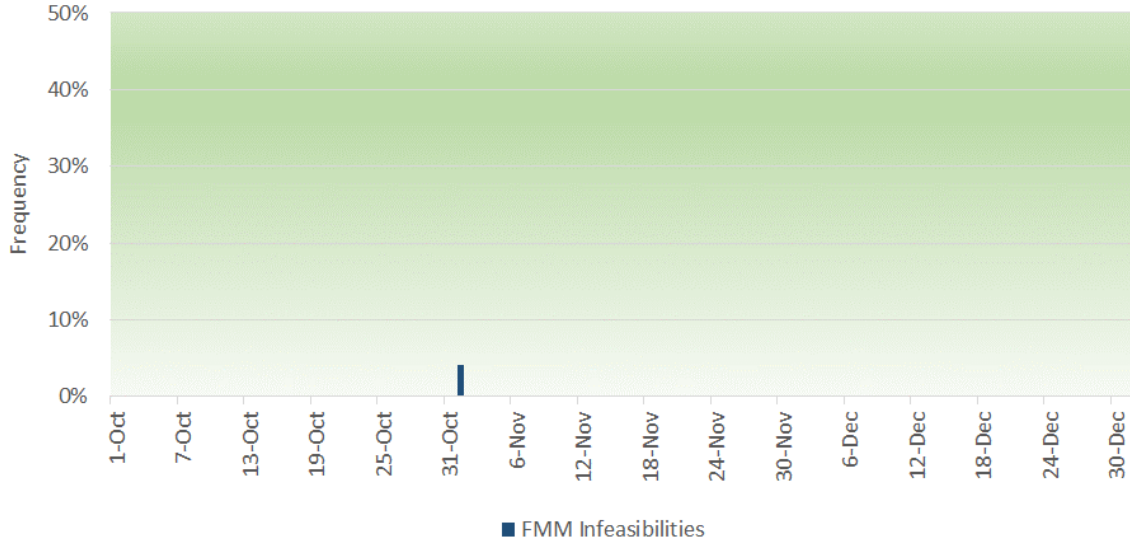
Figures 29 through 34 show the frequency of intervals in which the power balance constraint was relaxed for under-supply or over-supply conditions in each of the EIM entity’s respective BAA for both the FMM and RTD. A bar with positive frequency stands for an under-supply power balance constraint infeasibility, while a bar with negative frequency stands for an over-supply power balance constraint infeasibility. These frequencies reflect only actual infeasibilities; any power balance constraint infeasibilities for intervals that were subject to a price correction under the CAISO tariff were excluded, as they would not reflect valid infeasibilities.

The CAISO uses a load conformance limiter in the CAISO BAA to prevent over-adjustments through use of the load conformance limiter, and thus 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 or below feasibility. 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 BAA has avoided invalid constraints that arise through operations rather than because of real supply issues. This feature applies to either over- or under-supply infeasibilities. The red bars in Figures 29 through 34 explicitly show the instances of infeasibilities

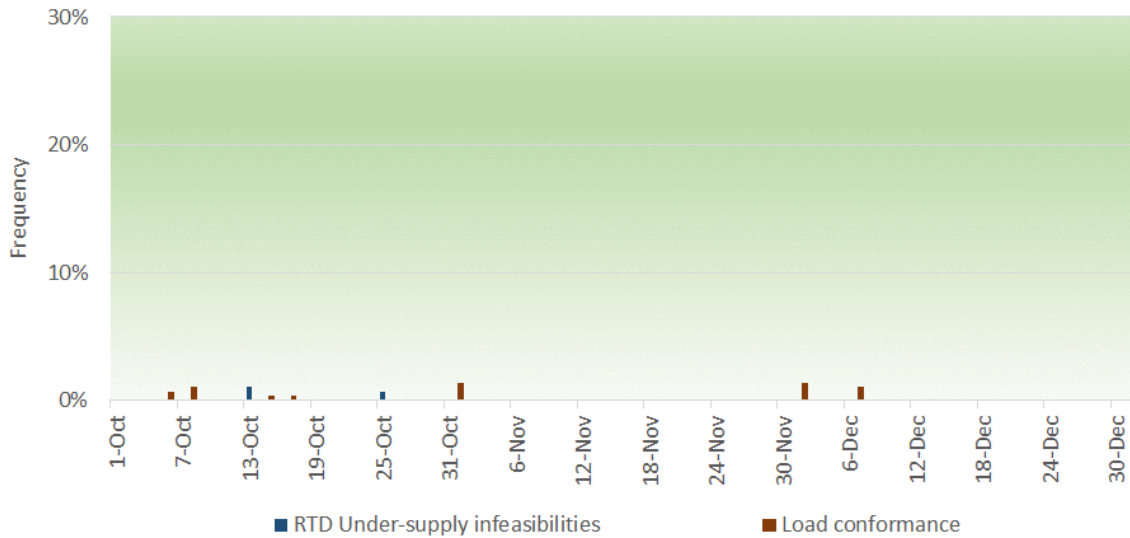
covered with the load conformance limiter.

For the NV Energy BAA, there were only four (0.05 percent of the time) FMM under-supply infeasibilities in the reported three-month period. There were 23 (0.09 percent of the time) under-supply infeasibilities in the RTD, with 18 (0.07 percent of the time) infeasibilities covered by the load conformance.

**Figure 29: Frequency of FMM Power Balance Infeasibilities in the NV Energy BAA**

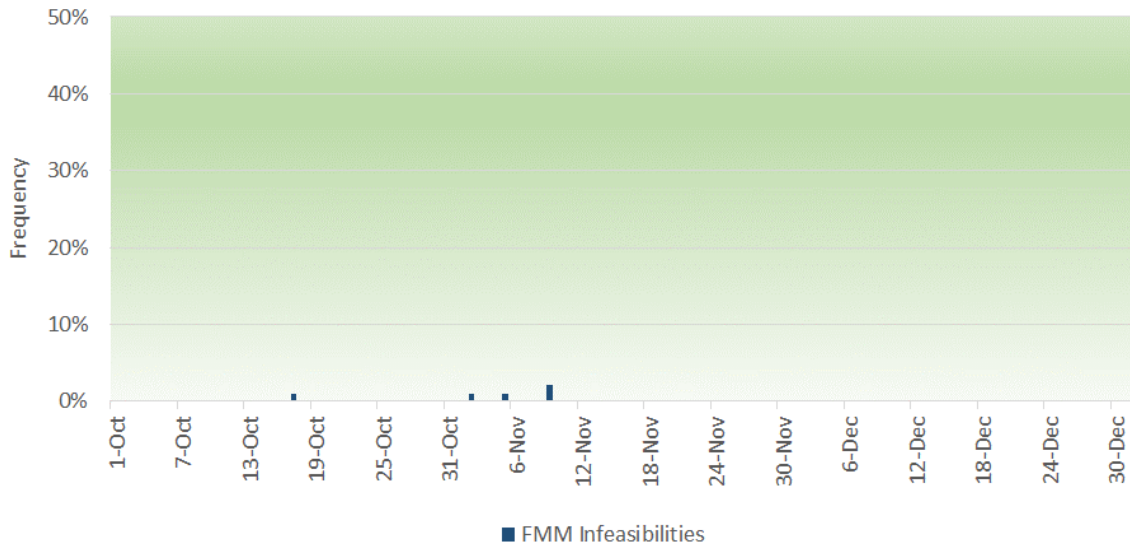


**Figure 30: Frequency of RTD Power Balance Infeasibilities in the NV Energy BAA**

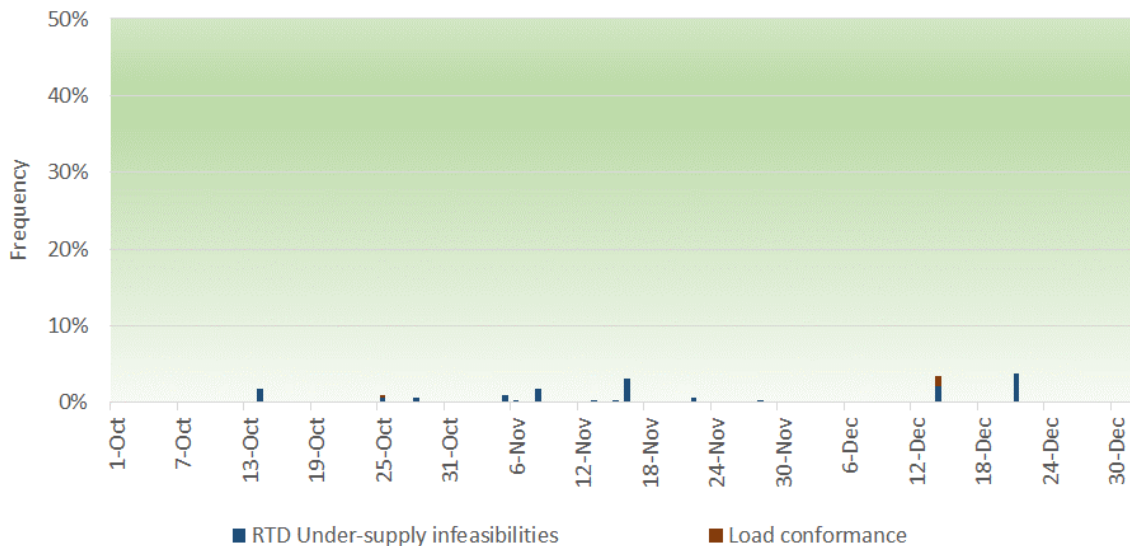


For the PAC West BAA, there were four (0.05 percent of the time) FMM under-supply infeasibilities in the reported three-month period, while there were 16 (0.18 percent of the time) under-supply infeasibilities in the RTD, with five infeasibilities covered by the load conformance.

**Figure 31: Frequency of FMM Power Balance Infeasibilities in the PAC West BAA**



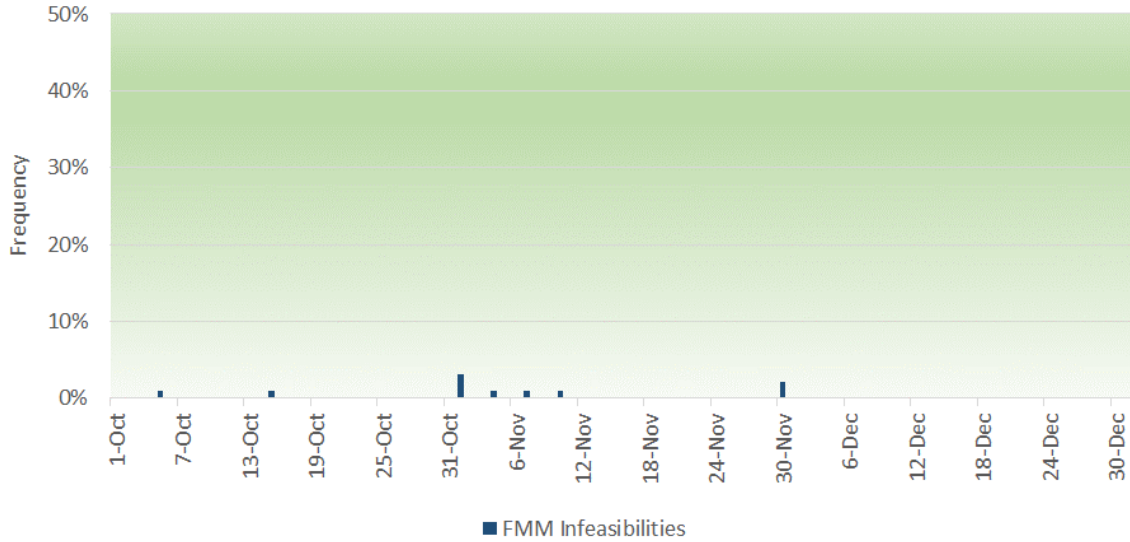
**Figure 32: Frequency of RTD Power Balance Infeasibilities in the PAC West BAA**



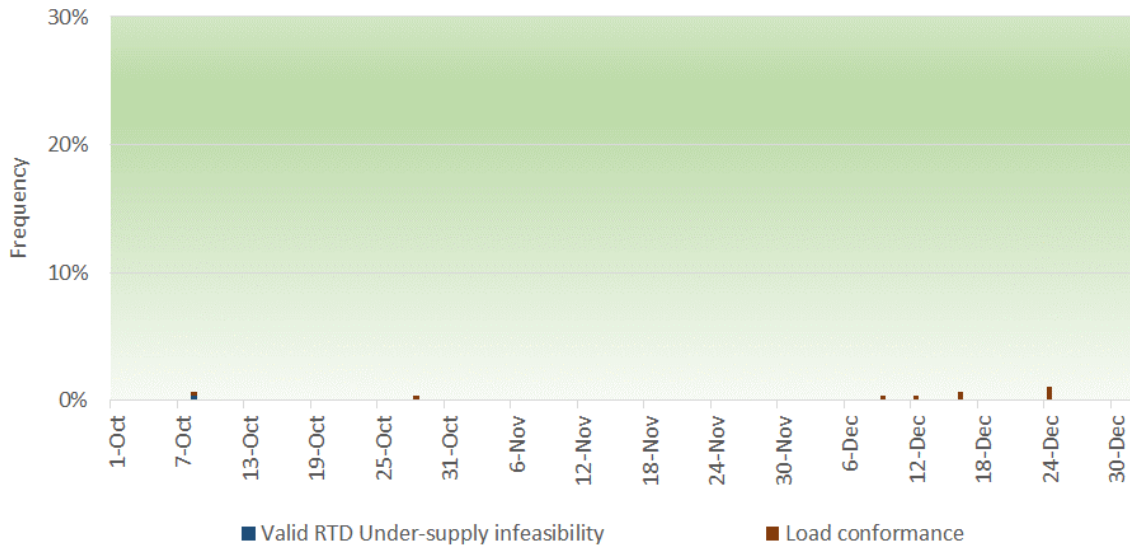
There were seven (0.08 percent) valid undersupply infeasibilities in the FMM in the PAC East BAA during the reported three-month period, while there

were 12 under-supply infeasibilities (0.05 percent of the time) in the RTD. The load conformance limiter covered all but one instance.

**Figure 33: Frequency of FMM Power Balance Infeasibilities in the PAC East BAA**



**Figure 34: Frequency of RTD Power Balance Infeasibilities in the PACE East BAA**

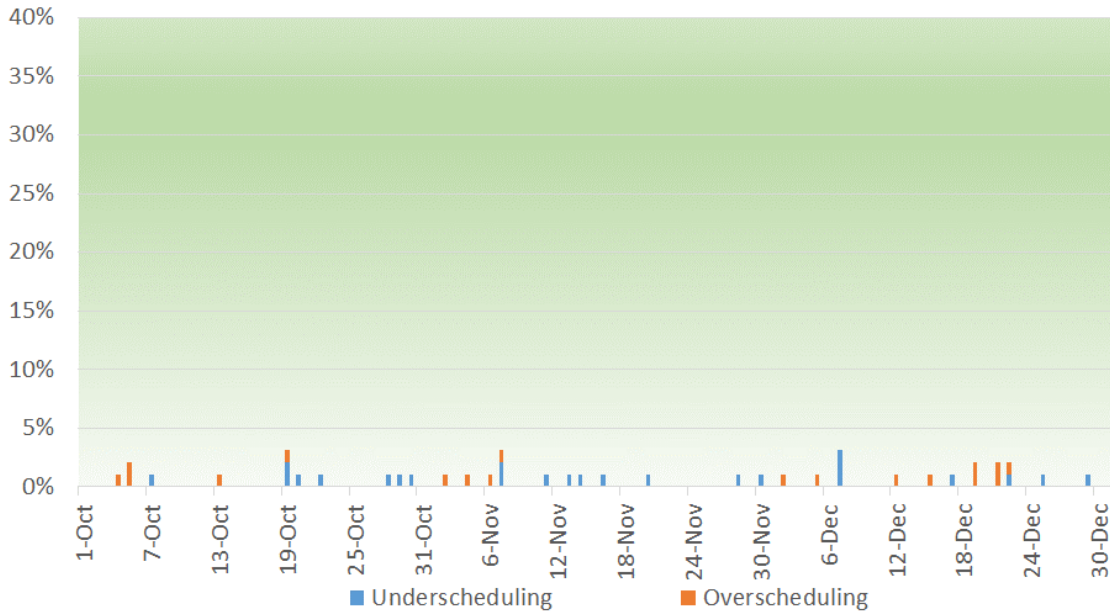


**c. Balancing and Sufficiency Test Failures**

Figures 35 through 37 show the trend of balancing test failures for the period of October 1 through December 31, 2016 for each of the EIM entity BAAs. This test is performed pursuant to Section 29.34(k) of the CAISO Tariff. The NV Energy BAA passed the balancing test 98.09 percent of the time. About 57 percent of the failures were for under-scheduling. These failures are within usual ranges and reflect the incidence of the forecasting and balancing process that

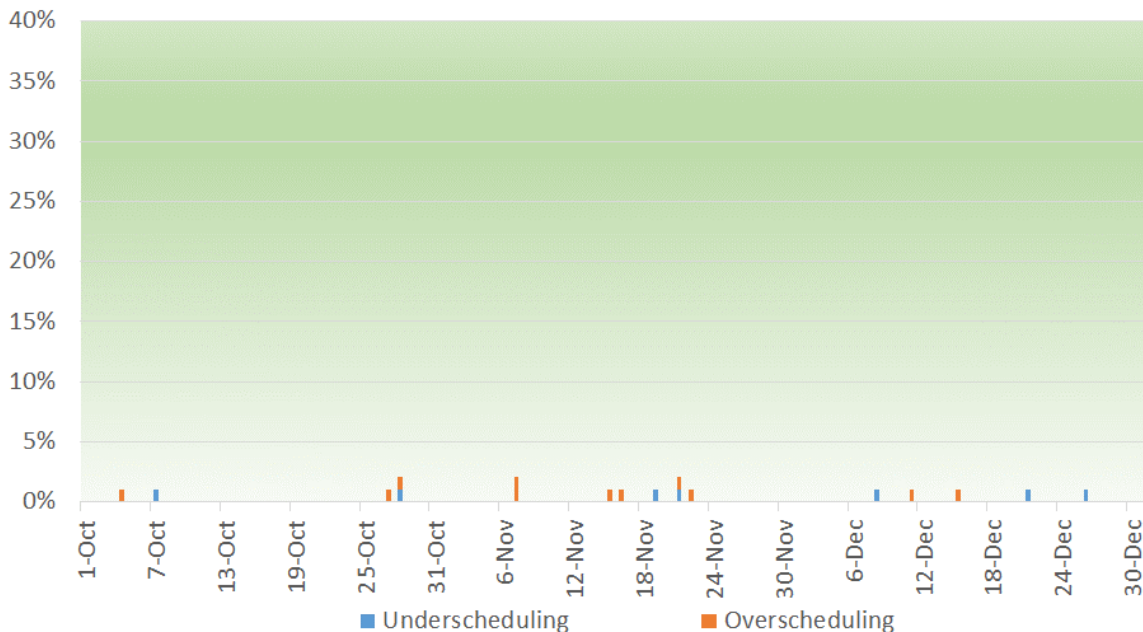
has occurred at a frequency that is well within expected performance tolerances.

**Figure 35: Frequency of Balancing Test Failures for the NV Energy BAA**



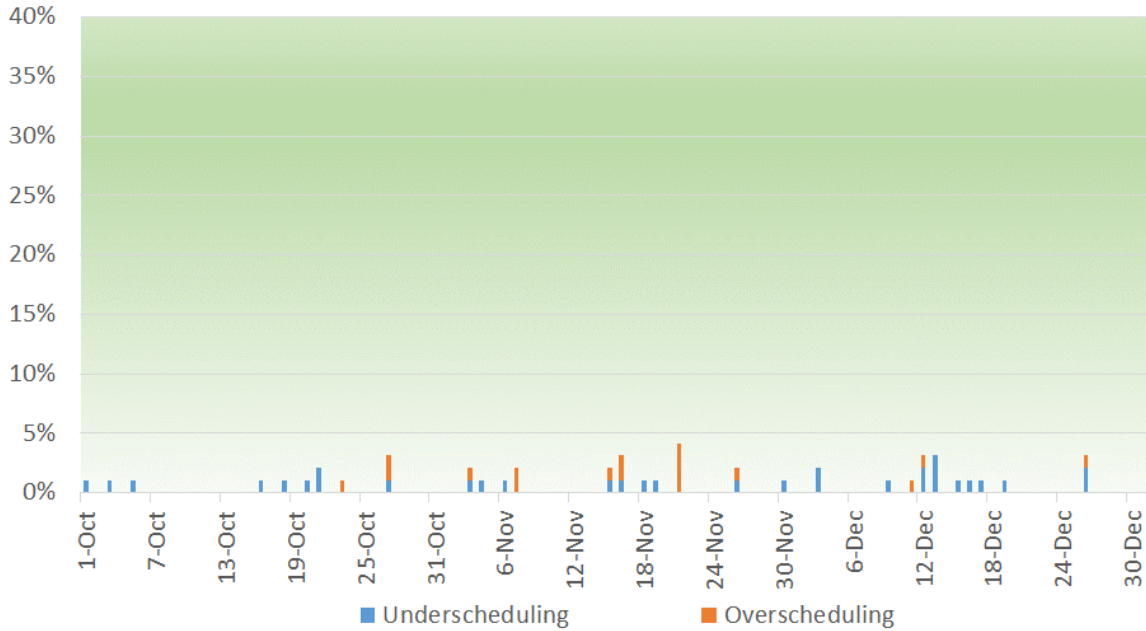
For the PAC West BAA the passing rate of the balancing test for the reported period was about 99.18 percent of the time, with 40 percent of the failures reflecting under-scheduling. Similarly, the PAC East BAA passed the balancing test about 97.69 percent of the time, with about 60 percent of the failures associated with under-scheduling.

**Figure 36: Frequency of Balancing Test Failures for the PAC West BAA**



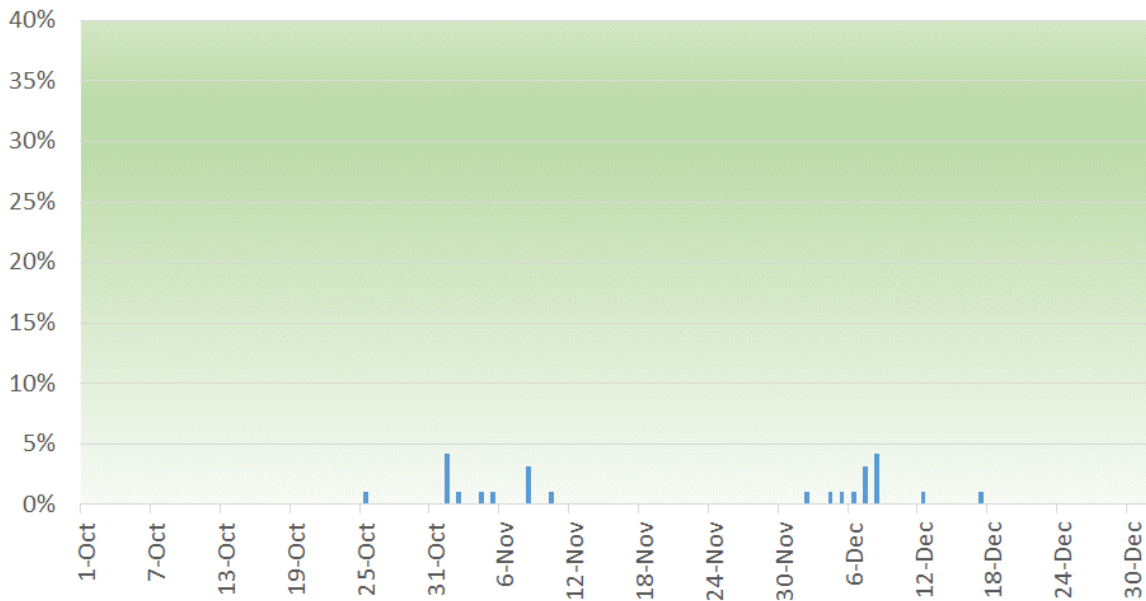


**Figure 37: Frequency of Balancing Test Failures for the PAC East BAA**

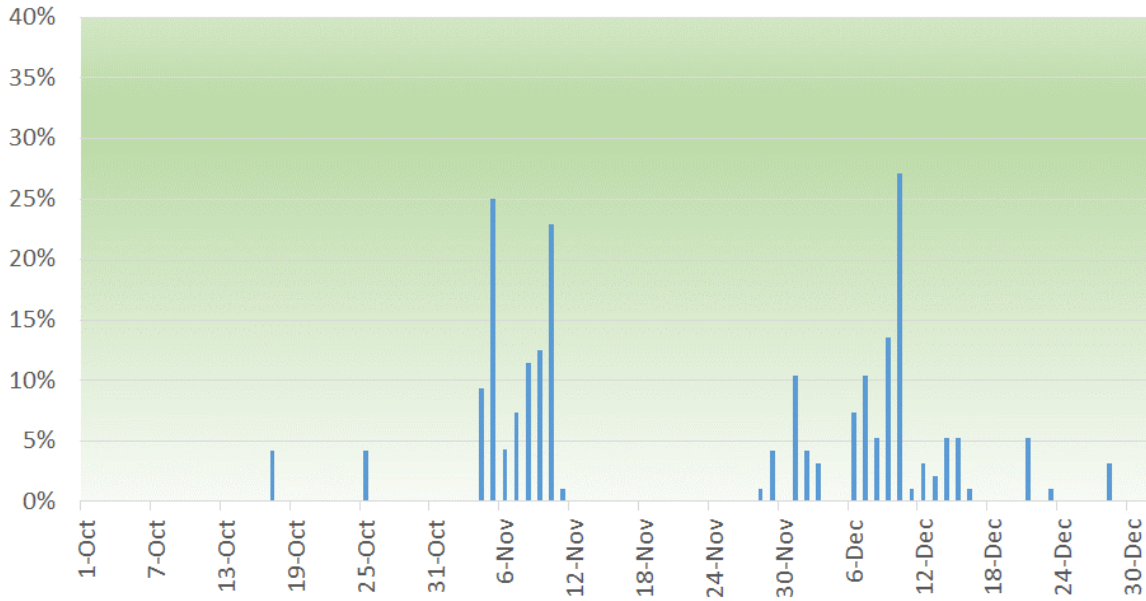


Figures 38 through 40 show the trend of upward flexible ramping sufficiency test failures for the period of October 1 through December 31, 2016 for each of the EIM entity BAAs. The passing rate of this test was 98.45 percent for the PAC East BAA, 97.65 percent for the PAC West BAA, and 99.71 percent for the NV Energy BAA.

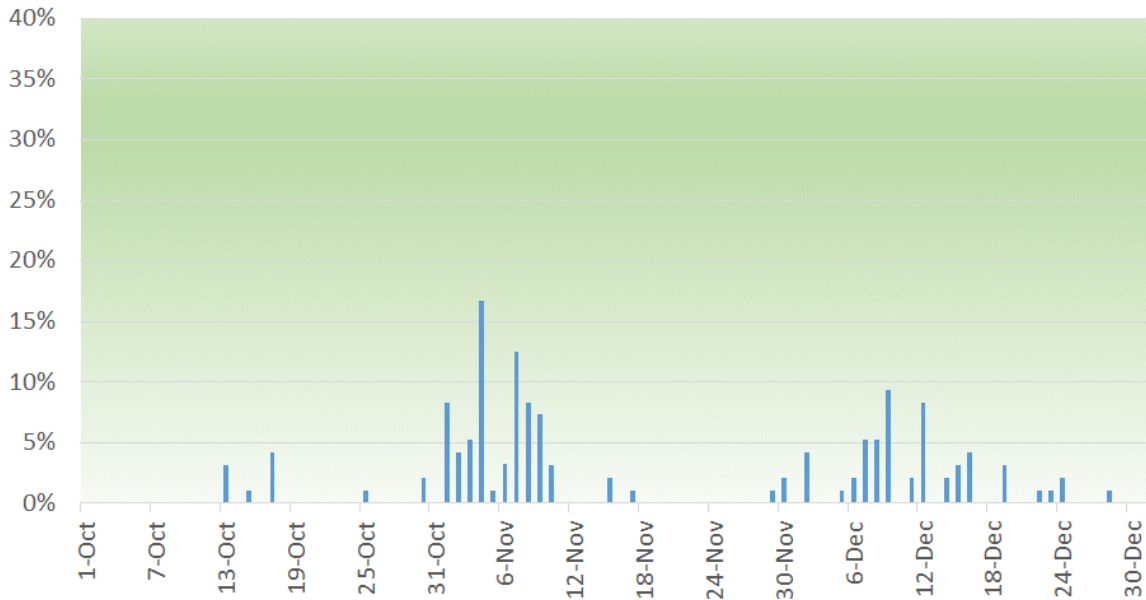
**Figure 38: Frequency of Flexible Ramping Sufficiency Test Failures in the NV Energy BAA**



**Figure 39: Frequency of Flexible Ramping Sufficiency Test Failures in the PAC West BAA**



**Figure 40: Frequency of Flexible Ramping Sufficiency Test Failures in the PAC East BAA**



**D. Flexible Ramping Constraint Infeasibilities**

As described in the monthly EIM transitional period reports for the APS and PSE BAAs, the flexible ramping product was implemented on November 1,

2016. With the flexible ramping product, there are no longer constraint infeasibilities related to the flexible ramping constraint. Rather, the flexible ramping product uses price-responsive demand curve. Therefore, there are no longer constraint infeasibilities for the flexible ramping constraint to report.

#### **E. Impact on non-EIM nodes**

With the implementation of the EIM with PacifiCorp's BAAs (PAC East and PAC West) with the first trading day on November 1, 2014, there was an identified pricing reporting issue for shared locations between the CAISO markets and the EIM. These shared locations have associated mirror resources since they are used to schedule energy for the CAISO BAA and are located in the EIM BAA. In late 2014, the CAISO worked on improving these shared locations' modelling, and reported its progress in the corresponding transitional period reports for the PAC East and PAC West BAAs. Currently, there are no known issues impacting such locations that need to be discussed in this report.



## 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 16<sup>th</sup> day of November 2017.

*/s/ Grace Clark*  
Grace Clark