Energy Imbalance Market
March 23 – June 30, 2016
Available Balancing Capacity Report

November 10, 2016

California ISO Department of Market Quality and Renewable Integration

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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 in FERC Docket No. ER15-861-006 to adopt the Available Balancing Capacity (ABC) functionality so the Energy Imbalance Market (EIM) automatically recognizes and accounts for capacity an EIM entity identifies as available to maintain reliable operations in its own balancing authority area (BAA) and that is not otherwise bid into the market.[1] 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 the CAISO implements the ABC functionality. The quarterly informational reports are to provide information on the performance of the ABC functionality and provide the same information the CAISO provides in its monthly informational reports submitted during an EIM entity's first six-month transition period.[2] The CAISO will continue to file the quarterly report until the first year of ABC operation is complete.

II. Highlights

- On March 23, 2016, the CAISO implemented the ABC functionality and terminated the price discovery mechanism previously for PAC West and PAC East ended.
- PacifiCorp submitted ABC upward capacity in 34 and 67 percent of the intervals for PAC East and PAC West BAAs, respectively.
- NV Energy did not submit upward capacity for NV Energy BAA in the first three months; NV Energy submitted downward capacity for 91 percent of the intervals.
- The market dispatched ABC capacity less than 10 percent of the intervals.
- The number of resources supporting the submitted ABC capacity during the first three months has been as few as one resource in PAC West and as many as six resources in NV Energy.

[1] *Cal. Indep. Sys. Operator Corp.*, 153 FERC ¶ 61, 305 (2015) (December 17 Order).

[2] December 17 Order at P 39.

III. Available Balancing Capacity

A. ABC Capacity submitted to the market

Each EIM entity can set and define through their resource plan the amount of ABC and the resources supporting this identified capacity. The EIM entity submits this information on an hourly basis and the identified capacity is then available for both the fifteen-minute market (FMM) and the five-minute real-time dispatch (RTD) that follow. Figures 1 through 6 show the ABC identified in each of the EIM BAAs, namely, PAC West, PAC East and NV Energy and the ABC capacity dispatched in the FMM and RTD.

Figure 1: Submitted and Cleared Available Balancing Capacity in PAC West – FMM

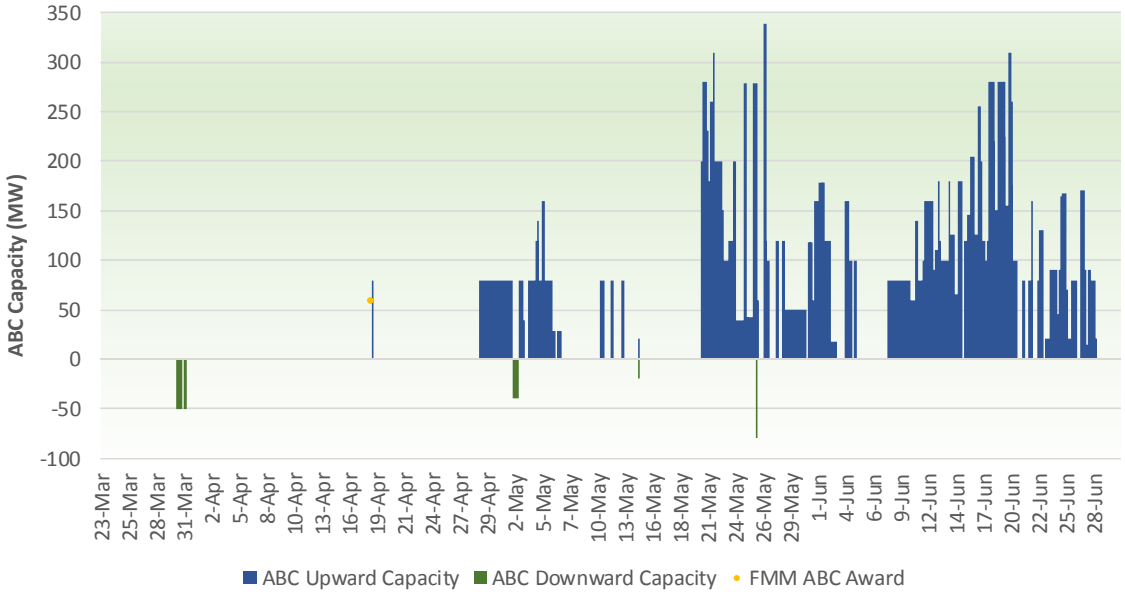
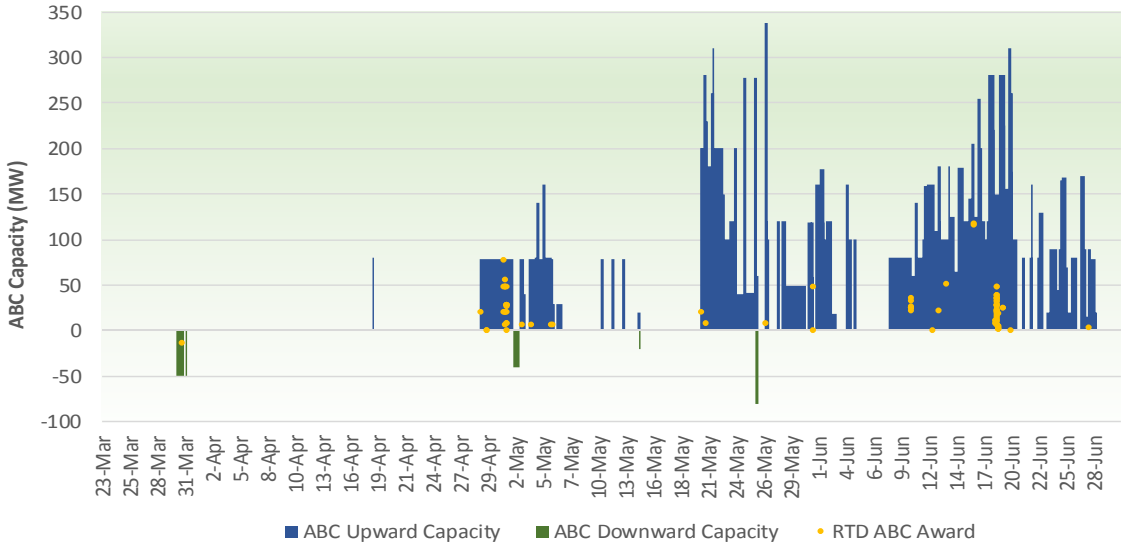


Figure 2: Submitted and Cleared Available Balancing Capacity in PAC West – RTD



The blue bars and positive values define upward capacity and the green bars and negative values define the downward capacity. For about the first half of the reported period, PAC West submitted upward ABC capacity infrequently. In the period of March 23 through June 30, PAC West submitted ABC capacity in 34.2% of the time for upward capacity and 1% downward capacity. Table 1 summarizes the percentage of intervals in which each of the BAAs submitted ABC capacity.

Table 1: Frequency of ABC capacity submitted to market

BAA	Upward Capacity	Downward Capacity
PAC West	34.2%	1.0%
PAC East	64.1%	57.8%
NV Energy	0.0%	91.0%

PAC East did not submit any upward ABC capacity in the first three months and its submission of downward ABC capacity gradually decreased since the CAISO implemented the ABC functionality.

The EIM awarded ABC capacity in the FMM and RTD in PAC East more frequently in earlier months and in later months awarded ABC in PAC East a few instances. By the end of April and beginning of May, the EIM awarded ABC capacity in PAC West in the RTD more frequently when ABC capacity was available in the market. Table 2 shows the frequency in which the CAISO market dispatched ABC capacity when there was ABC capacity made available.

Table 2: Frequency of ABC capacity dispatched in the market

	Upward Capacity		Downward Capacity	
BAA	FMM	RTD	FMM	RTD
PAC West	0.03%	1.02%	0.00%	0.35%
PAC East	0.03%	0.37%	6.09%	0.02%
NV Energy	-	-	1.64%	1.61%

Overall, the FMM and RTD dispatched ABC capacity at a low rate, relative to the amount of capacity made available. The dispatch rates are illustrated by the yellow dots in Figures 3 to 6.

Figure 3: Submitted and Dispatched Available Balancing Capacity in PAC East – FMM

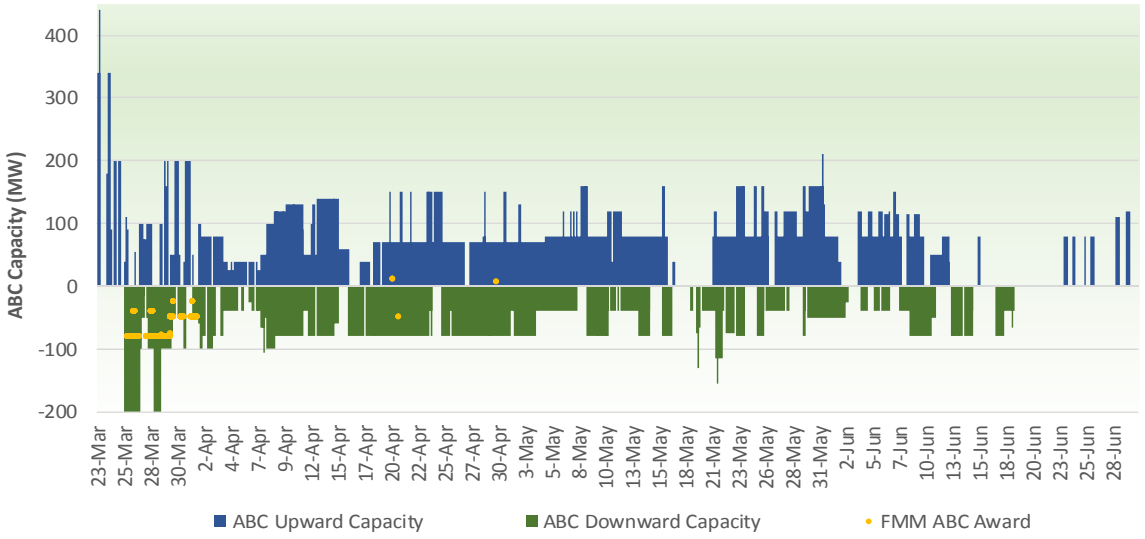


Figure 4: Submitted and Dispatched Available Balancing Capacity in PAC East – RTD

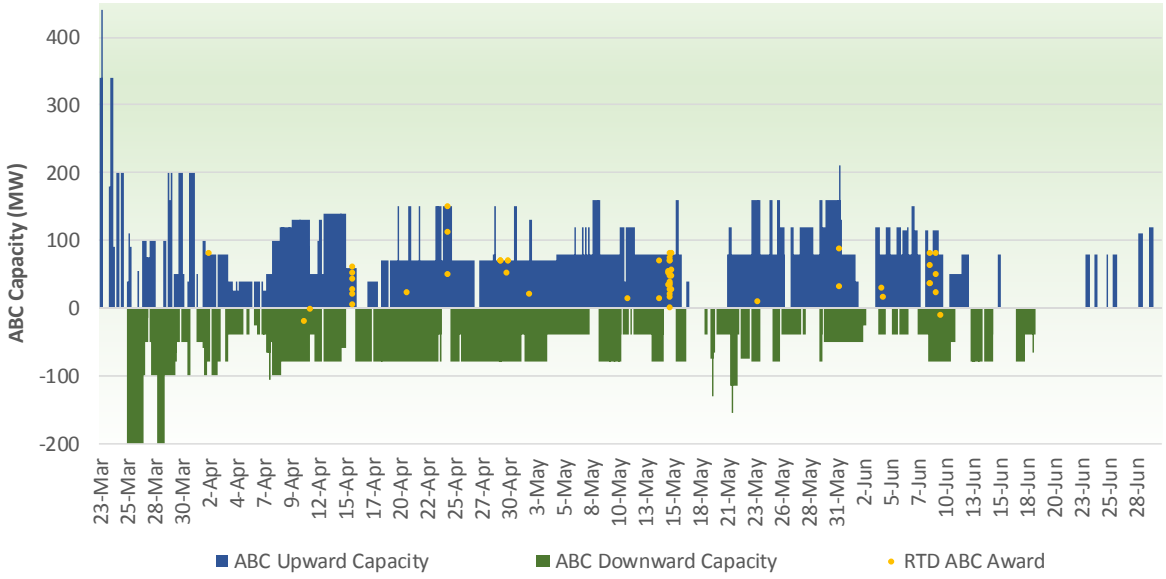


Figure 5: Submitted and Cleared Available Balancing Capacity in NV Energy – FMM

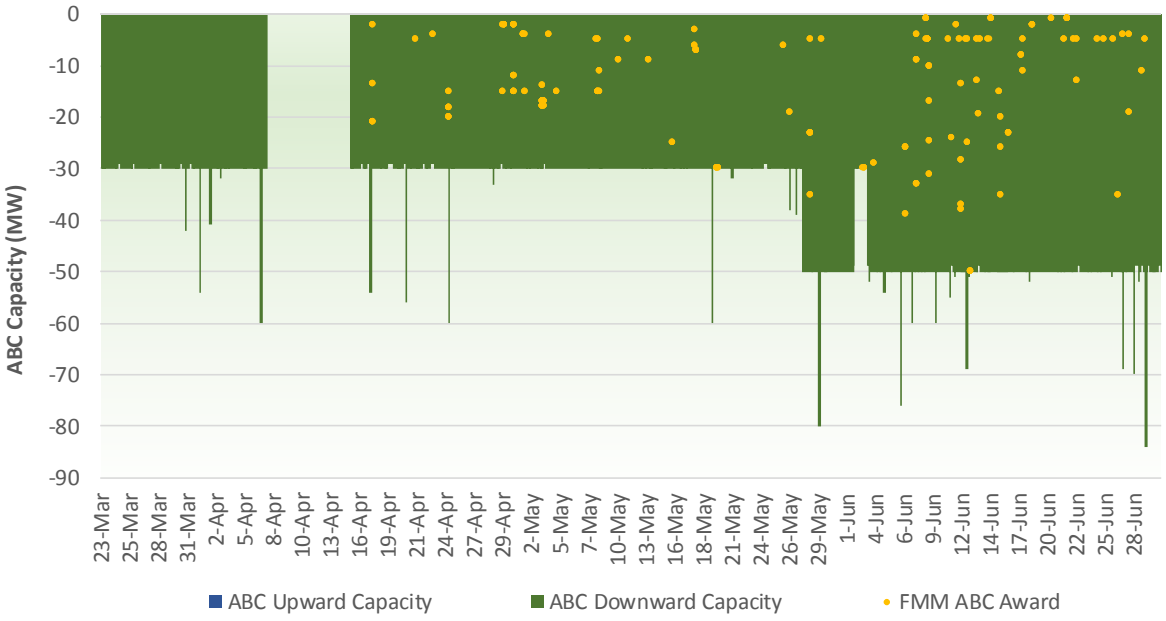
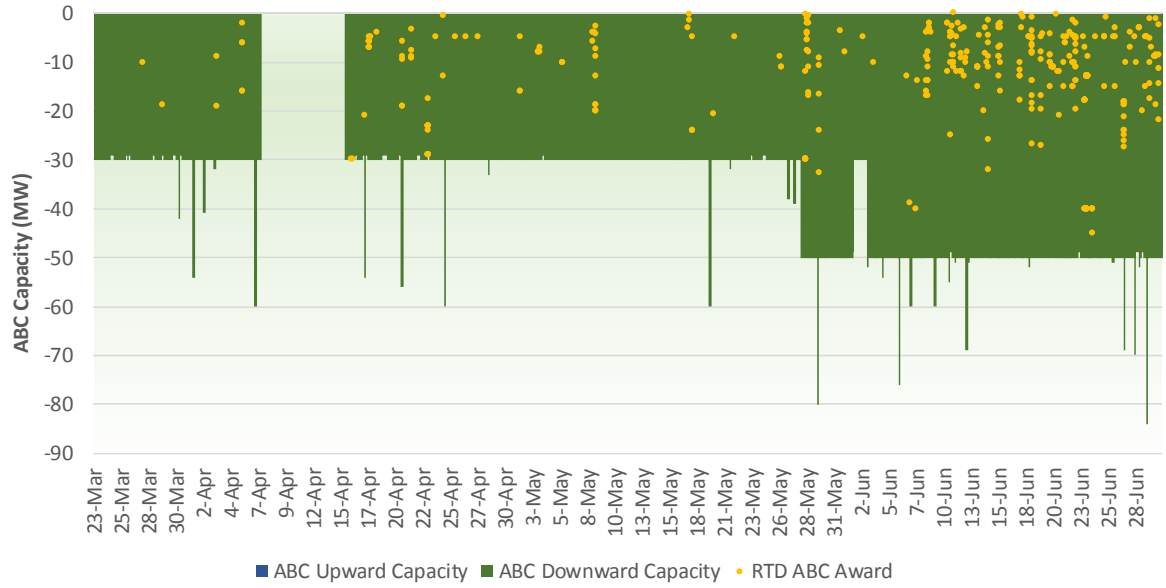


Figure 6: Submitted and Dispatched Available Balancing Capacity in NV Energy – RTD



B. Resources supporting ABC capacity

Figures 7 through 9 illustrate the number of resources supporting the ABC capacity submitted to the market. NV Energy had the largest spread of its ABC capacity among up to six different resources to support ABC capacity.

Figure 7: Number of resources supporting the submitted ABC capacity in PAC West

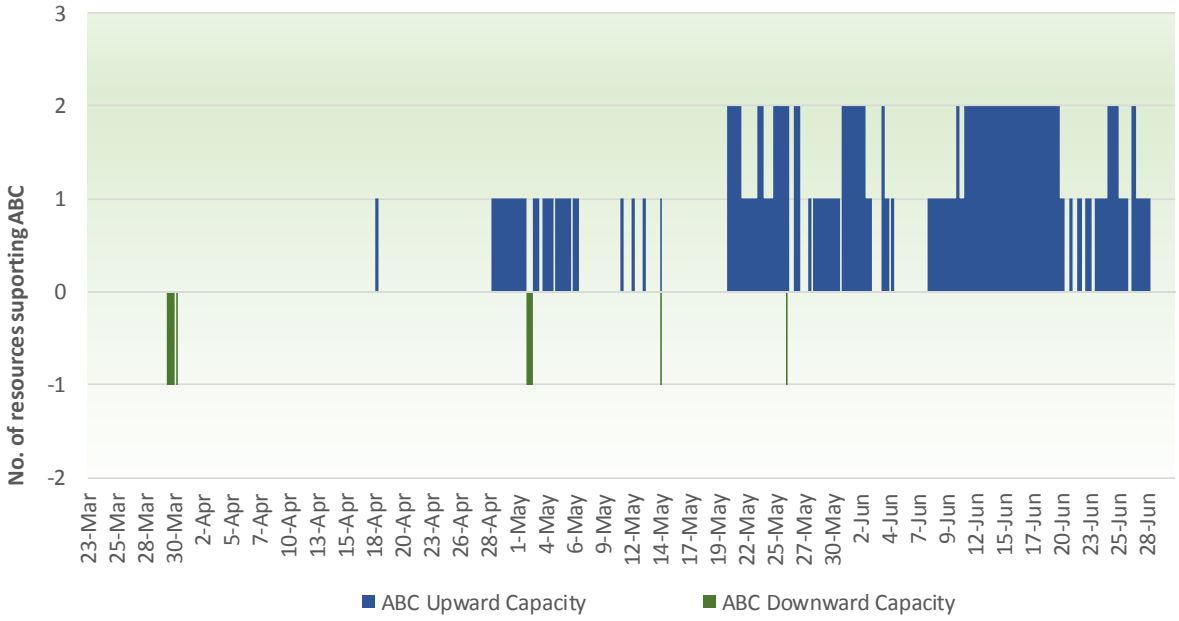


Figure 8: Number of resources supporting the submitted ABC capacity in PAC East

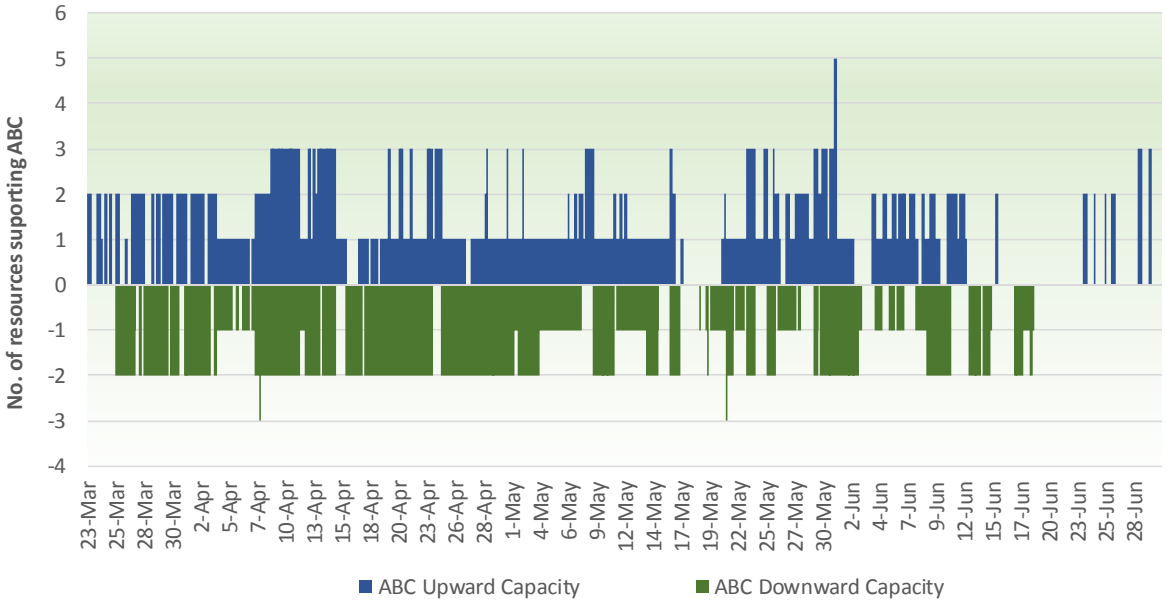
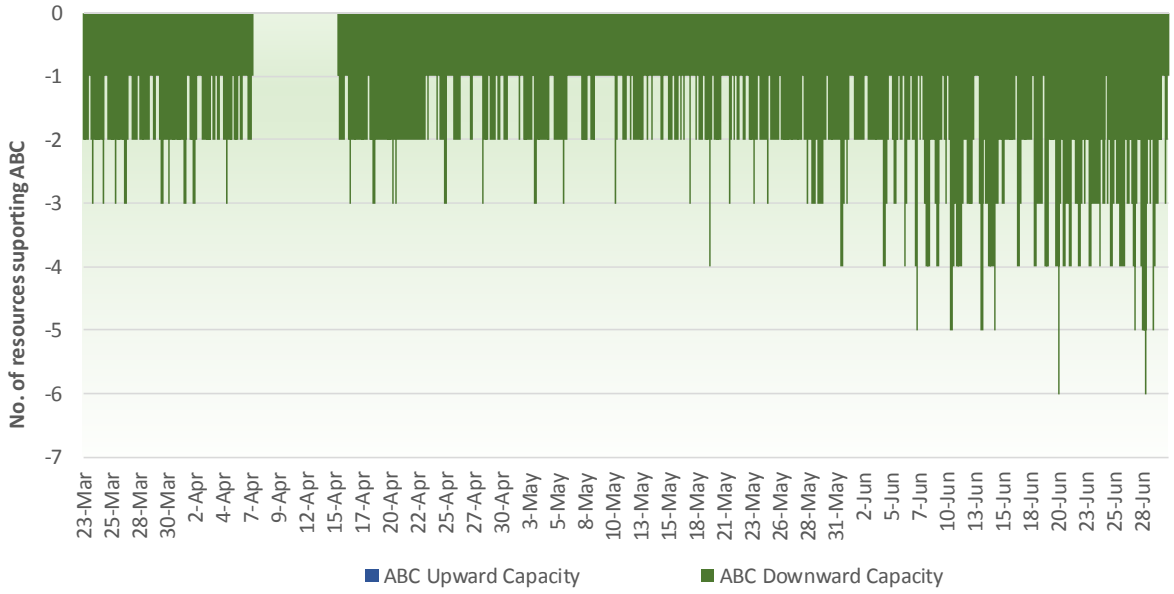


Figure 9: Number of resources supporting the submitted ABC capacity in NV Energy



C. ABC Capacity and Power Balance Constraint Infeasibilities

The ABC functionality was intended to make capacity available to the market that otherwise would not be available because the EIM balancing authority can only use that capacity to manage reliability issues on its own system. The ABC functionality ensures that the EIM market systems will only access such capacity if made available to the EIM when conditions warrant its use consistent with the EIM balancing authority's reliability requirements for its own BAA when the market is running out of capacity made available through economic bids. For illustrative purposes, the ABC capacity can be portrayed as capacity stacked above economic bids but below the power balance constraint relaxation penalty price. Thus, when the market is tight in supply, the clearing process will go through the bid stack in economic order; once the economic bids are exhausted then the market will access the ABC capacity. If there is sufficient ABC capacity, the market will not need to use the power balance constraint relaxation process to clear. As such, the market uses the ABC capacity to resolve the power balance infeasibility. If instead the ABC capacity identified is not sufficient to cure the infeasibility, the ABC capacity may be exhausted and a power balance infeasibility still occurs.

Figures 10 through 15 compare the ABC capacity submitted in the market and power balance constraint infeasibilities in both the FMM and RTD. In PAC West, there were no power balance constraints infeasibilities during intervals with ABC capacity available in the FMM. However, in the RTD, the majority of power balance constraint infeasibilities were for over-supply conditions but the ABC capacity available was mostly to cover under-supply infeasibilities (upward ABC capacity). For PAC East, towards the end of the reporting period, there were

more frequent power balance constraint infeasibilities, which was when less ABC capacity was available.

NV Energy consistently made downward ABC capacity available, but the majority of power balance constraint infeasibilities were for under-supply conditions, which can only be resolved with upward ABC capacity. NV Energy indicated that before mid-July, NV Energy had modeled its Contingency Reserves and upward Regulating Reserves in a single reserve calculation. NV Energy therefore did not offer that capacity into the market because it could not represent its contingency reserves as available to the market. Since mid-July, NV Energy has offered some upward ABC – as it separated Regulating Reserves from the Contingency Reserves calculation. However, NV Energy has indicated that most of NV Energy's capacity over the summer is either base-scheduled, bid into the market, or reserved for contingencies. Therefore, the low offer rate reflects that NV Energy has had very little to offer as upward ABC.

Figure 10: Submitted ABC capacity and power balance constraint infeasibilities in the FMM in PAC West

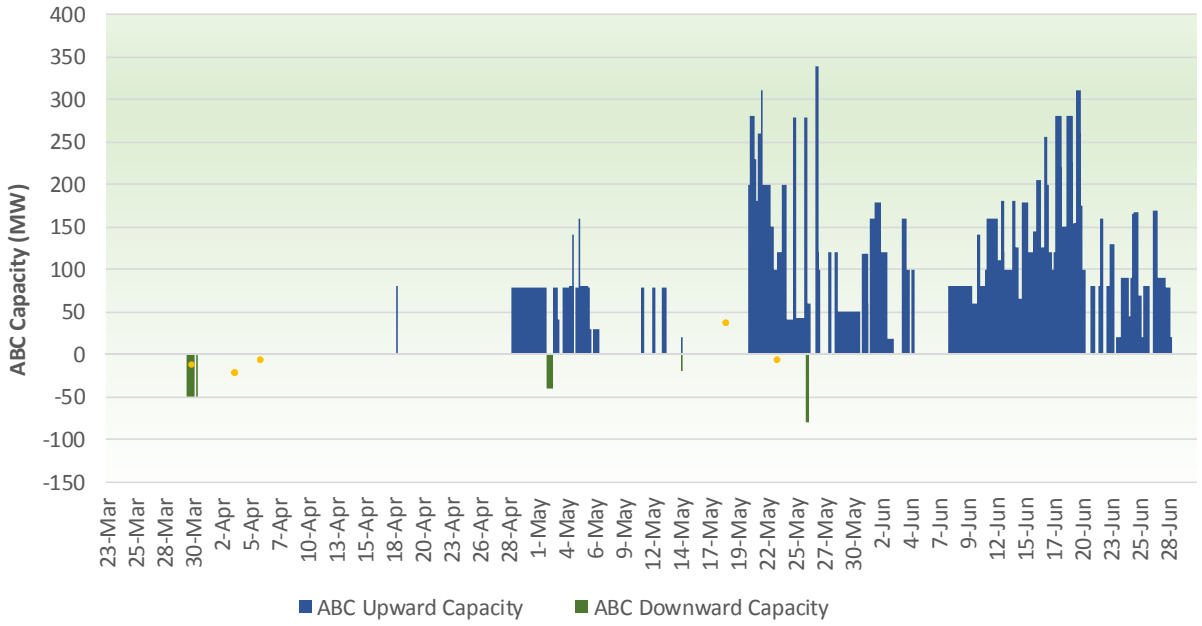


Figure 11: Submitted ABC capacity and power balance constraint infeasibilities in RTD in PAC West

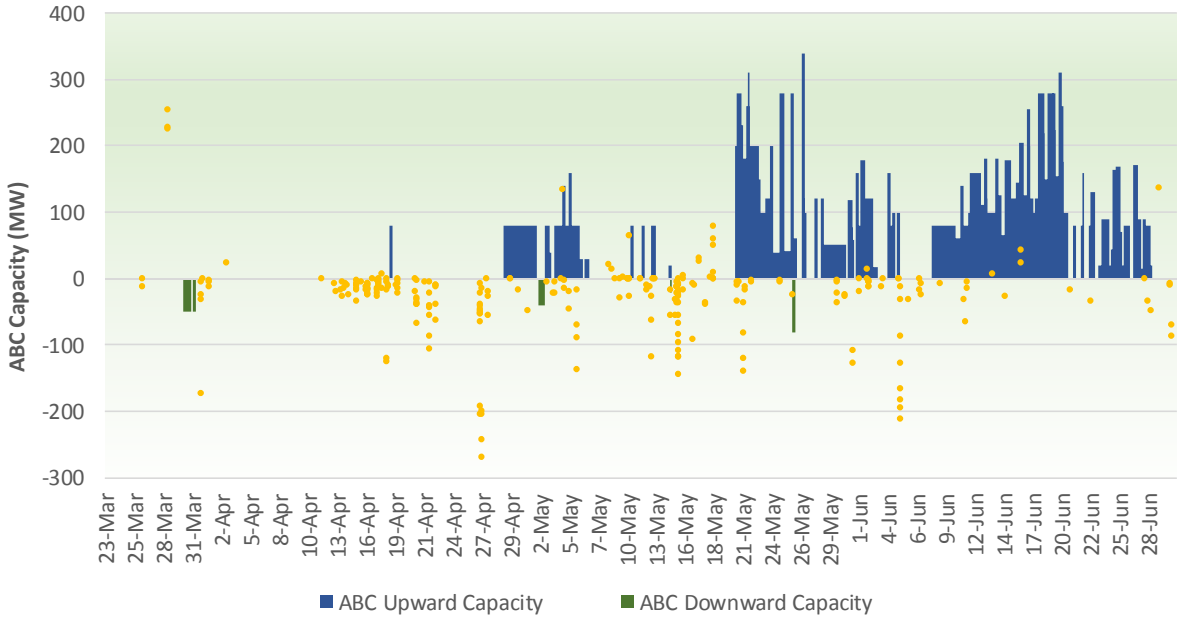


Figure 12: Submitted ABC capacity and power balance constraint infeasibilities in the FMM in PAC East

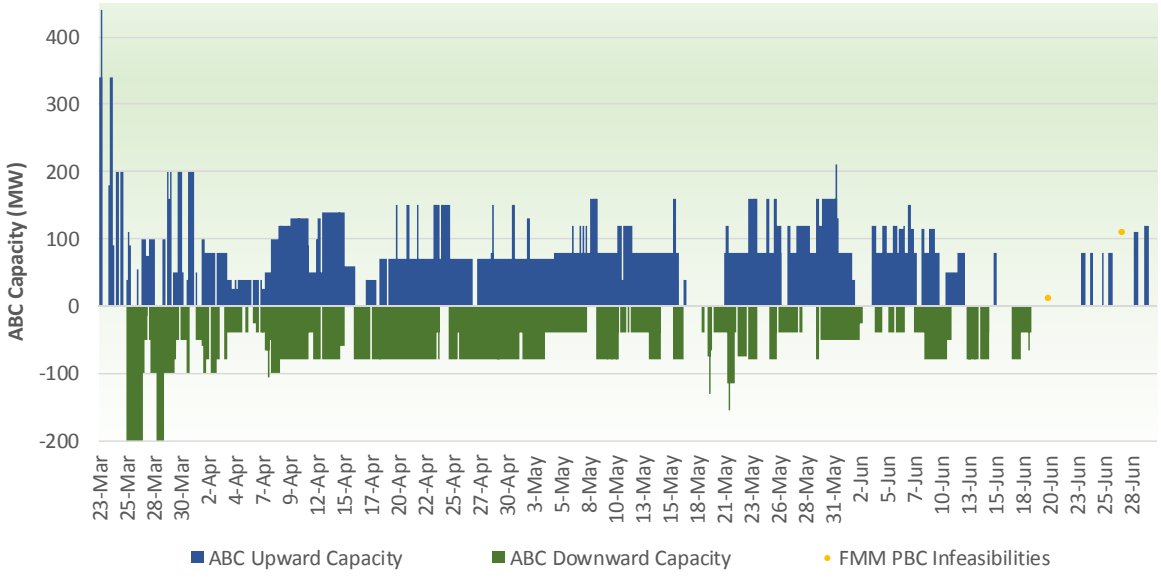


Figure 13: Submitted ABC capacity and power balance constraint infeasibilities in RTD in PAC East

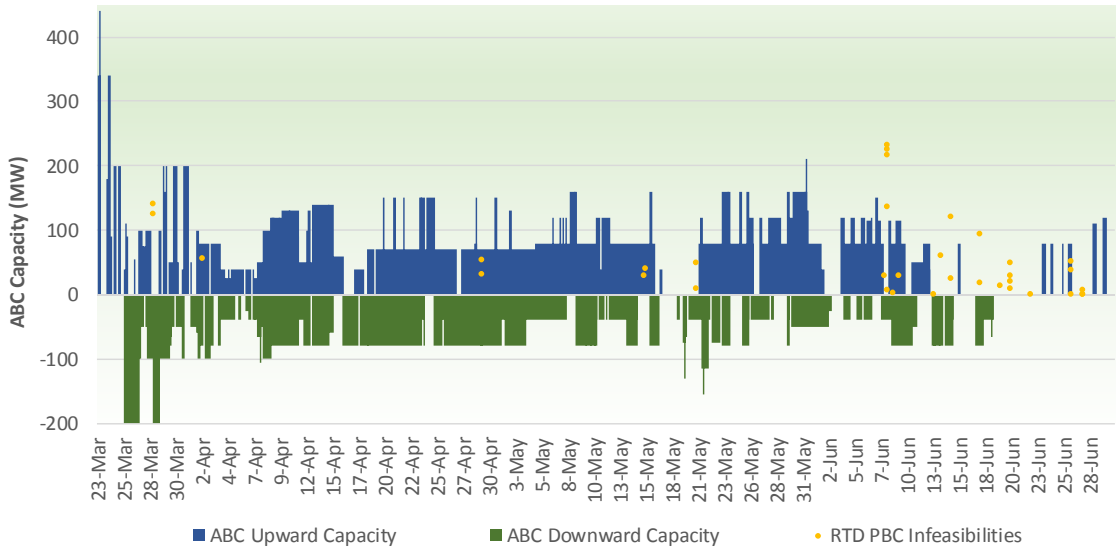


Figure 14: Submitted ABC capacity and power balance constraint infeasibilities in the FMM in NV Energy

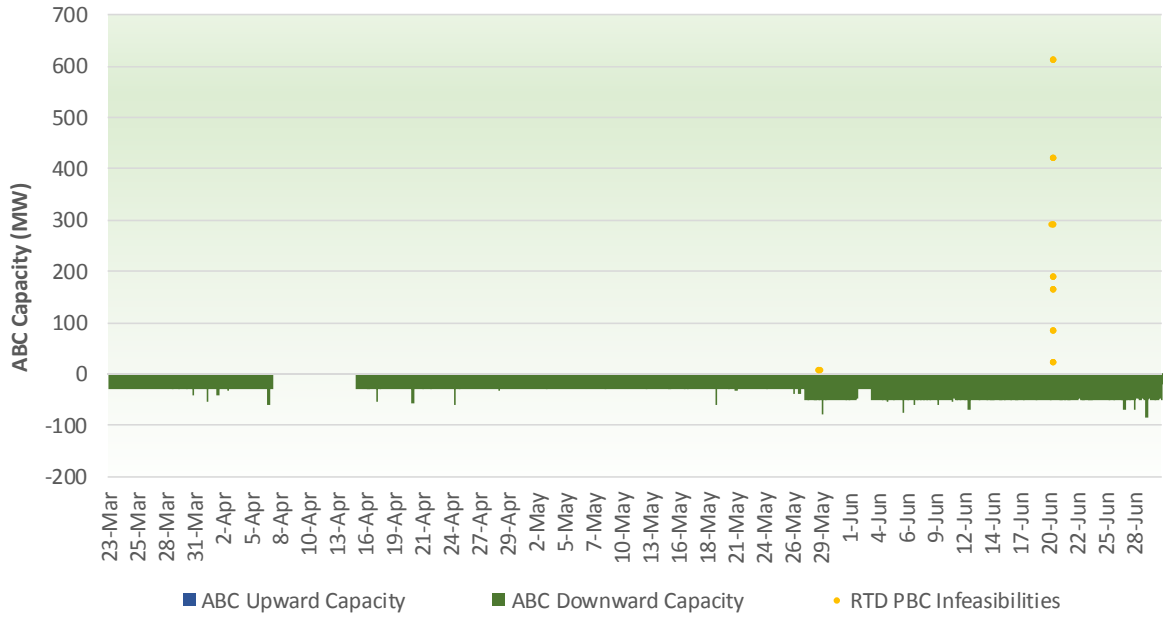


Figure 15: Submitted ABC capacity and power balance constraint infeasibilities in the RTD in NV Energy

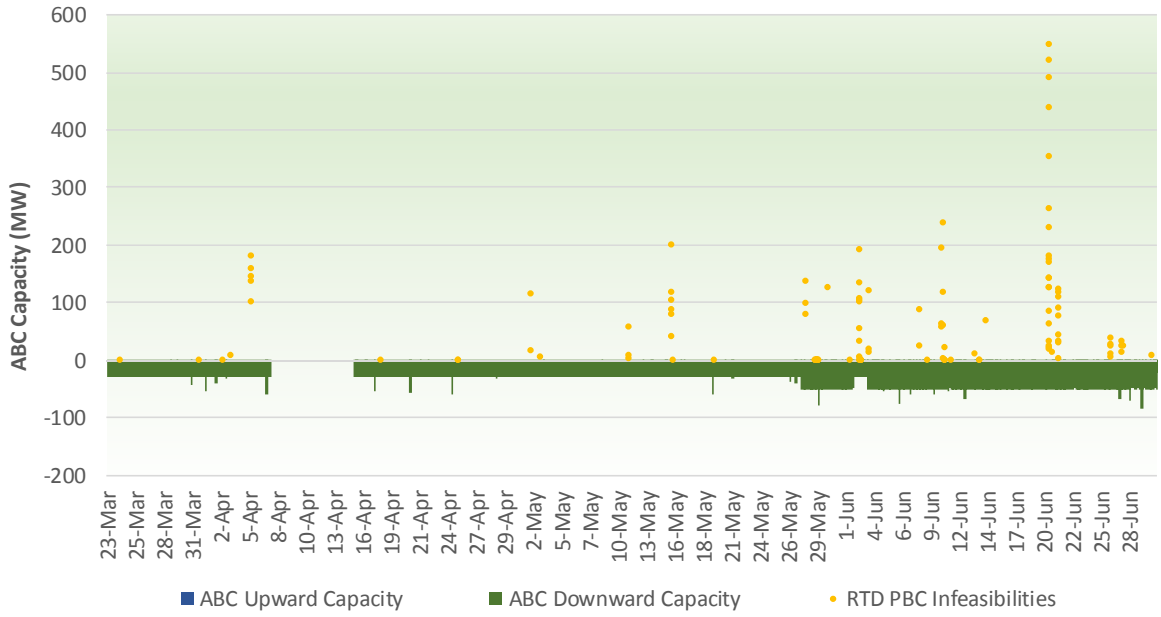


Table 3 below provides the frequency of intervals in which there was no ABC capacity made available in the market and a power balance constraint infeasibility was observed based on the data provided in the figures above. This is organized for over-supply infeasibilities where downward ABC capacity is needed and for under-supply infeasibilities where upward ABC capacity is needed. For instance, for NV Energy, both the fifteen and five minute markets are a 100 percent for under-supply infeasibilities, indicating that in every interval when an under-supply infeasibility was observed, there was no upward ABC capacity made available to the market. As described above, NV Energy has indicated it did not have additional capacity to offer as upward ABC beyond the capacity scheduled for base-load, market bids, or contingency reserves.

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

	Over-supply		Under-supply	
	FMM	RTD	FMM	RTD
PAC West	75%	99.2%	100.0%	83.0%
PAC East	-	100%	80.0%	84.1%
NV Energy	-	0%	100%	100%

Through the CAISO's evaluation of the ABC functionality's performance during the first months after implementation the CAISO also observed the following:

1) Use of ABC Related to Resource Constraints: The CAISO market optimization software recognizes the constraints and characteristics of capacity identified as ABC as it does of any other capacity that participates in the market. Therefore, at times the market is unable to use the identified capacity due to the operational characteristics of the resources identified as such. In several instances when there was a power balance constraint infeasibility, the ABC capacity identified by the EIM entity could not resolve the infeasibility because of the operational ramp limitations of the resources. In some cases, the ramp rate was low given the operating point of the resource. In other cases, the resources needed to cross a forbidden region first in order to access the ABC capacity, and that may take several market intervals, thereby preventing the market optimization software from using the identified capacity. In some instances, a resource was 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 was by dispatching it within the operating region with ABC.

2) Use of ABC Related to Congestion Management: The CAISO market systems release 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 pricing run of the CAISO markets and 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 BAAs 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 on the system as a whole. Therefore, in some instances the ABC was released in the EIM BAA 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 a part of the single market optimization for the entire EIM area, the need to re-dispatch resources to manage congestion efficiently would have resulted in the re-allocation of resources such that the ABC capacity would need to be released to ensure the EIM are could operate its system reliably.

3) However, because the CAISO must ensure the EIM area can operate its system reliably with the use of the ABC capacity it identifies, the CAISO enforces a constraint that ensures that when ABC capacity is cleared; such capacity stays within the EIM entity BAA. While the CAISO is not able to isolate the electrons, the constraint ensures that EIM BAA does not export the ABC to another area to the detriment of the EIM BAA by ensuring that the exports from the EIM BAA are net of the ABC capacity released in an EIM entity BAA. In a few instances, software defects regarding the reported amount of ABC affected the performance of the ABC enhancement. In these cases, some MW schedules were incorrectly reported as ABC capacity. The CAISO implemented a fix for this reporting issue on October 1, 2016.

IV. EIM performance

This section presents the information the CAISO has provided in its monthly informational reports submitted during an EIM entity's first six-month transition period.

A. Prices

Figures 16 through 19 show the EIM Entity Load Aggregation Point (EIM LAP) prices[3] for the FMM and RTD in each EIM. These trends show only the factual prices, which are financially binding. In prior reports, the CAISO provided these factual prices in comparison to counterfactual prices in order to show the effect of using the pricing waiver of the price discovery mechanism. This comparison is no longer meaningful because PAC West and PAC East tariff waivers ended with the activation of the ABC feature on March 23, 2016, and NV Energy's transitional period expired by the end of May.[4]

[3] The ELAP provides aggregate prices that are representative of pricing in the overall area of NV Energy.

[4] 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 NV Energy, 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 the Commission.

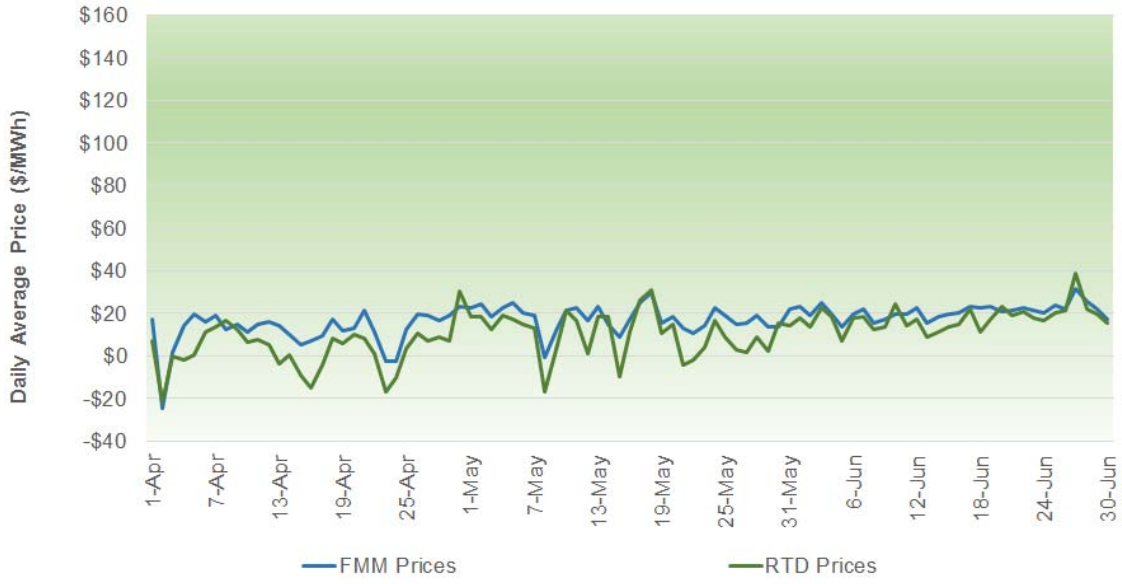
Figure 16: Daily average price for NV Energy EIM LAP

Under the CAISO's price correction authority (section 35 of the CAISO Tariff), the CAISO may correct prices posted on its 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 16 through 19 include all prices produced by the CAISO consistent with its 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; and (3) any prices the CAISO adjusted pursuant to transition period pricing reflected in section 29.27.

Figure 17: Daily average price for PAC East EIM LAP

For the period of April 1 through June 30, 2016, EIM LAP prices in NV Energy were on average $22.45/MWh and $22.91/MWh in the FMM and RTD, respectively. Prices in PAC West were on average $16.85/MWh and $10.47/MWh, while prices in PAC East were on average $20.83/MWh and $19.97/MWh in the FMM and RTD, respectively.

Figure 18: Daily average price for PAC West EIM LAP



B. Frequency of Power Balance Constraint Infeasibilities

Figures 19 through 24 show the frequency of intervals in which the power balance constraint was relaxed for under-supply or over-supply conditions in each of the three EIM entity areas for the FMM and RTD, respectively. 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 are already filtered out, as they would not reflect valid infeasibilities.

For NV Energy, there were only seven FMM under-supply infeasibilities in the reported three-month period, with all of them observed on June 20, 2016. The RTD market experience the highest number of infeasibilities, with 17 infeasibilities. The common driver for the infeasibilities was tight supply conditions with high loads observed not only on the NV Energy area but also on the CAISO BAA. In total, NV Energy observed 0.08 percent of the time (seven intervals) infeasibilities in the FMM market. In the RTD market, NV Energy observed 0.32 percent of the time (86 intervals) undersupply infeasibilities, with 0.2 percent (52 intervals) of the time had infeasibilities covered by the load conformance limiter feature.

Figure 19: Frequency of FMM power balance infeasibilities in NV Energy area

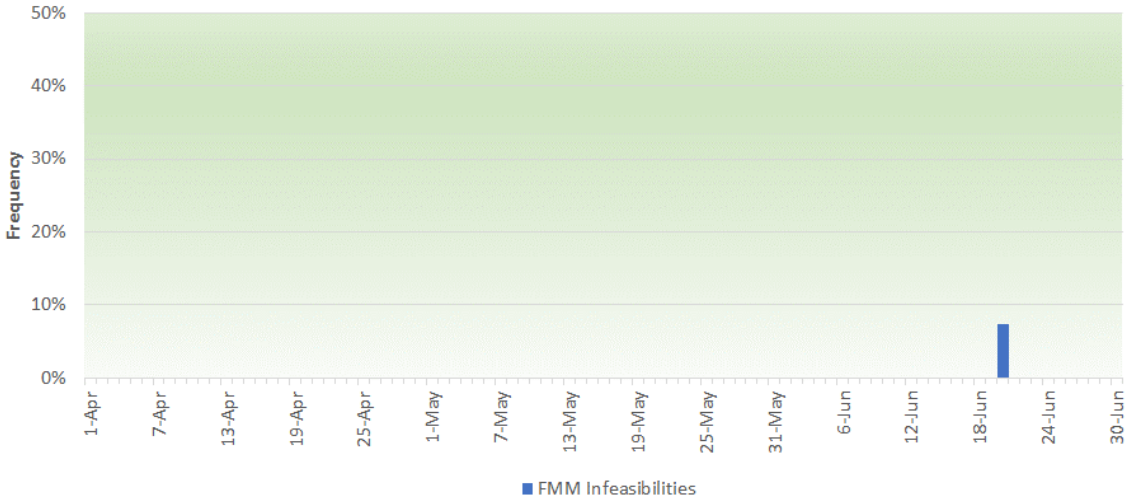
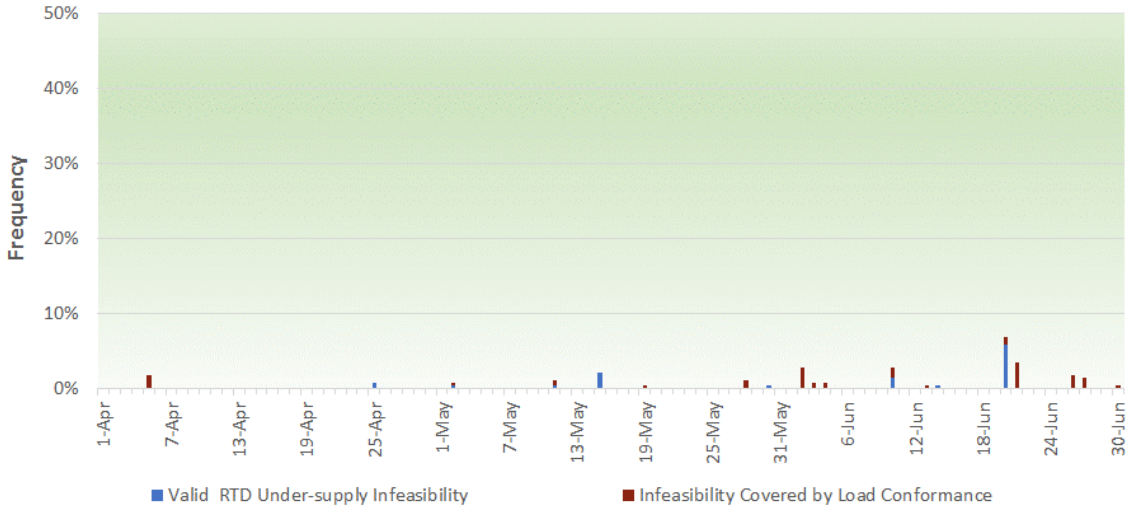


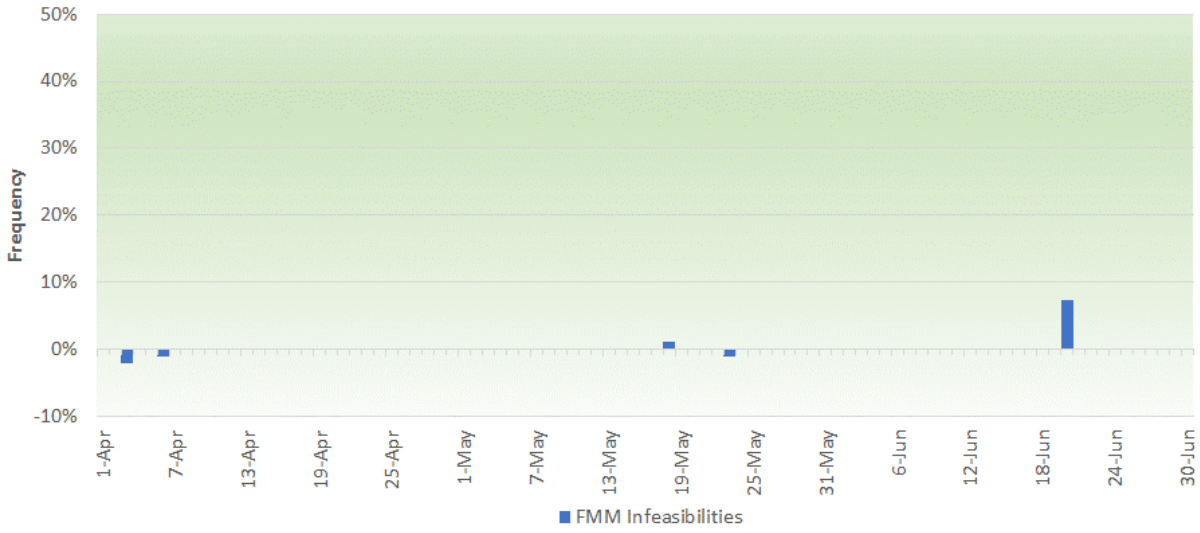
Figure 20: Frequency of RTD power balance infeasibilities in NV Energy area



The CAISO uses a load conformance limiter in the CAISO BAA to prevent over-adjustments through use of load conformance, and thus prevent an artificial infeasibility – that is, 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 instances of

infeasibilities covered with the load conformance limiter are explicitly shown in the plots with bars in red.

Figure 21: Frequency of FMM power balance infeasibilities in PAC West area



For PAC West area, the FMM market observed four (0.04 percent of the time) and eight intervals (0.092 percent of the time) with over- and under-supply infeasibilities, respectively. Seven of the eight under-supply infeasibilities were observed also on June 20, 2016. For the RTD market, 0.85 percent of the time over-supply infeasibilities were observed, with 41 percent of these infeasibilities covered by the load conformance limiter. Under-supply infeasibilities were minimal, happening in 0.05 percent of the time.

Figure 22: Frequency of RTD power balance infeasibilities in PAC West area

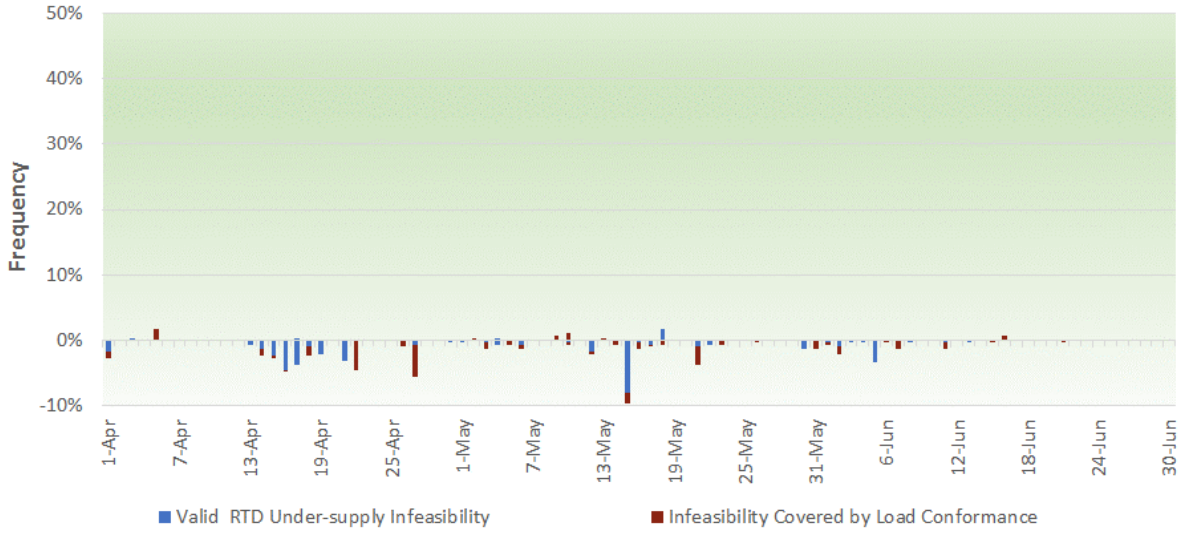
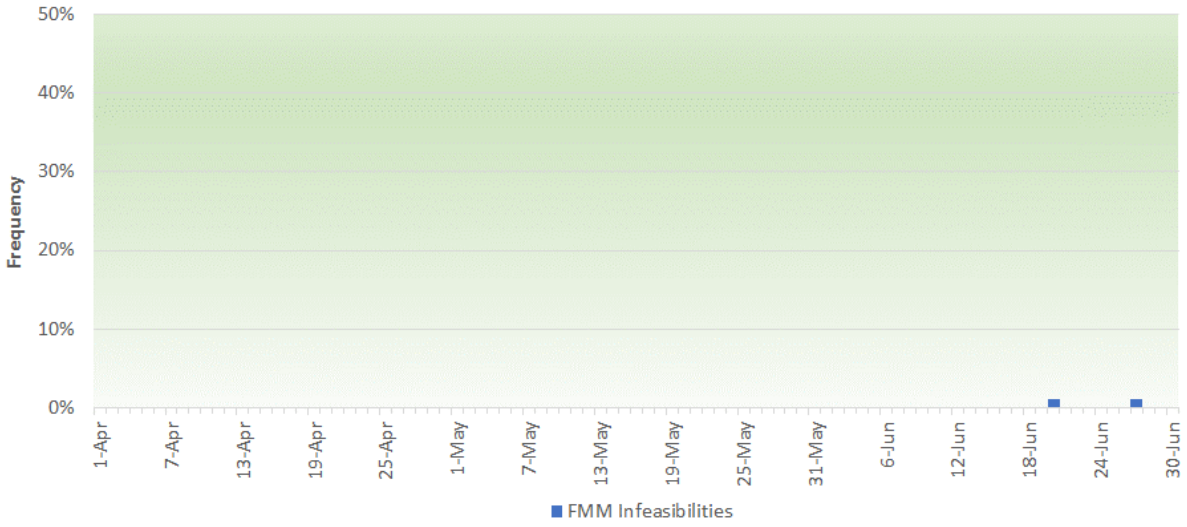
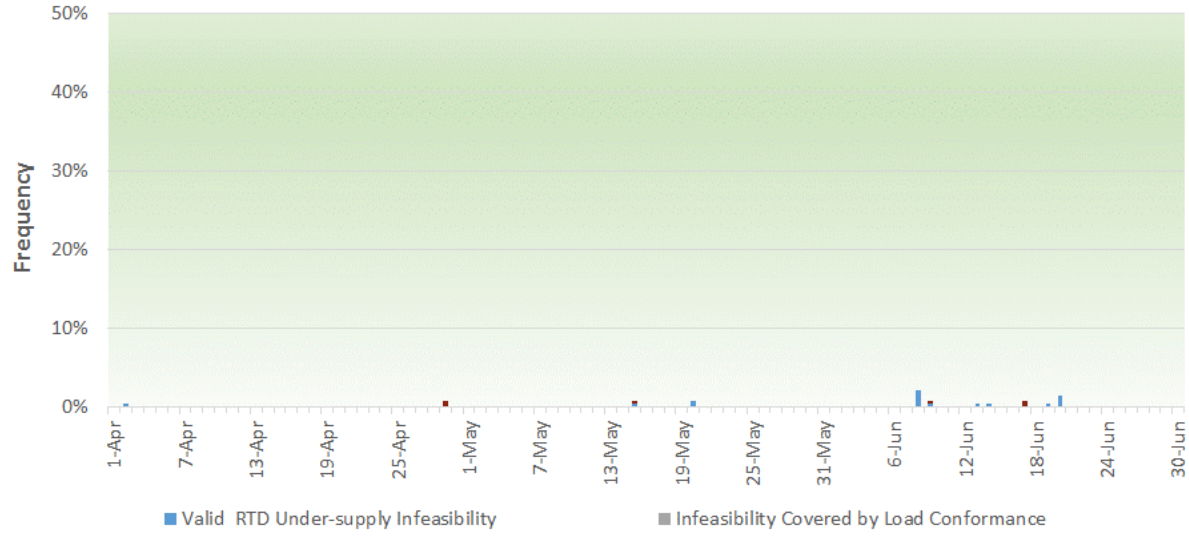


Figure 23: Frequency of FMM power balance infeasibilities in PAC East area



Similarly, infeasibilities in the PAC West area were minimal with only two instances (0.02 percent of the time) observed in the reported three-month period, with one of them observed also on June 20, 2016. For the real-time market, all infeasibilities observed in this period were for under-supply conditions with 0.1 percent of the time (27 intervals). About 22 percent of these instances were covered by the load conformance limiter.

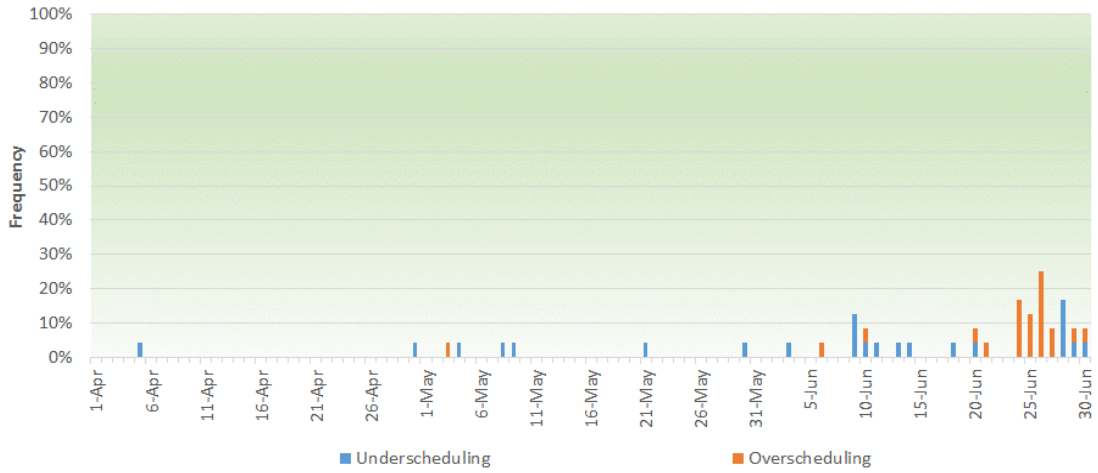
Figure 24: Frequency of RTD power balance infeasibilities in PACE East area



C. Balancing and Sufficiency Test Failures

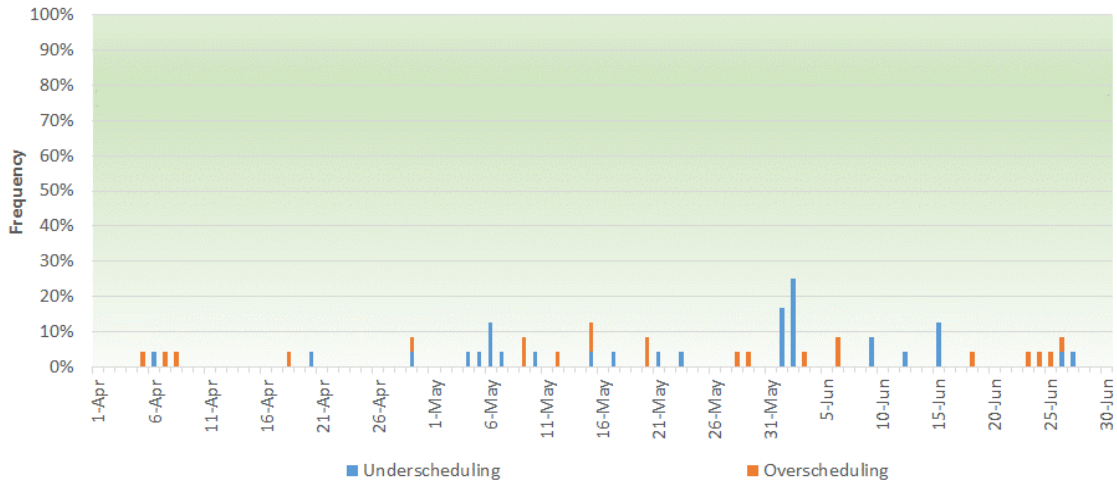
Figures 25 through 27 show the trend of balancing test failures for the period of April 1 through June 30 for each of the EIM entity areas. This test is performed pursuant to section 29.34 (k) of the CAISO Tariff. NV Energy passed the balancing test 97.9 percent of the time. Of the 45 hours out of 2184 in which NV Energy did not pass the balancing test, about half of those 45 hours reflect under-scheduling, which is the normal incidence of the forecasting and balancing process that has occurred at a frequency that is well within expected performance tolerances.

Figure 25: Frequency of Balancing test failures for NV Energy area



For PAC West area, the passing rate of the balancing test for the reported period was about 97.9 percent of the time, with about 1.4 percent of the failures being for under-scheduling. Similarly, PAC East passed the balancing test about 97.85 percent of the time, with a about the half of the failures associated with under-scheduling.

Figure 25: Frequency of Balancing test failures for PAC West area



Figures 27 through 29 show the trend of failures for the flexible ramp sufficiency test in each of the EIM entity areas. For the reported period, the passing rate of this test was about 99.68 percent, 99.22 percent and 99.3 percent in NV Energy, PAC West and PAC East area, respectively.

Figure 26: Frequency of Balancing test failures for PAC East area

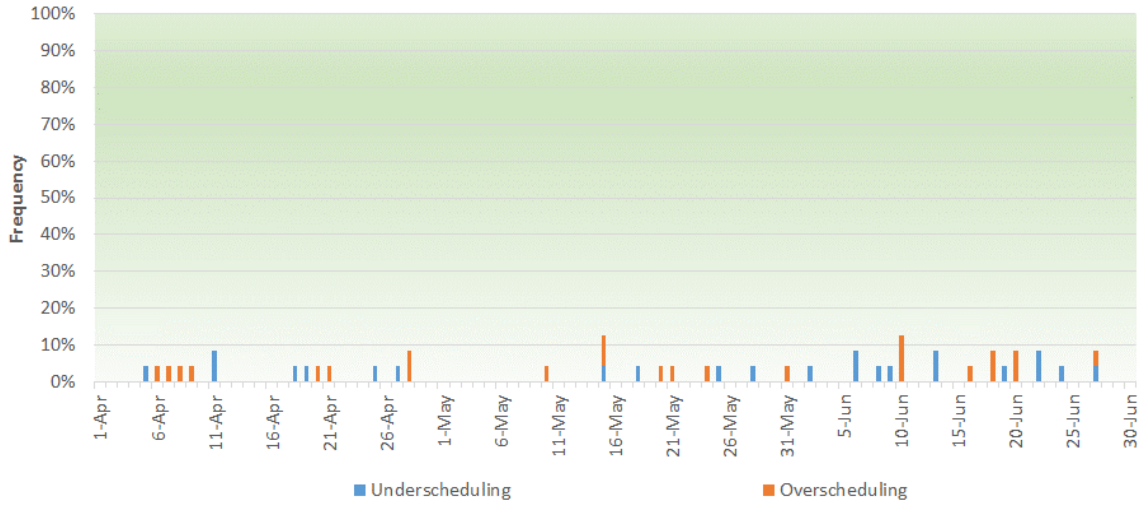


Figure 27: Frequency of flexible ramp sufficiency test failures in NV Energy area

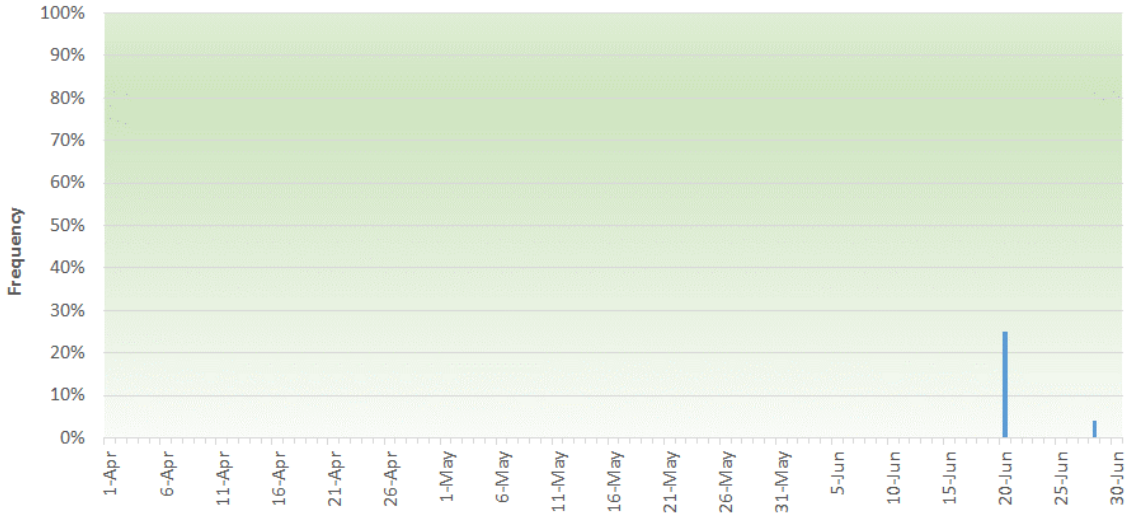


Figure 28: Frequency of flexible ramp sufficiency test failures in PAC West area

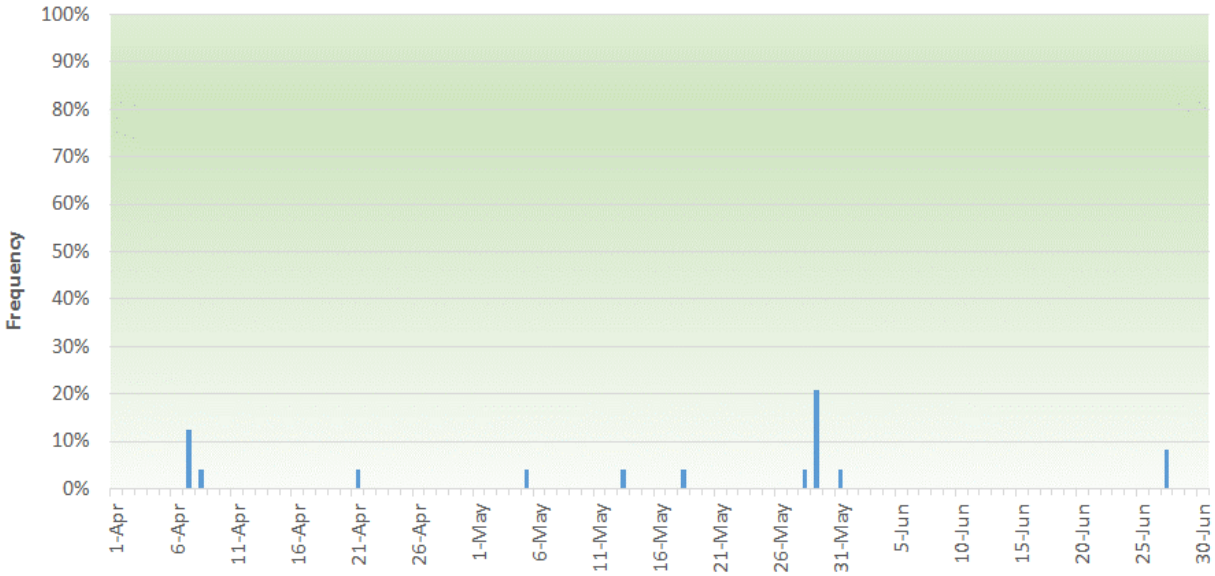
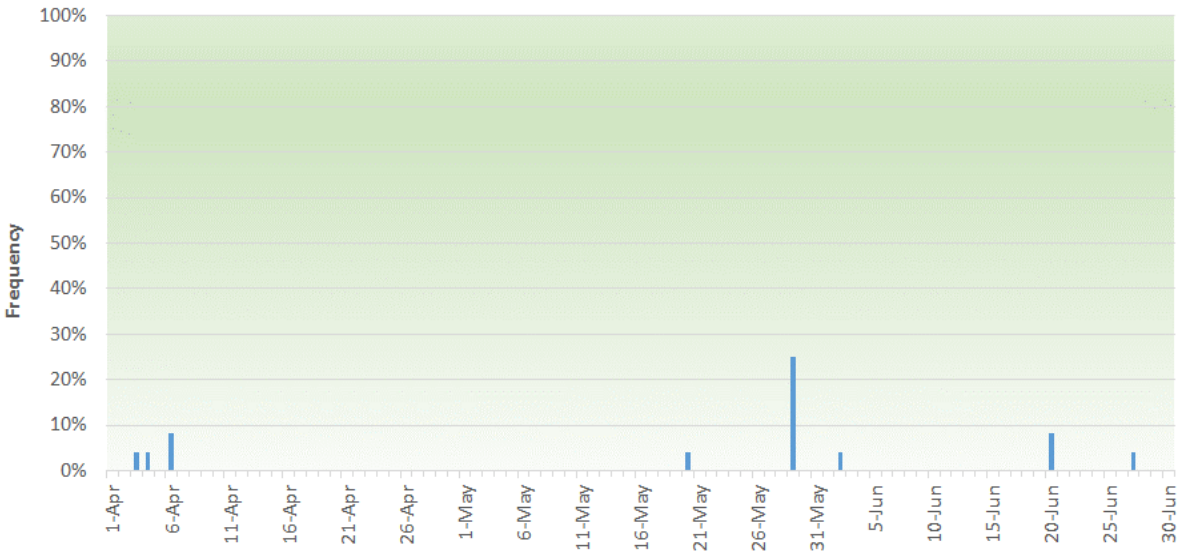


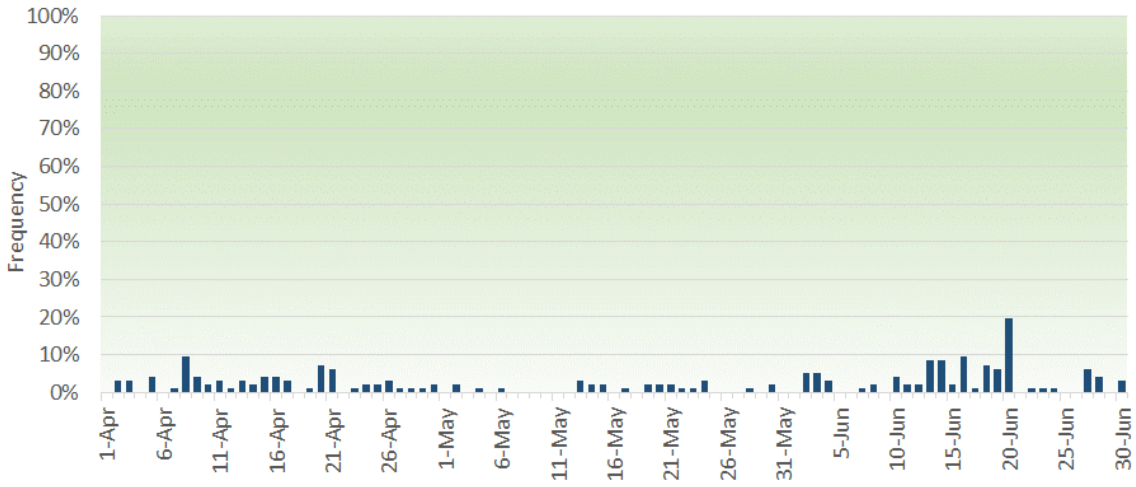
Figure 29: Frequency of flexible ramp sufficiency test failures in PAC East area



D. Flexible Ramping Constraint Infeasibilities

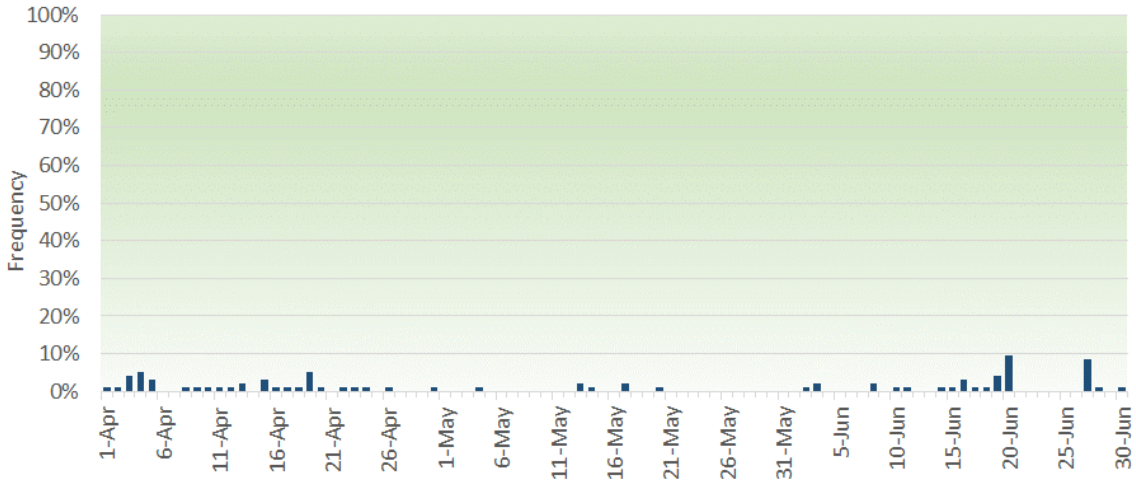
Figures 31 through 33 show the frequency of flexible ramp constraint infeasibilities; the instances where the infeasibilities were not valid and have been filtered out.

Figure 30: Frequency of flexible ramp constraint infeasibilities in NV Energy



During the reported three-month period, the flexible ramping constraint in the NV Energy EIM area was infeasible, on a daily average, in 2.2 percent of the FMM intervals. As in prior months, these infeasibilities are mainly driven by the economics of flex ramp and its opportunity cost. Because the market co-optimizes the procurement of energy and flexible ramp capacity, resources in the NV Energy area may be incrementally dispatched to provide economic transfers to the CAISO BAA rather than to provide flexible ramping capacity for the NV Energy BAA. Consequently, these economics sometimes cause flexible ramping scarcity that causes the constraint to bind in the NV Energy area. This circumstance is not unusual.

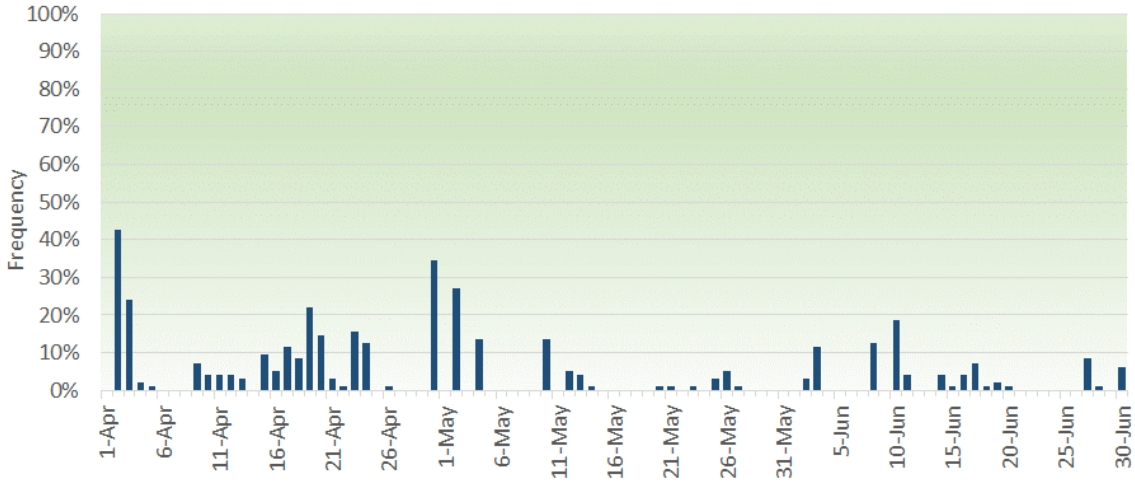
Figure 31: Frequency of flexible ramp constraint infeasibilities in PAC East



For PAC East and PAC West, the flexible ramping constraint infeasibilities, on a daily average, in 0.93 percent and 4.3 percent, respectively.

Similarly, opportunity costs played a large role in the frequency of infeasibilities, together with the limited capacity made available for flexible ramp.

Figure 32: Frequency of flexible ramp constraint infeasibilities in PAC West



CERTIFICATE OF SERVICE

I 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 10th day of November, 2016.

/s/ Grace Clark
Grace Clark