2016 REGULATION RESERVE STUDY

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I. Introduction

This 2016 Regulation Reserve Study ("Regulation Reserve Study") estimates the regulation reserve required to maintain PacifiCorp's system reliability and comply with North American Electric Reliability Corporation ("NERC") reliability standards. The Regulation Reserve Study supports PacifiCorp's rate proposals for Schedules 3 and 3A of PacifiCorp's Open Access Transmission Tariff.

PacifiCorp operates two Balancing Authority Areas ("BAAs") in the Western Electricity Coordinating Council ("WECC") NERC region, PacifiCorp East ("PACE") and PacifiCorp West ("PACW"). The PACE and PACW BAAs are interconnected by a limited amount of transmission across a third-party transmission system and the two BAAs are each required to comply with NERC standards. PacifiCorp must provide sufficient regulation reserve to remain within NERC's balancing authority area control error ("ACE") limit in compliance with BAL-001-2,[1] as well as the amount of contingency reserve required in order to comply with NERC standard BAL-002-WECC-2.[2] As discussed in more detail in section V.B. below, BAL-001-2 is a new regulation reserve standard that became effective July 1, 2016, and BAL-002-WECC-2 is a contingency reserve standard that became effective October 1, 2014. Regulation reserve and contingency reserve are components of operating reserve, which NERC defines as "the capability above firm system demand required to provide for regulation, Load forecasting error, equipment forced and scheduled outages and local area protection."[3]

Apart from disturbance events that are addressed through contingency reserve, regulation reserve is necessary to compensate for changes in Load demand and generation output, so as to maintain ACE within mandatory parameters established by the BAL-001-2 standard. The Regulation Reserve Study estimates the amount of regulation reserve required to manage variations in Load, variable energy resources[4] ("VERs"), and resources that are not VERs ("Non-VERs") in each of PacifiCorp's BAAs. Load, VERs and Non-VERs were each studied because PacifiCorp's data indicates that these components or customer classes place different regulation reserve burdens on PacifiCorp's system due to differences in the magnitude, frequency, and timing of their variations from forecasted levels. Specifically, PacifiCorp's calculations described in section V below demonstrate that the regulation reserve burden associated with VER deviations from scheduled amounts are three times greater than the regulation reserve burden associated with

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1 NERC Standard BAL-001-2, http://www.nerc.com/files/BAL-001-2.pdf, which became effective July 1, 2016. ACE is the difference between a BAA's scheduled and actual interchange, and reflects the difference between electrical generation and Load within that BAA.

2 NERC Standard BAL-002-WECC-2, http://www.nerc.com/files/BAL-002-WECC-2.pdf, which became effective October 1, 2014.

3 NERC Glossary of Terms: http://www.nerc.com/files/glossary_of_terms.pdf, updated July 13, 2016.

4 VERs are resources that resources that: (1) are renewable; (2) cannot be stored by the facility owner or operator; and (3) have variability that is beyond the control of the facility owner or operator. *Integration of Variable Energy Resources*, Order No. 764, 139 FERC ¶ 61,246 at P 281 (2012) ("Order No. 764"); *order on reh'g*, Order No. 764-A, 141 FERC ¶ 61,232 (2012) ("Order No. 764-A"); *order on reh'g and clarification*, Order No. 764-B, 144 FERC ¶ 61,222 at P 210 (2013) ("Order No. 764-B").

Load deviations and four times greater than the regulation reserve burden associated with Non-VERs. As a result, PacifiCorp attributes different levels of regulation reserve to Load, VERs, and Non-VERs.

The Regulation Reserve Study is based on PacifiCorp operational data recorded from January 2015 through December 2015 ("Study Term") for Load, VERs, and Non-VERs. The estimated regulation reserve amounts determined in this Regulation Reserve Study represent the incremental capacity needed to ensure compliance with BAL-001-2 for a particular operating hour. The regulation reserve requirement is first calculated for Load, VERs, and Non-VERs independently. The regulation reserve requirement for the combined portfolio is the sum of the individual requirements for Load, VERs, and Non-VERs, less the reserve "savings" associated with diversity between the different classes, including diversity benefits realized as a result of PacifiCorp's participation in the Energy Imbalance Market ("EIM") operated by the California Independent System Operator Corporation ("CAISO").

The methodology in the Regulation Reserve Study differs in several ways from that employed in PacifiCorp's previous regulation reserve requirement analyses.[5,6,7] First, regulation reserve requirements are now tied directly to compliance with the BAL-001-2 standard. Second, the Regulation Reserve Study uses a portfolio wide approach to determine the overall regulation reserve requirement, including the aggregated diversity benefits for all customer classes. Third, all customer classes that contribute to the overall regulation reserve requirement are now allocated a share of the diversity benefits resulting from aggregating their requirement with that of the system as a whole. Fourth, the Regulation Reserve Study reflects updated data based on actual operational experience during the Study Term, including the data and benefits from PacifiCorp's participation in the EIM. Finally, the Regulation Reserve Study identifies the potential benefits associated with the implementation of intra-hour forecasting and scheduling.

The Regulation Reserve Study provides an analysis of data collected during the Study Term, extrapolated to determine the estimated amount of deviation that PacifiCorp can prudently expect at any given point in time—allowing PacifiCorp to carry sufficient regulation reserve to ensure the reliability of the transmission system and compliance with NERC and WECC standards. The Regulation Reserve Study includes the following components: (1) data input description; (2) data refinement to ensure accuracy; (3) initial regulation reserve requirement determination, and (4) adjusted regulation reserve requirement determination. Each of these components is addressed individually below.

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[5] 2012 Wind Integration Study report, Appendix H in Volume II of PacifiCorp's 2013 IRP report: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2013IRP/PacifiCorp-2013IRP_Vol2-Appendices_4-30-13.pdf

[6] 2013 PacifiCorp Schedule 3 and 3A Study, Exhibit PAC-8 in testimony of Greg Duvall, FERC Docket No. ER13-1206 (filed April 1, 2013).

[7] 2014 Wind Integration Study, Appendix H in Volume II of PacifiCorp's 2015 IRP report: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2015IRP/PacifiCorp_2015IRP-Vol2-Appendices.pdf

II. Executive Summary

As shown in Table ES1 below, this Regulation Reserve Study concludes that the total regulation reserve requirement for PacifiCorp's system-wide portfolio was 562 MW for 2015, which is the amount necessary to satisfy the NERC and WECC mandatory reliability standard requirements. To develop this figure, PacifiCorp took into account the following: (1) Load, VER, and Non-VER data; (2) Load, VER, and Non-VER base schedules;[8] (3) corrections and adjustments to account for data anomalies, and (4) system portfolio diversity and EIM intra-hour benefits. Using this information, PacifiCorp then developed a total regulation reserve requirement that satisfies the NERC and WECC requirements and that accounts for PacifiCorp and EIM resource diversity.

As shown in Table ES1 below, the reserve forecasts necessary to independently ensure reliability compliance for Load, VERs, and Non-VERs result in a total requirement of 900 MW. When the requirements of all classes in the PacifiCorp BAAs are considered as a portfolio, a total requirement of 654 MW is sufficient to ensure reliability compliance, a reduction of 27 percent from the stand-alone requirements. When the intra-hour benefits associated with PacifiCorp's participation in EIM are also accounted for, a total requirement of 562 MW is sufficient to ensure reliability compliance, a reduction of 38 percent from the stand-alone requirements. These requirements amount to 9.2 percent of capacity for VERs, 2.3 percent of capacity for Non-VERs, and 2.8 percent of the monthly average coincident peak demand ("12CP") for Load.

Table ES1: 2016 Regulation Reserve Study Results

Scenario	Stand-alone Regulation Forecast (aMW)	Portfolio Regulation Forecast (aMW)	Portfolio Regulation Forecast with EIM (aMW)	Portfolio Rate with EIM (%)	2015 Capacity (MW)	Rate Determinant
Non-VER	83	60	52	2.3%	2,228	Nameplate
Load	433	315	271	2.8%	9,696	12CP
VER - Wind	384	279	240	9.2%	2,588	Nameplate
Total	900	654	562			
Portfolio LOLP (hours/year)	0.03	0.88	0.88			
Reduction from Total, Stand-alone Regulation Forecast (%)		27%	38%			

Section III of this Regulation Reserve Study begins by describing the data inputs PacifiCorp used to develop the total regulation reserve requirement and identifies the VERs and Non-VERs relied upon by the Regulation Reserve Study. Section IV then analyzes the Load, VER, and Non-VER data identified in section III to develop the base schedules for each class of Load or resources

[8] A "base schedule", as used throughout the Regulation Reserve Study, is equivalent to a "forecast" and is the term PacifiCorp's OATT employs for this purpose since the implementation of the EIM.

and ensure accuracy of the data provided in Section III. In particular, section IV.B first develops proxy Load base schedules, while section IV.C makes adjustments to all base schedules to account for the ramping built into the calculation of PacifiCorp's ACE. Section IV.D makes certain corrections to the data to account for Load, VER, and Non-VER data anomalies, and section IV.E makes further deviation adjustments to the data to account for a period of anomalous data for Non-VERs during the first part of the Study Term.

Using the data and base schedules developed in sections III and IV, section V then explains the methodology PacifiCorp used when developing its initial regulation reserve requirement. PacifiCorp begins by explaining the components of operating reserve, including both contingency reserve and regulation reserve, and then focuses on the recently-effective NERC standard governing regulation reserve, BAL-001-2. In particular, PacifiCorp explains the methodology required by BAL-001-2 and highlights why the change in NERC standards resulted in the Regulation Reserve Study using a different methodology than previously used by PacifiCorp to calculate the total regulation reserve requirement. Using the updated methodology, PacifiCorp calculates its regulation reserve need for each hour of 2015, taking into account certain adjustments and corrections.

PacifiCorp next develops regulation reserve forecasts based on the 2015 historical data. These forecasts are separately prepared for VERs, Non-VERs, and Load, and are designed to meet PacifiCorp's planning reliability target of 0.88 loss of Load hours per year due to regulation reserve shortages, which is intended to satisfy the requirements contained in the NERC and WECC standards. Based on these forecasts and consideration of the data and base schedules from the prior sections, PacifiCorp was able to develop an initial regulation reserve requirement for each class.

Section VI adjusts the initial regulation reserve requirement to account for the benefits from the diverse portfolio of Loads and resources in the PacifiCorp BAAs, EIM, and intra-hour scheduling. In particular, PacifiCorp's analysis demonstrates that the initial regulation reserve requirement can be reduced to account for the diversity of the regulation requirements in PacifiCorp's BAAs, intra-hour benefits provided by the EIM, and increased forecast accuracy where intra-hour schedules are used.

Taking these adjustments to the initial regulation reserve requirement into account, section VII provides the summary of PacifiCorp's adjusted, total regulation reserve requirement. Additionally, Appendix A contains a list of relevant definitions used in this Regulation Reserve Study. Appendix B contains the list of generators studied and their corresponding nameplate capacities. Finally, Appendix C demonstrates how PacifiCorp calculated its 12CP total Load billing determinant.

III. Description of Data Inputs

A. Overview

This section describes the data used to determine PacifiCorp's regulation reserve requirements. In order to estimate PacifiCorp's required regulation reserve amount, PacifiCorp must determine the difference between the expected Load and resources and actual Load and resources. The difference between Load and resources is calculated every four seconds and is represented by the ACE. ACE must be maintained within the limits established by BAL-001-2, so PacifiCorp must estimate the amount of regulation reserve that is necessary in order to maintain ACE within these limits.

To estimate the amount of regulation reserve that will be required in the future, the Regulation Reserve Study identifies the scheduled use of the system as compared to the actual use of the system during the Study Term. For the baseline determination of scheduled use for Load and resources, the Regulation Reserve Study used hourly base schedules. Hourly base schedules are the power production forecasts used for imbalance settlement in the EIM and represent the best information available concerning the upcoming hour.[9]

The deviation from scheduled use was derived from data provided through participation in the EIM. The deviations of generation resources in EIM were measured on a five-minute basis, so the Regulation Reserve Study used five-minute intervals throughout the analysis.

EIM base schedule and deviation data for each VER and Non-VER transaction point were downloaded using the Report Explorer application to query PacifiCorp's nMarket Application database, which is populated with data provided by the CAISO. Since PacifiCorp's implementation of EIM on November 1, 2014, PacifiCorp requires certain operational forecast data from all of its transmission customers pursuant to the provisions of Attachment T to PacifiCorp's Federal Energy Regulatory Commission ("FERC")-approved Open Access Transmission Tariff ("OATT"). This includes EIM base schedule data (or forecasts) from all resources included in the EIM network model at transaction points. EIM base schedules are submitted by transmission customers with hourly granularity, and are settled using hourly data for Load, and fifteen-minute and five-minute data for resources. A primary function of the EIM is to measure Load and resource imbalance (or deviations) as the difference between the hourly base schedule and the actual metered values.

The methodology used to develop the regulation reserve requirement is described in more detail below in Section V. A summary of the data gathered for this analysis is listed below, and a more detailed description of each type of source data is contained in the following subsections.

[9] The CAISO, as the market operator for the EIM, requests base schedules at 75 minutes ("T-75") prior to the hour of delivery. PacifiCorp's transmission customers are required to submit base schedules by 77 minutes ("T-77") prior to the hour of delivery – two minutes in advance of the EIM Entity deadline. This allows all transmission customer base schedules enough time to be submitted into the EIM systems before the overall deadline of T-75 for the entirety of PacifiCorp's two BAAs. The base schedules are due again to CAISO at 55 minutes ("T-55") prior to the delivery hour and can be adjusted up until that time by the EIM Entity (i.e., PacifiCorp Grid Operations). PacifiCorp's transmission customers are required to submit updated, final base schedules no later than 57 minutes ("T-57") prior to the delivery hour. Again, this allows all transmission customer base schedules enough time to be submitted into the EIM systems before the overall deadline of T-55 for the entirety of PacifiCorp's two BAAs. Base schedules may be finally adjusted again, by the EIM Entity only, at 40 minutes ("T-40") prior to the delivery hour in response to CAISO sufficiency tests. T-55 is the base schedule time point used throughout this study because it is the deadline which most closely corresponds to the final T-57 deadline for all transmission customers to submit final base schedules.

Source data:

- Load data
  - Five-minute interval actual Load
  - Proxy hourly base schedules developed from actual prior hour and prior week data (discussed in Section IV.B.)

- VER data
  - Five-minute EIM deviations
  - Hourly base schedules

- Non-VER data
  - Five-minute EIM deviations
  - Hourly base schedules

B. Load Data

The Load class represents the aggregate firm demand of end users of power from the electric system. While the requirements of individual users vary, there are diurnal and seasonal patterns in aggregated demand. The Load class can generally be described to include three components: (1) average Load, which is the base Load during a particular scheduling period; (2) the trend, or "ramp," during the hour and from hour-to-hour; and (3) the rapid fluctuations in Load that depart from the underlying trend. The need for a system response to the second and third components is the function of regulation reserve in order to ensure reliability of the system.

The PACE BAA includes several large industrial Loads with unique patterns of demand. Each of these Loads is either interruptible at short notice or includes behind the meter generation. Due to their large size, abrupt changes in their demand are magnified for these customers in a manner which is not representative of the aggregated demand of the large number of small customers which make up the majority of PacifiCorp's Loads. Additionally, interruptible Loads are included in the cost of regulation reserve service just like dispatchable resources and would be allocated a zero regulation reserve requirement for the same reasons. Although the reserve requirement for the large industrial Loads is not included in the analysis, these Loads are however still included in the denominator of PacifiCorp's regulation reserve rate, so the large industrial Loads are attributed a proportionate share of the costs. In contrast to PacifiCorp's proposal, removing these loads from the denominator would increase the Schedules 3 and 3A regulation reserve rate.

In addition, interruptible Loads can be curtailed if their deviations are contributing to a resource shortfall. Because of these unique characteristics, these Loads are excluded from the Regulation Reserve Study. This treatment is consistent with that used in the CAISO Load forecast methodology (used for PACE and PACW operations), which also nets these interruptible customer Loads out of the PACE BAA.

Actual average Load data was collected separately for the PACE and PACW BAAs for each five-minute interval over the Study Term. Load data for the Study Term was downloaded from PacifiCorp's Ranger PI system and has not been adjusted for transmission and distribution losses. Only actual Load data is available from Ranger PI, not base schedule data that could be used to determine the deviation associated with Load. Because of differences in the Load defined in EIM and in the Ranger PI system, the EIM Load base schedules are not consistent with the Ranger PI actual results. To address the inconsistency, PacifiCorp developed proxy Load base schedules, as discussed in section IV.B. below.

C. VER Data

The VER class includes resources that: (1) are renewable; (2) cannot be stored by the facility owner or operator; and (3) have variability that is beyond the control of the facility owner or operator.[10] VERs, in comparison to Load, often have larger upward and downward fluctuations in output that impose significant and sometimes unforeseen challenges when attempting to maintain reliability. For example, as recognized by FERC in Order No. 764, "Increasing the relative amount of [VERs] on a system can increase operational uncertainty that the system operator must manage through operating criteria, practices, and procedures, *including the commitment of adequate reserves*."[11] In general, VERs include wind and solar generation; however, during the Study Term, the solar resources in PacifiCorp's BAAs were too small to be tracked. As a result, the data included in the Regulation Reserve Study for the VER class includes all wind resources in PacifiCorp's BAAs, which includes: (1) third-party resources (OATT or legacy contract transmission customers); (2) PacifiCorp-owned resources; and (3) other PacifiCorp-contracted resources, such as qualifying facilities, power purchases, and exchanges. Appendix B, Table 1 contains the list of the VERs included in the Study Term. In total, the Regulation Reserve Study includes 2,588 megawatts of VERs.

D. Non-VER Data

The Non-VER class is a mix of thermal and hydroelectric resources and includes all resources which are not VERs, and which do not provide either contingency or regulation reserve. Non-VERs, in contrast to VERs, are often more stable and predictable. Non-VERs are thus easier to plan for and maintain within a reliable operating state. For example, in Order No. 764, FERC suggested that many of its rules were developed with Non-VERs in mind and that such generation "could be scheduled with relative precision."[12] The output of these resources is largely in the control of the resource operator, particularly when considered within the hourly timeframe of the Regulation Reserve Study. The deviations by resources in the Non-VER class are thus significantly lower than the deviations by resources in the VER class. The Non-VER class includes third-party resources (OATT or legacy transmission customers); many PacifiCorp-owned resources; and other PacifiCorp-contracted resources, such as qualifying facilities, power purchases, and exchanges. Appendix B, Table 2 contains the list of the Non-VERs included in the Study Term. In total, the Regulation Reserve Study includes 2,228 megawatts of Non-VERs.

In the Regulation Reserve Study, resources that provide contingency or regulation reserve are considered a separate, dispatchable resource class. The dispatchable resource class compensates for deviations resulting from other users of the transmission system in all hours. While non-

10 Order No. 764 at P 281; Order No. 764-B at P 210.

11 Order No. 764 at P 20 (emphasis added).

12 *Id.* at P 92.

dispatchable resources may offset deviations in Loads and other resources in some hours, they are not in the control of the system operator and contribute to the overall requirement in other hours. Because the dispatchable resource class is a net provider rather than a user of regulation reserve service, its stand-alone regulation reserve requirement is zero (or negative), and its share of the system regulation reserve requirement is also zero. The allocation of regulation reserve requirements and diversity benefits is discussed in more detail in section IV below.

IV. Data Analysis and Adjustment

A. Overview

This section provides details on adjustments made to the data to develop base schedules that correspond to the Load data, align the ACE calculation with actual operations, and address data issues.

B. Load Base Schedule Development

Load deviations are settled using hourly imbalance data in EIM, whereas resource deviations are settled using fifteen-minute and five-minute imbalance data. As a result, the five-minute deviations necessary to assess the regulation reserve requirements associated with Load were not available through EIM. For the Study Term, PacifiCorp has used actual Load data from its Ranger PI system, which can provide data at a five-minute granularity. The Ranger PI system does not have the associated base schedules necessary to calculate deviations, however, so PacifiCorp developed proxy Load base schedules consistent with the measured actual Loads.

The Load base schedule for each hour was calculated from actual Load at 55 minutes prior to the hour ("T-55") in question, with a scaling factor applied based on the change in Load over that same interval in the prior week. The five-minute interval ending at T-55 is the last Load data point available prior to base schedule submission to CAISO at hour T-55 and represents the current state of Load in the PacifiCorp BAAs. Load follows different patterns depending on season and day of the week. Using data from one week prior ensures that recent conditions on a similar day are used in the calculation of the Load base schedule.

Figure 1 below illustrates measurement of the expected Load change between T-55 data and the hourly base schedule over three hours. The five-minute interval ending at 17:05 (first green column) has a Load of 2,643 MW. The actual Load in hour 18 averages 2,837 MW (middle solid horizontal line), an increase of 7.4 percent. Similarly, the expected Load change from the five-minute interval ending at 18:05 to hour 19 is a decrease of 1.1 percent (difference between second green column and second horizontal line). Figure 2 below shows how those Load measurements are applied seven days later to determine the proxy Load base schedules for hours 18 and 19. The proxy Load base schedule for hour 18 is calculated as the actual Load in the five-minute interval ending at 17:05, plus an additional 7.4 percent. The proxy Load base schedule for hour 19 is calculated as the actual Load in the five-minute interval ending at 18:05, minus 1.1 percent. Deviations are then calculated as the difference between the proxy Load base schedule and actual five-minute Loads over the hour.

Figure 1: Expected Load Change From Prior Week

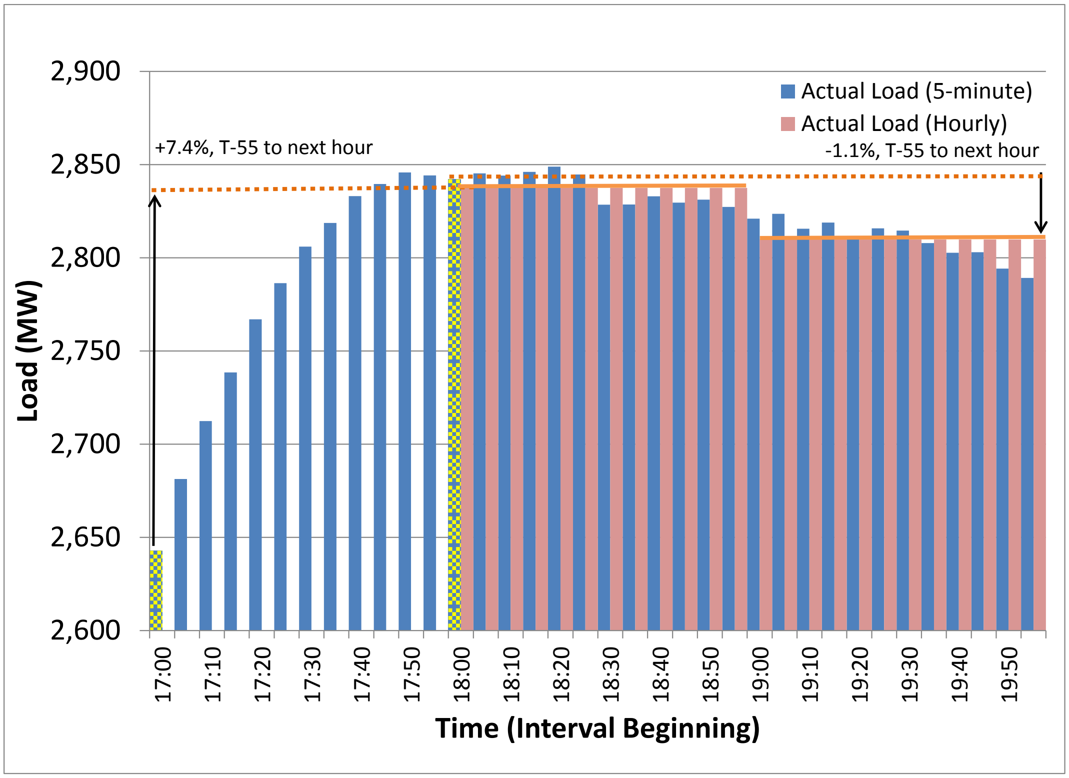
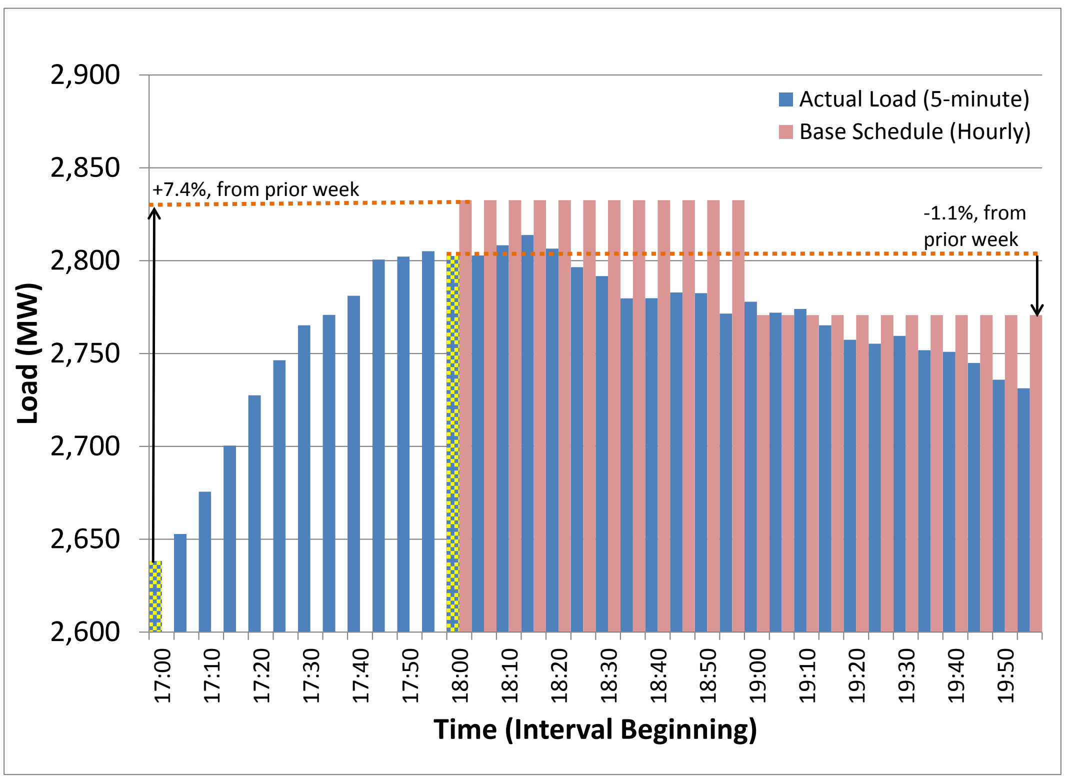


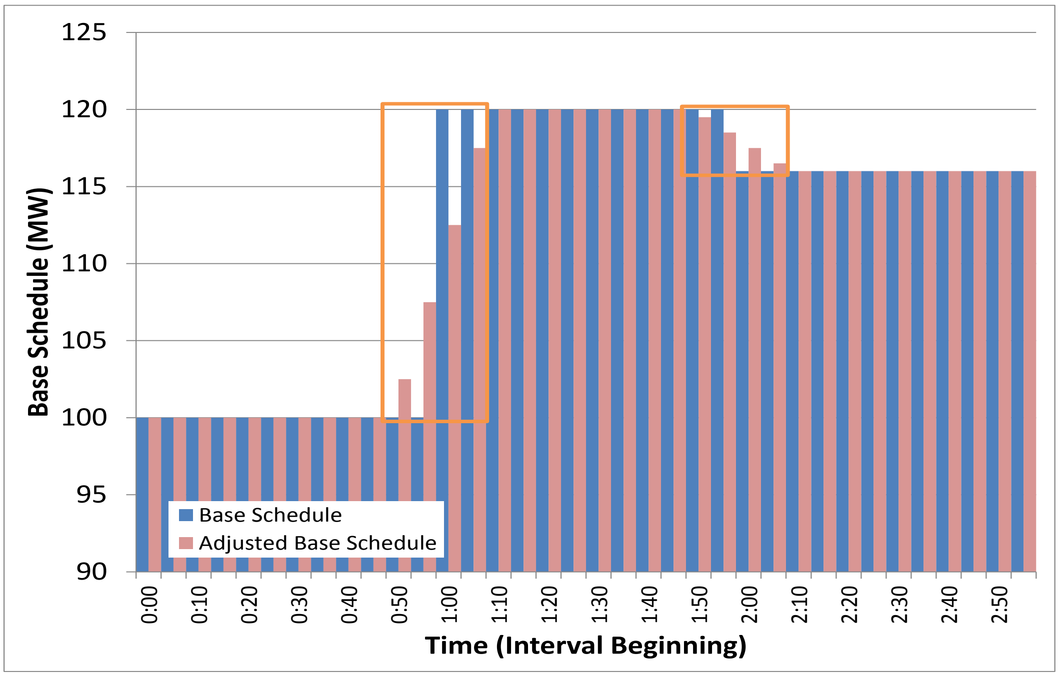
Figure 2: Proxy Load Base Schedule



C. Base Schedule Ramping Adjustment

In actual operations, PacifiCorp's ACE calculation includes a linear ramp from the base schedule in one hour to the base schedule in the next hour, starting ten-minutes before the hour and continuing until ten-minutes past the hour. The hourly base schedules used in the Study Term are adjusted to reflect this transition from one hour to the next. This adjustment step is important because, to the extent actual Load or generation is transitioning to the levels expected in the next hour, the adjusted base schedules will result in reduced deviations during these intervals, potentially reducing the regulation reserve requirement. Figure 3 below illustrates the hourly base schedule and the ramping adjustment. The same calculation applies to all base schedules: Load, VERs, Non-VERs, and the combined portfolio.

Figure 3: Base Schedule Ramping Adjustment



D. Data Corrections

The raw data extracted from PacifiCorp's systems for Load, VERs, and Non-VERs was reviewed to identify potentially spurious data points prior to performing the regulation reserve requirement calculations contained in section V below. Hourly intervals of data were excluded from the Regulation Reserve Study results if any five-minute interval within that hour suffered from at least one of the data anomalies that are described further below:

Load:

- Stuck meter/flat meter reading
- Telemetry spike/poor connection to meter

VERs and Non-VERs:

- Deviations missing in CAISO database
- Base schedules missing in CAISO database
- Generator trip events
- Wind curtailment events

Load in PacifiCorp's BAAs changes continuously. While a BAA could potentially maintain the exact same Load levels in two five-minute intervals in a row, it is extremely unlikely for the exact same Load level to persist over longer time frames. When PacifiCorp's energy management system ("EMS") Load telemetry fails, updated Load values may not be logged, and the last available Load measurement for the BAA will continue to be reported. For instance, in one observed example, a PACW BAA Load remained stuck at a single level for two days beginning at 2:00 PM on January 6, 2015. The change in Load relative to the prior interval was calculated for the entire test period and instances where multiple successive intervals showed no change in Load were excluded from the analysis since they are not indicative of actual operating conditions.

Similarly, rapid spikes in Load either up or down are also unlikely to be a result of conditions which require deployment of regulation reserve, particularly when they are transient. For example, a 637 MW drop in PACE BAA Load occurred over one five-minute interval on May 15, 2015. Roughly one hour later, PACE BAA Load increased by 849 MW over two five-minute intervals. Such events could be a result of a transmission or distribution outage, which would allow for the deployment of contingency reserve, and would not require deployment of regulation reserve. A similar spike on March 23, 2015, spanned just one five-minute interval, and was likely a result of a single bad Load measurement. Load telemetry spike irregularities were identified by examining the intervals with the largest changes from one interval to the next, either up or down. Intervals with inexplicably large and rapid changes in Load, particularly where the Load reverts back within a short period, were assumed to have been covered through contingency reserve deployment or to reflect inaccurate Load measurements. Because they don't reflect periods that require regulation reserve deployment, such intervals are excluded from the analysis.

The available VER and Non-VER data also includes some data irregularities. PacifiCorp evaluated these irregularities and in some cases removed data that appears to be inaccurate. For instance, PACW VER deviation data is missing in 36 five-minute intervals out of the 105,108 intervals in the Study Term. Deviations are directly tied to regulation reserve requirements, so the hours in which deviation data is missing are excluded from the analysis. Base schedules for PACE Non-VERs are missing in 75 hours, while the other VER and Non-VER categories have smaller amounts of missing data. While VER base schedules are directly linked to the regulation requirement forecast, missing base schedule data in PacifiCorp's database may be indicative of inconsistencies in deviation results, which may be calculated off of a stale or erroneous base. Given the limited frequency of such events, PacifiCorp has excluded from the analysis intervals where deviations or base schedules are missing.

As with Load, certain VER and Non-VER deviations are more likely to be a result of conditions that allow for the deployment of contingency reserve, rather than regulation reserve. In particular, contingency reserve can be deployed to compensate for unexpected generator outages.

For Non-VERs, these are relatively straightforward—namely, periods when generation drops to zero despite base schedules indicating otherwise. Certain VER outages also qualify as contingency events. Notably, VERs can be curtailed when wind speed exceeds the maximum rating of the equipment (sometimes referred to as “high speed cutout”). In such instances, generation is curtailed until wind speeds drop back into a safe operating range in order to protect the equipment. When wind speed oscillates above and below the cut-off point, generation may ramp down and up repeatedly. Because events which qualify for deployment of contingency reserve do not require deployment of regulation reserve they have been excluded from the analysis.

As the regulation reserve requirements are calculated using a rolling thirty-minute timeline (refer to Sections V.B.1 and V.B.2 below), data from the prior hour is necessary during the first several five-minute intervals of the next hour. An error in one hour thus results in the need to remove the following hour. This is relevant to error adjustments for both VERs and Non-VERs.

For Load, an hour of spurious data will prevent the calculation of the base schedule for the next hour, since the actual Load at T-55 is not available. The spurious data also impacts the same two hours in the following week as the expected Load change used to determine the base schedule for those hours utilizes the hour in question. For example, if the hour beginning at midnight on February 1, 2015, is found to be spurious, four hours are removed from the Study Term: the spurious hour (the hour ending midnight, February 1, 2015); the hour following the spurious hour (the hour ending 1:00 AM, February 1, 2015), which relies on the spurious hour to inform the regulation forecast; and the two corresponding hours in the following week (the hour ending at midnight, February 8, 2015 and the hour ending at 1:00 AM, February 8, 2015), each of which no longer has a valid prior-week hour from which to develop a proxy Load base schedule. The description of “Load Base Schedule Development” in the section IV.B above contains further discussion about this relationship and development of the base schedule.

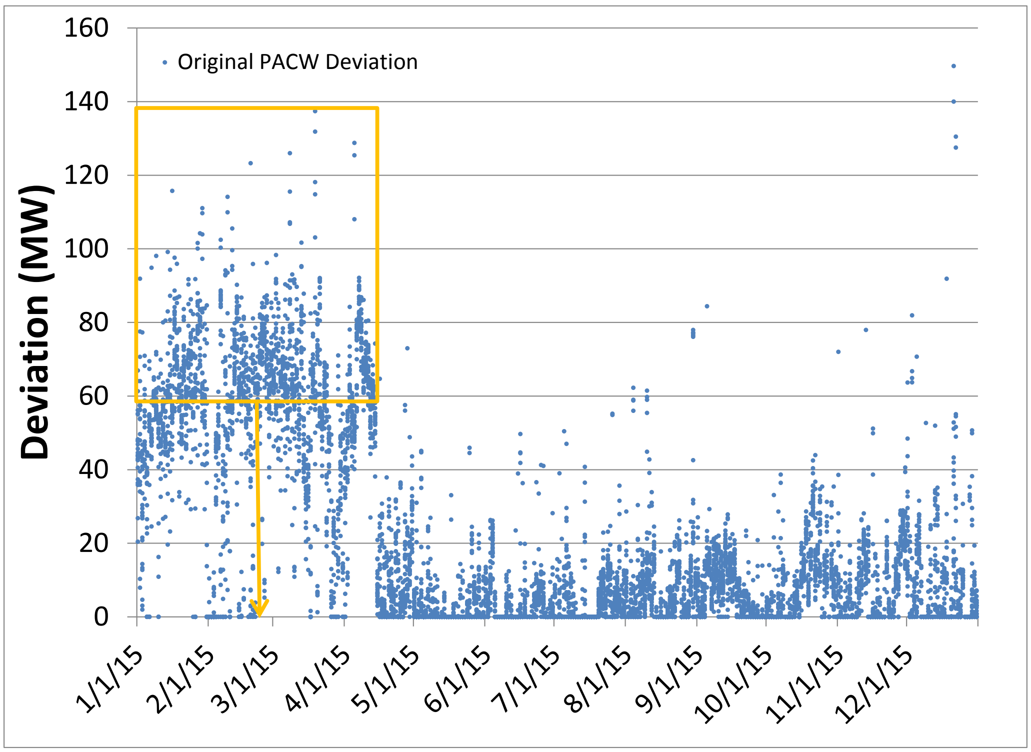
After review of the data for each of the above anomaly types, and out of 105,120 five-minute intervals in the Study Term, only 5.9 percent and 3.6 percent of the total Regulation Reserve Study term hours were removed from PACW and PACE, respectively. The system-wide error rate was 9.1 percent, slightly lower than the sum of the PACW and PACE rates due to coincident hours. While cleaning up or replacing anomalous hours could yield a more complete data set, determining the appropriate conditions in those hours would be difficult and subjective. By removing anomalies, the Regulation Reserve Study sample is smaller but remains reflective of the range of conditions PacifiCorp actually experiences, including the impact on regulation reserve requirements of all weather events experienced during the Study Term.

E. Non-VER Deviation Adjustment

The deviations associated with the Non-VER class show a clear anomaly between January 2015 and April 14, 2015. The abrupt change is evident in the hourly data for PACW shown in Figure 4 below and a comparable anomaly was seen over the same time frame for PACE (not shown). The anomaly ends abruptly at midnight on April 14, 2015, in both BAAs. PacifiCorp has concluded that this issue is a result of errors in base schedule submission rather than an actual deviation. During the early stages of the EIM there were differences between the CAISO’s EIM model and PacifiCorp’s EMS. The modeling of Colstrip generation was one of those differences. Within the PacifiCorp EMS, 100 percent of Colstrip generation output is pseudo-tied into the PACW BAA. However, the EIM modeled 50 percent of Colstrip generation as being in the PACW BAA and the other 50 percent of Colstrip generation as modeled in the PACE BAA. This mismatch between the two systems resulted in the measured deviation.

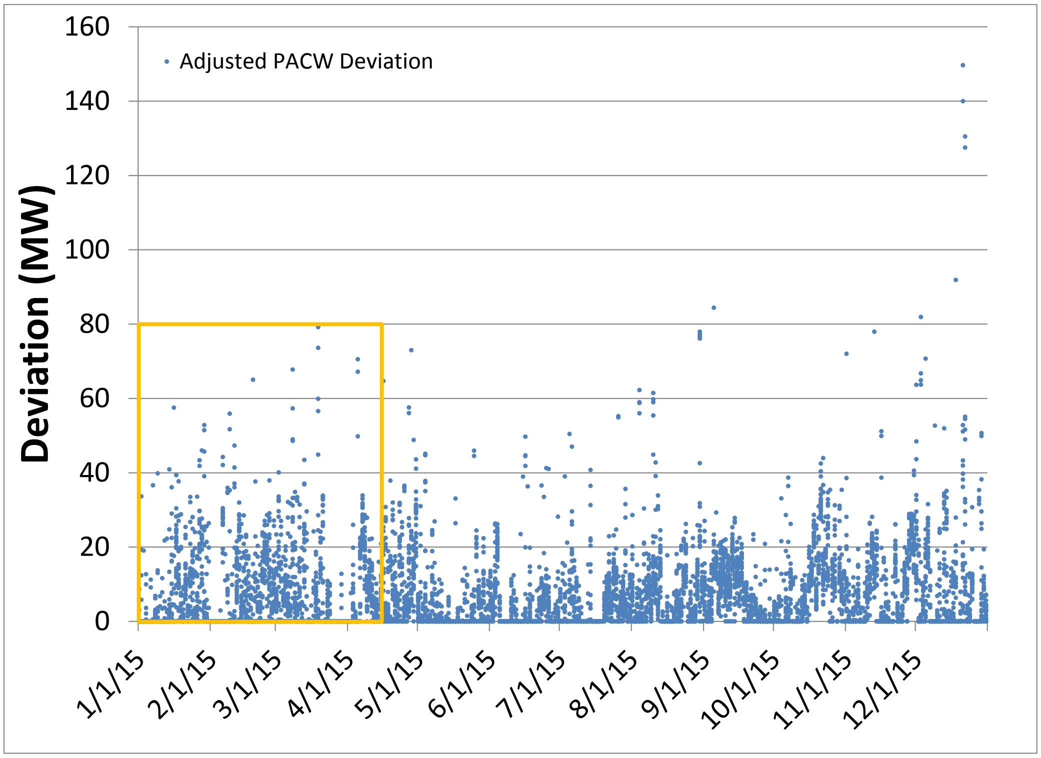
The Colstrip EIM base schedule of 50 percent to PACE and 50 percent to PACW was compared to the EMS output of 100 percent to PACW to determine the deviation. This resulted in a positive deviation to base schedule for PACW. When the EIM model mismatch was discovered it was corrected to align to PacifiCorp's EMS system. This eliminated the persistent deviation on April 14, 2015. For the purposes of the Regulation Reserve Study, the regulation reserve requirement for this period was reduced by 58 MW such that the average requirement during this period is equal to the average in the remainder of 2015. The box in Figures 4 and 5 below shows the affected data before and after the adjustment is applied.

Figure 4: Original PACW Non-VER Deviations



The adjusted regulation reserve requirement is shown in Figure 5 below.

Figure 5: Adjusted PACW Non-VER Deviations



V. Methodology to Determine Initial Regulation Reserve Requirement

A. Overview

This section presents the methodology used to determine the initial regulation reserve needed to manage Load and resource balance within PacifiCorp's BAAs. The five-minute interval Load and resource deviation data described above informs a regulation reserve forecast methodology that achieves the following goals:

- Complies with NERC standard BAL-001-2;
- Minimizes regulation reserve held; and
- Uses data available at time of EIM base schedule submission at T-55.[13]

The components of the methodology are described in section V.B below, and include:

- Operating Reserve: Reserve Categories;
- Calculation of Regulation Reserve Need;
- Balancing Authority ACE Limit: Allowed Deviations;
- Planning Reliability Target: Loss of Load Probability ("LOLP"); and
- Regulation Reserve Forecast: Amount Held.

[13] *See* footnote 9 above for explanation of PacifiCorp's use of the T-55 base schedule time point in the Regulation Reserve Study.

Following the explanation below of the components of the methodology, section V.C details the forecasted amount of regulation reserve for:

- VERs;
- Non-VERs; and
- Load.

B. Components of Operating Reserve Methodology

1. Operating Reserve: Reserve Categories

Operating reserve consists of two categories: (1) contingency reserve (*i.e.*, spinning and supplemental reserve), and (2) regulation reserve. These requirements must be met by resources that are incremental to those needed to meet firm system demand. The purpose of the Regulation Reserve Study is to determine the regulation reserve requirement. The contingency reserve requirement is defined formulaically by a regional reliability standard. The types of operating reserve are further defined below.

Contingency reserve is capacity that PacifiCorp holds available to ensure compliance with the NERC regional reliability standard BAL-002-WECC-2.[14] The standard specifies that each BAA must hold as contingency reserve an amount of capacity equal to three percent of Load and three percent of generation in that BAA. Contingency reserve must be available within ten minutes, and at least half must be from "spinning" resources that are online and immediately responsive to system fluctuations. Contingency reserve may be deployed when unexpected outages of a generator or a transmission line occur. Contingency reserve may not be deployed to manage other system fluctuations such as changes in Load or wind generation output. Because deviations caused by contingency events are covered by contingency reserve rather than regulation reserve, they are excluded from the determination of the regulation reserve requirements. The costs of providing contingency reserve are recovered by PacifiCorp through Schedule 5 (spinning reserve service) and Schedule 6 (supplemental reserve service) charges.

Regulation reserve is capacity that PacifiCorp holds available to ensure compliance with the NERC Control Performance Criteria in BAL-001-2, which requires a BAA to carry regulation reserve incremental to contingency reserve to maintain reliability.[15] The costs of providing regulation reserve service are recovered by PacifiCorp through Schedule 3 (regulation and frequency response service) and Schedule 3A (generator regulation and frequency response service) charges. The regulation reserve requirement is not defined by a simple formula, but instead is the amount of reserve required by each BAA to meet specified control performance standards. Requirement 2 of BAL-001-2 defines the compliance standard as follows:

[14] NERC Standard BAL-002-WECC-2: http://www.nerc.com/files/BAL-002-WECC-2.pdf

[15] NERC Standard BAL-001-2, http://www.nerc.com/files/BAL-001-2.pdf

> *Each Balancing Authority shall operate such that its clock-minute average of Reporting ACE does not exceed its clock-minute Balancing Authority ACE Limit (BAAL) for more than 30 consecutive clock-minutes…*

The BAL-001-2 standard became effective as of July 1, 2016 and, upon its effectiveness, officially replaced the BAL-001-1 standard. The new BAL-001-2 standard is a fundamentally different requirement than the prior standard, BAL-001-1, though it is intended to achieve a similar result. BAL-001-1 required ten-minute average ACE to be within the static L_{10} limit in at least 90 percent of non-overlapping ten-minute intervals in a month.[16] The new BAL-001-2 standard requires average ACE to be within a dynamic limit for at least one minute in 100 percent of all rolling thirty-minute intervals. PacifiCorp has been operating under BAL-001-2 since March 1, 2010, as part of a NERC Reliability-Based Control field trial in the Western Interconnection, so PacifiCorp has experience operating under the new standard, even though it did not become effective until July 1, 2016.

PacifiCorp's 2012, 2013, and 2014 Schedule 3 and 3A Studies were all based on compliance with BAL-001-1. These studies utilized deviations over ten-minute intervals and allowed deviations up to the fixed L_{10} value.[17,18] While these studies all used a 99.7 percent confidence interval, they did not necessarily achieve 99.7 percent compliance with the BAL-001-1 standard. For instance, the 2014 Wind Integration Study had a failure rate of 1.4 percent for PACE and 2.0 percent for PACW.[19] This is higher than the 90 percent compliance requirement under BAL-001-1, but significantly lower than the 100 percent compliance requirement under BAL-001-2. In addition, prior studies separately distinguished between three categories of regulation reserve, all of which were intended to capture the total potential deviation over the ten-minute interval relevant under BAL-001-1:

- Ramping – flexibility required to follow the change in actual net system Load from hour to hour;
- Regulating – flexibility required to manage forecast uncertainty over ten-minute intervals; and
- Following – flexibility required to manage forecast uncertainty over sixty-minute intervals.

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16 BAL-001-1 (R2) stated: Each Balancing Authority shall operate such that its average ACE for at least 90 percent of clock-ten-minute periods (6 non-overlapping periods per hour) during a calendar month is within a specific limit, referred to as L_{10}.

17 L_{10} represents a bandwidth of acceptable deviation under BAL-001-1 prescribed by WECC between the net scheduled interchange and the net actual electrical interchange of PacifiCorp's BAAs.

18 The L_{10} for PacifiCorp's BAAs in 2015 were approximately 33.49MW for PACW and 49.92 MW for PACE. For more information, please refer to: http://www.nerc.com/comm/OC/RS%20Landing%20Page%20DL/CPS2%20Bounds%20Reports/2015%20CPS2%20Bounds%20Report%20Final%2020150615.pdf

19 *See* Redacted Rebuttal Testimony of Brian S. Dickman, Wyoming Public Service Commission Docket No. 20000-469-ER-15 at p. 46:1-6 (filed Sept. 16, 2015).

The Regulation Reserve Study fundamentally differs from the 2012, 2013, and 2014 Schedule 3 and 3A Studies because it is based on compliance with BAL-001-2. The impacts of the changes in three key elements of the new BAL-001-2 standard relative to the old standard are summarized in Table 1 below. The three key elements shown in Table 1 include: (1) the length of time (or "interval") used to measure compliance under the old versus new BAL standard; (2) the change in compliance threshold between the two standards, which represents the percentage of intervals that a BAA must be within the limits set in the standard; and (3) the bandwidth of acceptable deviation used under each standard to determine whether an interval is considered out of compliance. These changes are discussed in further detail below.

Table 1: BAL-001-1 vs. BAL-001-2

	Interval (minutes)	Compliance %	Allowed Variance
BAL-001-1	10	90%	Fixed: L_{10}
BAL-001-2	30	100%	Dynamic: BAAL
Impact on Requirement	Down	Up	Varies

The first change in Table 1 is related to the length of time used to measure compliance. Under the prior standard, BAL-001-1, compliance was measured over six, non-overlapping ten-minute intervals within each hour. If ACE was within the allowed limits for all ten minutes of an interval, that interval was in compliance, and only the maximum deviation in that interval was considered in determining compliance. Compliance under BAL-001-2 is measured over rolling thirty-minute intervals, with sixty overlapping periods per hour, some of which include parts of two clock-hours. In effect, this means that every minute of every hour is the beginning of a new, thirty-minute compliance interval under the new BAL-001-2 standard. If ACE is within the allowed limits at least once in a thirty-minute interval, that interval was in compliance, and only the minimum deviation in each thirty-minute interval is considered in determining compliance. This change reduces regulation reserve requirements because PacifiCorp does not need to hold regulation reserves for deviations with duration less than 30 minutes.

The second change in Table 1 above is related to the compliance percentage, or the number of intervals where deviations are allowed to be outside the limits set in the standard. BAL-001-1 required 90 percent compliance, that is, 10 percent of ten minute intervals were allowed to have deviations in excess of the requirement in the standard. BAL-001-2 requires 100 percent compliance, so deviations must be maintained within the requirement set by the standard for all rolling thirty-minute intervals. Under the old standard, overall compliance could be achieved despite shortfalls in the intervals with the largest deviations. Because shortfalls are not permitted when the compliance requirement is 100 percent, this change increases regulation reserve requirements.

The third change in Table 1 is related to the bandwidth of acceptable deviation before an interval is considered out of compliance. Under BAL-001-1, the acceptable deviation for each BAA was set at a fixed value in all intervals, referred to as L_{10}.[20] Under BAL-001-2, the acceptable deviation for each BAA is dynamic, varying as a function of the frequency deviation for the entire interconnect. The impact of this change is mixed as the limits under BAL-001-2 are generally higher, but at times can be lower than the limits under BAL-001-1.

In addition, the Regulation Reserve Study identifies a single category of flexible capacity, rather than the three categories used in the prior studies performed in compliance with the old standard. Because deviations over ten-minute intervals are only relevant to the extent they exacerbate deviations over longer time frames, measuring three separate categories does not provide an accurate depiction of the requirements under BAL-001-2. In addition, while the following and regulating requirements in prior studies were statistically uncorrelated over the course of the year, the root sum square methodology used in the prior studies fails to account for the few random intervals when these components both show large requirements. Because the root sum square methodology underestimates the frequency of outlier events, it underestimates the capacity needed to cover them. The Regulation Reserve Study eliminates complexity and distortion associated with combining multiple requirements by directly calculating a single component that allows for compliance with the BAL-001-2 standard.

2. Calculation of Regulation Reserve Need

The next step of the operating reserve methodology is to calculate the amount of regulation reserve required to be held under BAL-001-2. Regulation reserve requirements were calculated from five-minute EIM deviation data in a manner that emulates the requirements of the BAL-001-2 standard. The same calculation applies to all types of imbalances: Load, VERs, Non-VERs, and the combined portfolio.

First, the minimum five-minute imbalance was calculated for each thirty-minute rolling period in the Study Term. Second, for each hour, the maximum five-minute imbalance was selected from the values identified in the first step. An example is provided in the Table 2 and Figure 6 below.

In the example in Table 2 below, the minimum five-minute imbalance in the thirty minutes beginning at 0:15 is 40 MW. This is also the maximum five-minute imbalance in any thirty-minute period in this hour. Assuming 40 MW of regulation reserve was available in this hour and the allowable ACE deviation was zero, this hour would still be compliant with the BAL-001-2 requirement—even though the imbalance exceeds the regulation reserve available for five consecutive, five-minute intervals—because the allowable ACE deviation was exceeded for less than 30 minutes.

[20] The L_{10} for PacifiCorp's BAAs in 2015 were approximately 33.49 MW for PACW and 49.92 MW for PACE. For more information, please refer to: http://www.nerc.com/comm/OC/RS%20Landing%20Page%20DL/CPS2%20Bounds%20Reports/2015%20CPS2%20Bounds%20Report%20Final%2020150615.pdf .

Table 2: Deviation and Regulation Reserve Requirement Example

Interval	Base Schedule	Actual	5-Minute Deviation	30-Minute Deviation	Reserve Requirement
0:00	2500	2510	10	10	40
0:05		2520	20	10	40
0:10		2530	30	10	40
0:15		2540	40	10	40
0:20		2550	50	10	40
0:25		2560	60	10	40
0:30		2570	70	20	40
0:35		2560	60	30	40
0:40		2550	50	40	40
0:45		2540	40	40	40
0:50		2530	30	30	40
0:55		2520	20	20	40

As shown in Figure 6 below, if the ACE deviations were only allowed for a ten minute interval, the requirement would be higher.

Figure 6: Deviation and Regulation Reserve Requirement Example

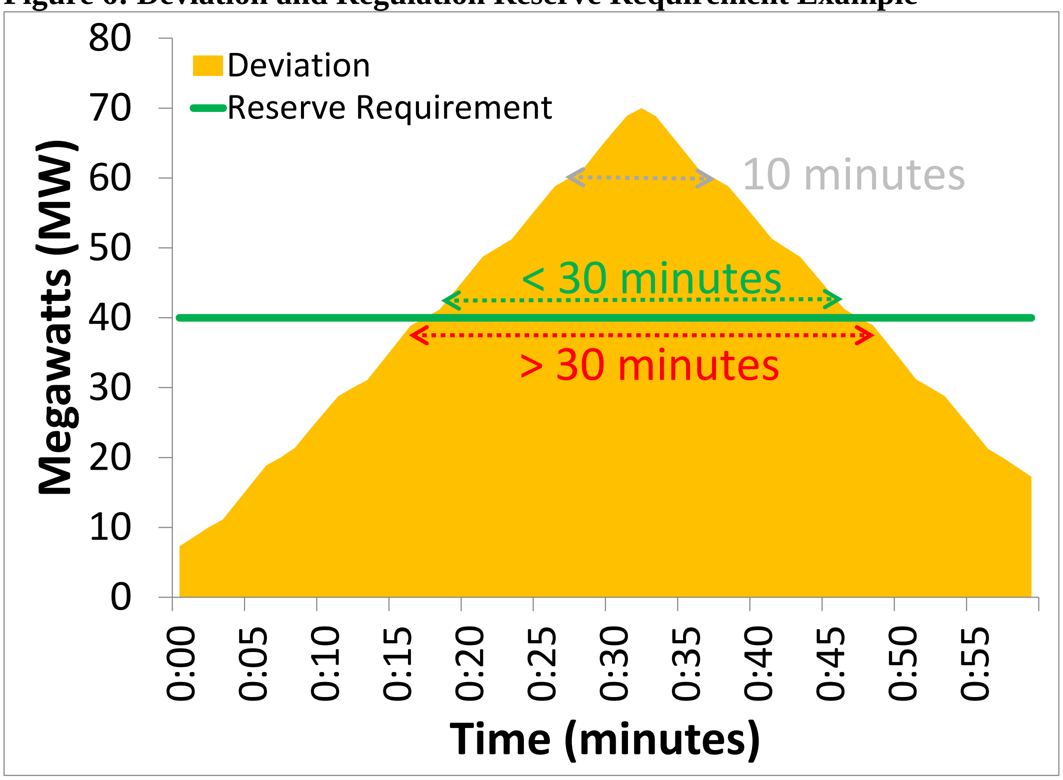
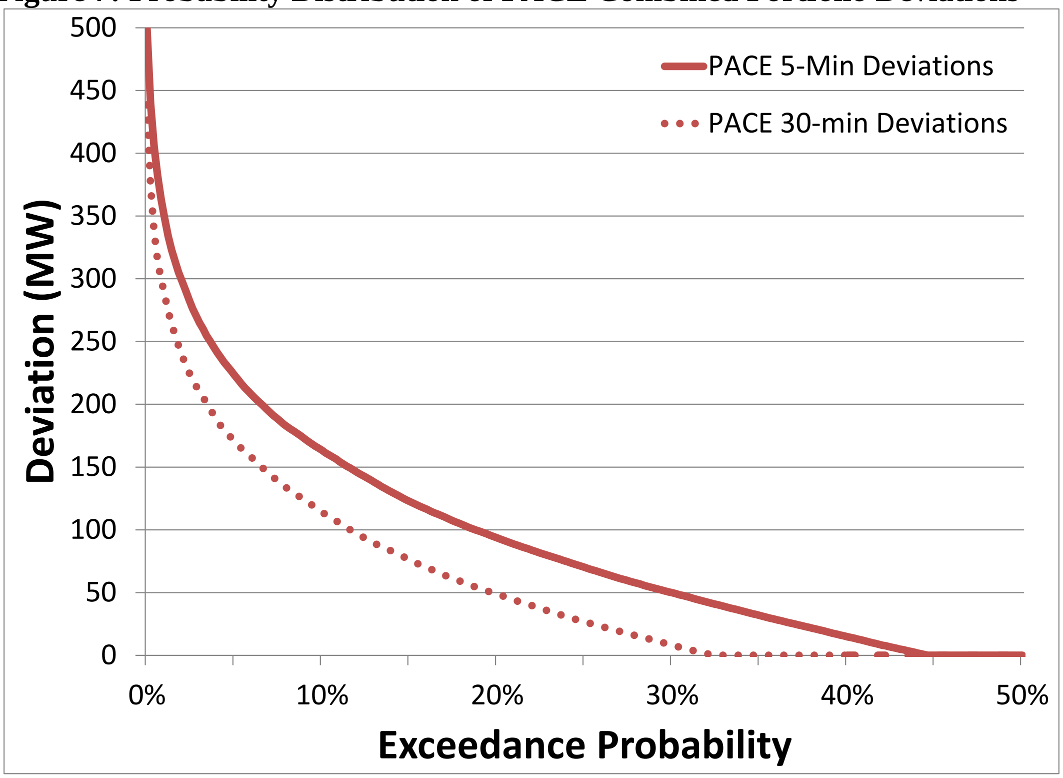


Figure 7 below illustrates the distribution of the combined five-minute deviations for Load, VERs, and Non-VERs in PACE during 2015, as well as the distribution of thirty-minute sustained deviations relevant to the BAL-001-2 standard. The effect for PACW was comparable (not shown). The thirty-minute window for compliance reduces the regulation reserve need.

The thirty-minute window can be particularly helpful with deviations in the last few intervals of each hour. This period has the longest forecast horizon (*i.e.*, the furthest out from T-55), so the potential deviations are expected to be larger. However, if the change resulting in the deviation is reflected in the base schedule for the next hour, PacifiCorp's ACE will return to zero on its own a few minutes later. Thus, so long as the duration of the deviation is less than 30 minutes, the size of the deviation in the last few intervals is irrelevant for compliance with BAL-001-2.

Figure 7: Probability Distribution of PACE Combined Portfolio Deviations



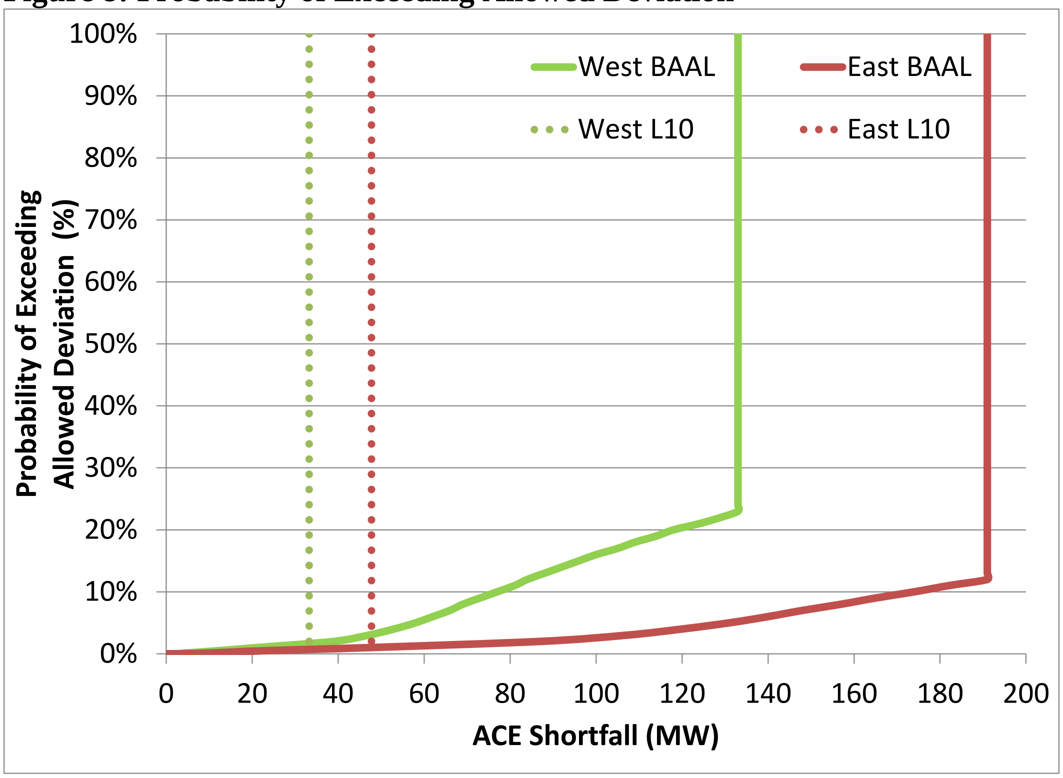
3. Balancing Authority ACE Limit: Allowed Deviations

Even if insufficient regulation reserve capability is available to compensate for a thirty-minute sustained deviation, a violation of BAL-001-2 does not occur unless the deviation also exceeds the Balancing Authority ACE Limit.

The Balancing Authority ACE Limit is specific to each BAA and is dynamic, varying as a function of interconnection frequency. When WECC frequency is close to 60 Hz, the Balancing Authority ACE Limit is large and large deviations in ACE are allowed. As WECC frequency drops further and further below 60 Hz, ACE deviations are increasingly restricted for BAAs that are contributing to the shortfall, *i.e.* those BAAs with higher Loads than resources. A BAA commits a BAL-001-2 reliability violation if in any thirty-minute interval it doesn't have at least one minute when its ACE is within its Balancing Authority ACE Limit.

While the specific Balancing Authority ACE Limit for a given interval cannot be known in advance, the historical probability distribution of Balancing Authority ACE Limit values is known. Figure 8 below shows the probability of exceeding the allowed deviation during a five-minute interval for a given level of ACE shortfall. For instance, a 47 MW ACE shortfall in PACE has a one percent chance of exceeding the Balancing Authority ACE Limit. The fixed value under the prior BAL-001-1 standard for L_{10} is also plotted for comparison. WECC-wide frequency can change rapidly and without notice, and this causes large changes in the Balancing Authority ACE Limit over short time frames. Maintaining ACE within the Balancing Authority ACE Limit under those circumstances can require rapid deployment of large amounts of operating reserve. To limit the size and speed of resource deployment necessitated by variation in the Balancing Authority ACE Limit, PacifiCorp's operating practice caps permissible ACE at the lesser of the Balancing Authority ACE Limit or four times L_{10}. This cap is reflected in Figure 8.

Figure 8: Probability of Exceeding Allowed Deviation



In 2015, PacifiCorp's deviations and Balancing Authority ACE Limits were uncorrelated, which indicates that PacifiCorp's contribution to WECC-wide frequency is small. PacifiCorp's deviations and Balancing Authority ACE Limits were also uncorrelated when periods with large deviations were examined in isolation. If PacifiCorp's large deviations made distinguishable contributions to the Balancing Authority ACE Limit, ACE shortfalls would be more likely to exceed the Balancing Authority ACE Limit during large deviations. Since this is not the case, the probability of exceeding the Balancing Authority ACE Limit is lower, and less regulation reserve is necessary to comply with the BAL-001-2 standard.

4. Planning Reliability Target: Loss of Load Probability

When conducting resource planning, it is common to use a reliability target that assumes a specified LOLP. In effect, this is a plan to curtail firm Load in rare circumstances, rather than acquiring resources for extremely unlikely events. The reliability target balances the cost of additional capacity against the benefit of incrementally more reliable operation. By planning to curtail firm Load in the rare event of a regulation reserve shortage, PacifiCorp can maintain the required 100 percent compliance with the BAL-001-2 standard and the Balancing Authority ACE Limit. This balances the cost of holding additional regulation reserve against the likelihood of regulation reserve shortage events.

PacifiCorp's 2015 Integrated Resource Plan ("IRP") utilized a planning reserve margin of 13 percent, which is intended to achieve 0.88 loss of Load hours per year.[21] This Regulation Reserve Study assumes that 0.88 loss of Load hours per year due to regulation reserve shortages is appropriate for planning and ratemaking purposes. The Regulation Reserve Study applies this reliability target as follows:

- If the regulation reserve available is greater than the regulation reserve need for an hour, the LOLP is zero for that hour.
- If the regulation reserve held is less than the amount needed, the LOLP is derived from the Balancing Authority ACE Limit probability distribution. As the magnitude of the shortfall increases, the probability of exceeding the Balancing Authority ACE Limit increases. For instance, as indicated above, a 47 MW ACE shortfall in PACE has a one percent chance of exceeding the Balancing Authority ACE Limit. A one percent probability of failing to meet the Balancing Authority ACE Limit in one hour is 0.01 loss of Load hours per year. A one percent probability of failing to meet the Balancing Authority ACE Limit in eighty-eight hours would be 0.88 loss of Load hours per year and corresponds to the targeted level of reliability.

5. Regulation Reserve Forecast: Amount Held

As previously shown in Figure 7, the instances requiring the largest amounts of regulation reserve occur infrequently, and many hours have very low requirements. If periods when requirements are likely to be low can be distinguished from periods when requirements are likely to be high, less regulation reserve is necessary to achieve a given reliability target. As described above, the regulation reserve forecast is not intended to compensate for every potential deviation. Instead, when a shortfall occurs, the size of that shortfall determines the probability of exceeding the Balancing Authority ACE Limit and a reliability violation occurring. The forecast should achieve a cumulative LOLP that corresponds to the annual reliability target.

PacifiCorp submits balanced base schedules to CAISO for its Load and resources by T-55.[22] Operating reserve is intended to cover demand in excess of the balanced Load and resources submitted in base schedules. Capacity to be used as operating reserve needs to be identified and set aside so that it is not utilized in the base schedule submission. Likewise, the regulation reserve forecast identifying the quantity of operating reserve to be set aside for the upcoming hour needs to be finalized by T-55.

[21] 2015 IRP, Appendix I, Table I.3

[22] *See* footnote 9 for explanation of PacifiCorp's use of the T-55 base schedule time point in the Regulation Reserve Study.

The base schedule itself reflects the best, most up-to-date information about conditions in the upcoming hour. The next section describes how the information available can be used to forecast regulation reserve requirements for each of the regulation reserve classes while maintaining reliability. The portfolio regulation reserve requirement forecast incorporates each of the resource/Load class forecasts and accounts for the reduced requirements resulting from diversity between the classes. All of these calculations are prepared separately for each of the PacifiCorp BAAs.

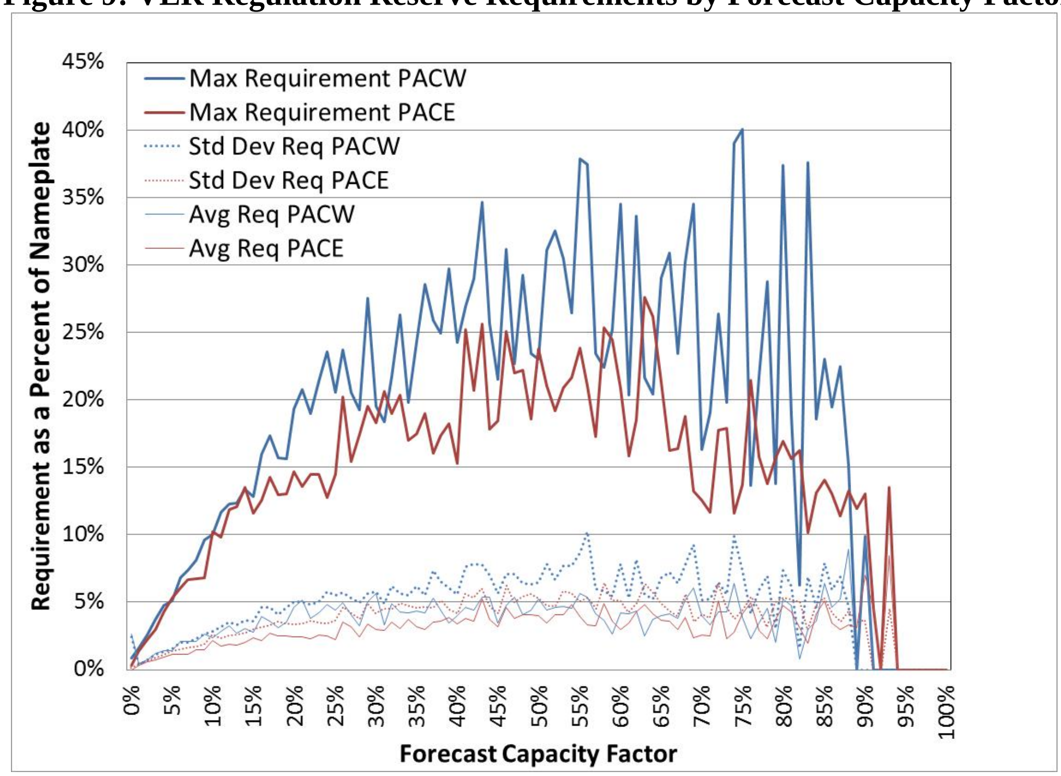
C. Regulation Reserve Forecast

1. VERs

Figure 9 illustrates the relationship between the observed regulation reserve requirements for VERs during 2015 and the forecasted level of output, stated as a capacity factor (*i.e.*, a percentage of the nameplate VER capacity).

Three distinct patterns are apparent in the figure. First, for capacity factors from zero percent to approximately 20 percent, the regulation reserve requirement increases linearly. The linear relationship in this first range reflects the fact that the largest possible deviation is equal to the base schedule and a very small amount of negative generation (station service). Second, for capacity factors from approximately 20 percent to approximately 80 percent, the maximum requirement varies somewhat widely and does not exhibit significant trends. Third, as capacity factors increase above approximately 80 percent, the observed maximum requirement declines.

Figure 9: VER Regulation Reserve Requirements by Forecast Capacity Factor



When evaluating the distribution of maximum requirements above an approximately 20 percent capacity factor, it is important to consider the characteristics of an observed maximum within a sample. The mean of a sample may be higher or lower than the mean of the population from which it is drawn, but it is not expected to vary systematically with sample size. This is not the case for the maximum of a sample, which will always be less than or equal to the maximum of the population from which it is drawn. In addition, the expected value of the sample maximum increases as the sample size increases.

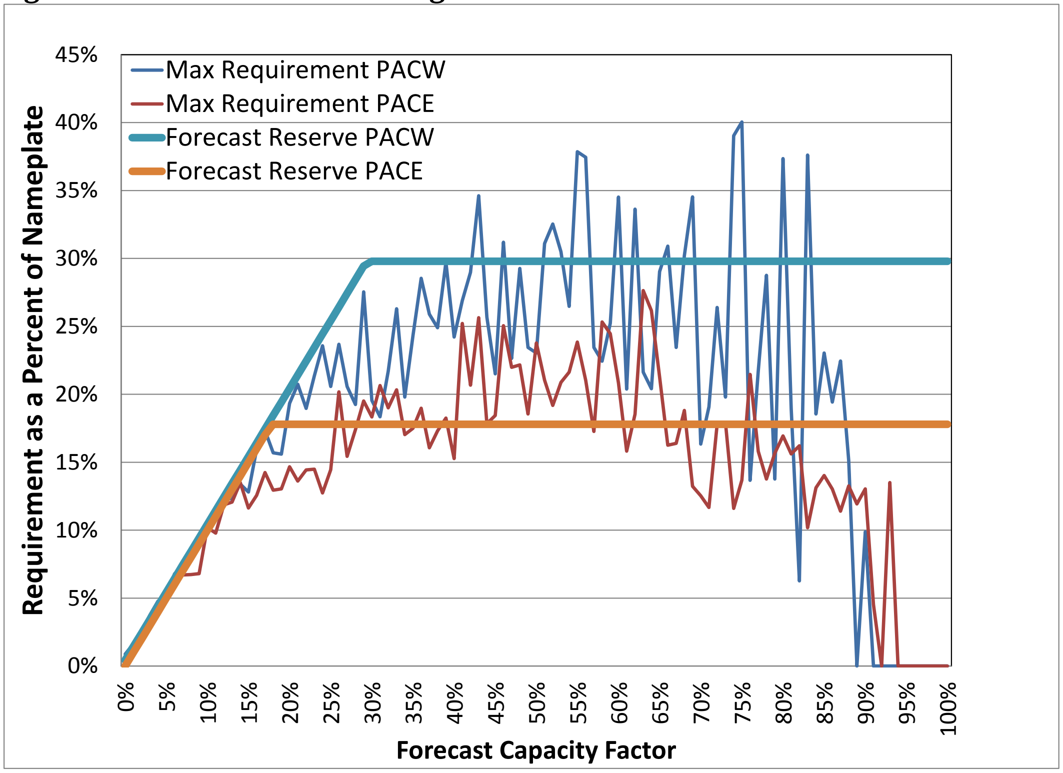
The sample size of each forecasted capacity factor varies, with very high capacity factors occurring less frequently. With this consideration in mind, the decline in observed maximum requirements at high capacity factors can be viewed as an artifact of the sample rather than a real trend related to the behavior of VERs under those specific conditions. This view is reinforced by the fact that the average and standard deviation of the requirements are relatively constant at forecasted capacity factors above roughly 20 percent. Because the probability of a large deviation doesn't vary for capacity factors above roughly 20 percent, a single regulation reserve requirement is a reasonable forecast for that range.

Figure 10 below presents the regulation reserve forecast for PACE and PACW VERs, incorporating the two trends described above: (1) the linear increase in requirements at low capacity factors (*i.e.*, below 20 percent); and (2) a uniform requirement at higher capacity factors (*i.e.*, from 20 percent to 100 percent). As illustrated in Figure 10, PACW had 888 hours with forecasted capacity factors between 41 percent and 55 percent, while PACE had 1,115 hours in that range. PACW only had 64 hours with forecasted capacity factors of 85 percent or more, while PACE only had 109 hours in that range.

The VERs regulation reserve forecast is a fixed percentage of the VERs nameplate capacity, but never more than the difference between minimum actual output and the base schedule. The fixed percentage of nameplate capacity is set at the minimum level that achieves the reliability target of 0.88 loss of Load hours per year. The forecast resulted in the possibility of reliability violations in roughly one percent of the hours. While the forecast does not result in any potential reliability violations at high capacity factors, this is likely due to the small number of observations in this range, as described above.

Using a forecast based on the hour-ahead base schedule results in a 2015 stand-alone regulation reserve requirement for VERs of 384 MW, or approximately 14.8 percent of nameplate capacity. This forecast does not account for any diversity benefit from combining the reserve requirements for VERs with the requirements of other classes. Diversity benefits are discussed in Section VI.

Figure 10: Stand-alone VER Regulation Reserve Forecast



2. Non-VERs

Figure 11 below illustrates the observed regulation reserve requirements for Non-VERs during 2015 as a function of the forecasted level of output, stated as a capacity factor (*i.e.*, a percentage of the nameplate Non-VERs capacity). For Non-VERs, the forecasted capacity factors during 2015 fall within limited ranges and do not approach either zero or 100 percent. Since the distribution of errors appears to be essentially random, the base schedule provides limited forecasting value for Non-VERs, resulting in a single reserve value applied in all hours.

Figure 11: Non-VER Regulation Reserve Requirements by Forecast Capacity Factor

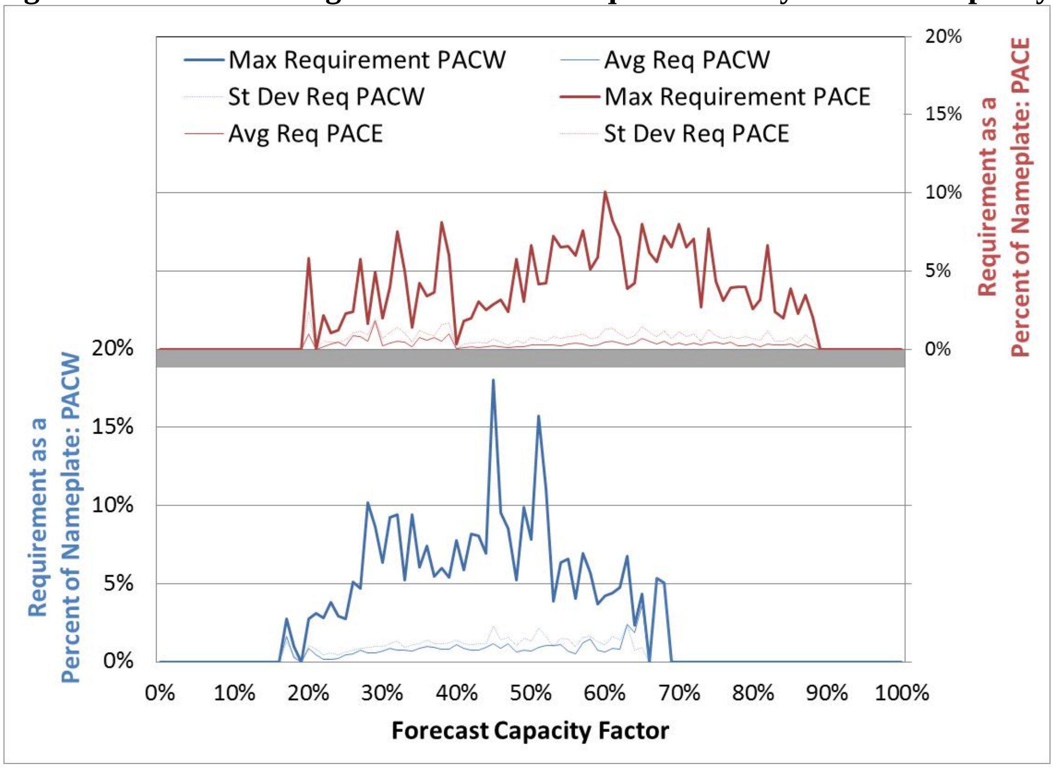


Figure 12 below illustrates the observed regulation reserve requirements for Non-VERs during 2015 as a function of hour of the day. The average and standard deviation are very low compared to the maximum events, indicating the relative rarity of large deviation events. However, the maximum, average, and standard deviation all exhibit comparable trends, indicating that the characteristics of the maximum are also reflected in the rest of the data for those periods. While an overall diurnal pattern is noticeable, significant volatility in the observed maximum requirements is apparent from hour to hour. For example, consider the significant drop in the observed maximum requirement for PACW in hour 19 relative to hours 18 and 20. The average and standard deviation do not indicate that hour 19 is significantly different from hours 18 and 20. As a result, this drop is more likely to be from randomness in the sample, rather than a specific characteristic of hour 19 itself.

Figure 12: Non-VER Regulation Reserve Requirements by Hour of the Day

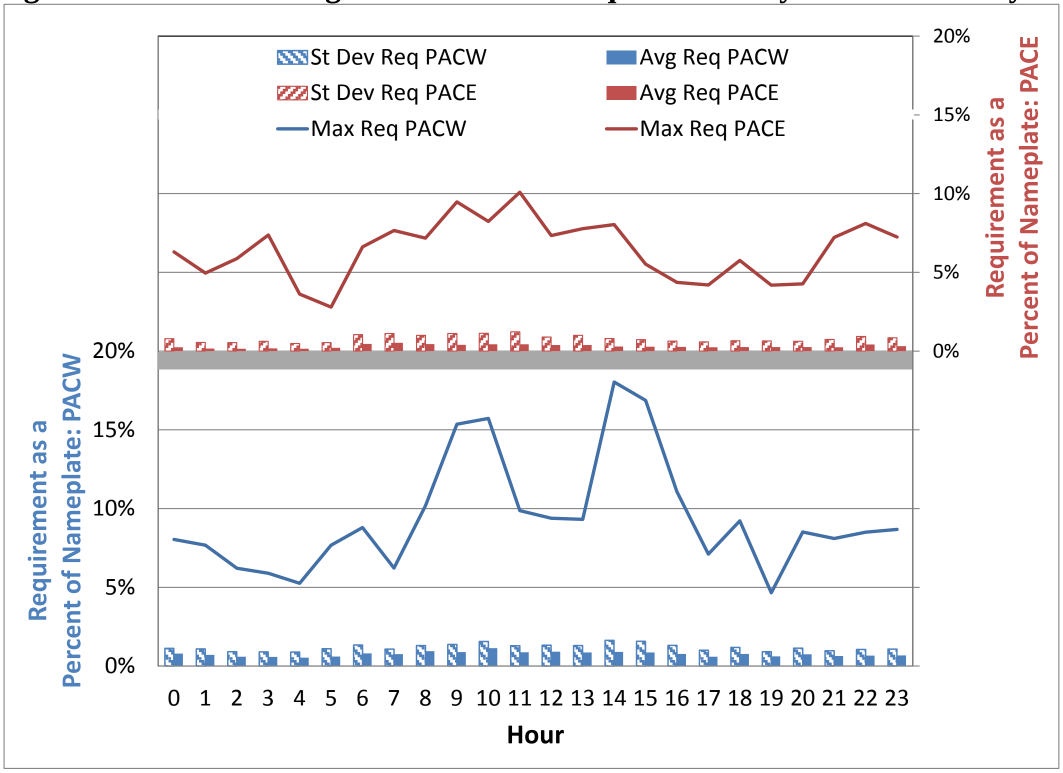
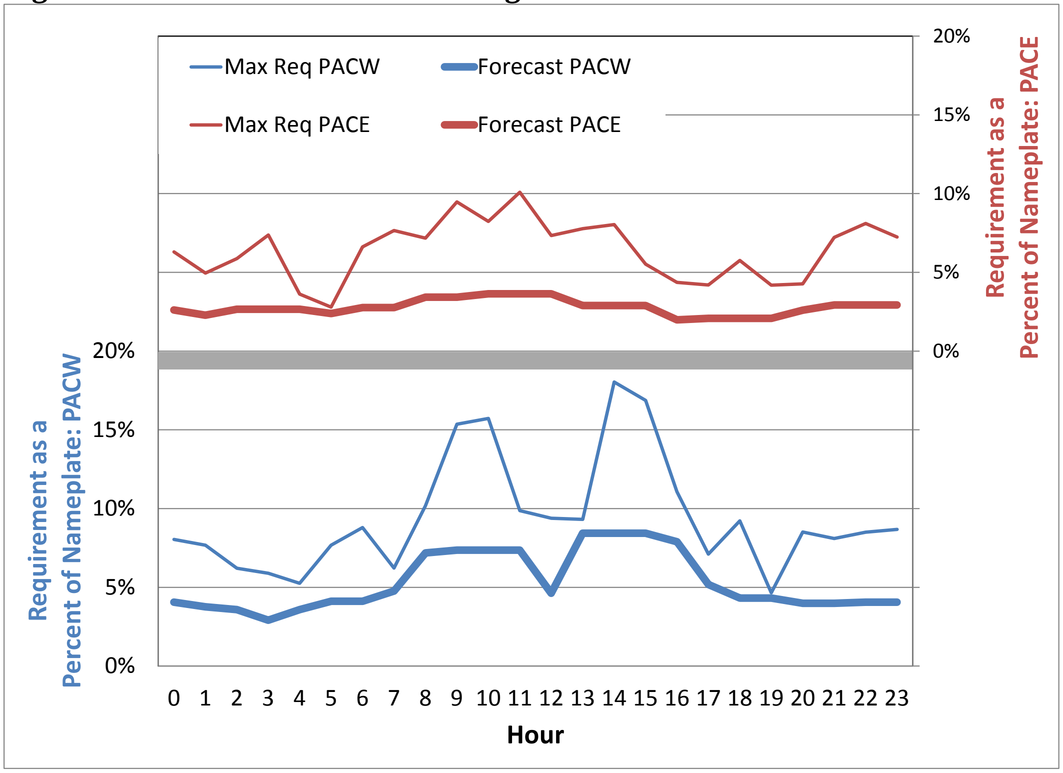


Figure 13 below presents the regulation reserve forecast for each hour of the day for PACE and PACW Non-VERs. The forecast is based on the rolling three-hour maximum of regulation reserve requirements from 2015. This produces a smoother forecast, reflecting realistic hourly variation rather than just aligning with the large events in the sampled data for 2015. The forecasted requirement is then reduced by a fixed percentage until it reaches the minimum level necessary to achieve the reliability target of 0.88 loss of Load hours per year. This forecast resulted in the possibility of reliability violations roughly 1.1 percent of the time on PACW, and 2.6 percent of the time on PACE. Due to the lower probability of a reliability violation in each hour for PACE Non-VERs, more hours of potential violations are aggregated to reach the reliability target of 0.88 loss of Load hours per year. Using a forecast based on the hour of the day results in a 2015 stand-alone regulation reserve requirement for Non-VERs of 83 MW, or approximately 3.7 percent of nameplate capacity. This forecast does not account for any diversity benefit from combining the regulation reserve requirements for Non-VERs with the requirements of other classes.

Figure 13: Stand-alone Non-VER Regulation Reserve Forecast



3. Load

Figure 14 below illustrates the relationship between the observed regulation reserve requirements for Load during 2015 and hour of the day. Similar to the results for Non-VERs, the average and standard deviation are very low compared to the maximum events, indicating the relative rarity of large deviation events. However, the maximum, average, and standard deviation all exhibit comparable trends, indicating that the characteristics of the maximum are also reflected in the rest of the data for those periods.

Figure 14: Stand-alone Load Regulation Reserve Requirements by Hour of the Day

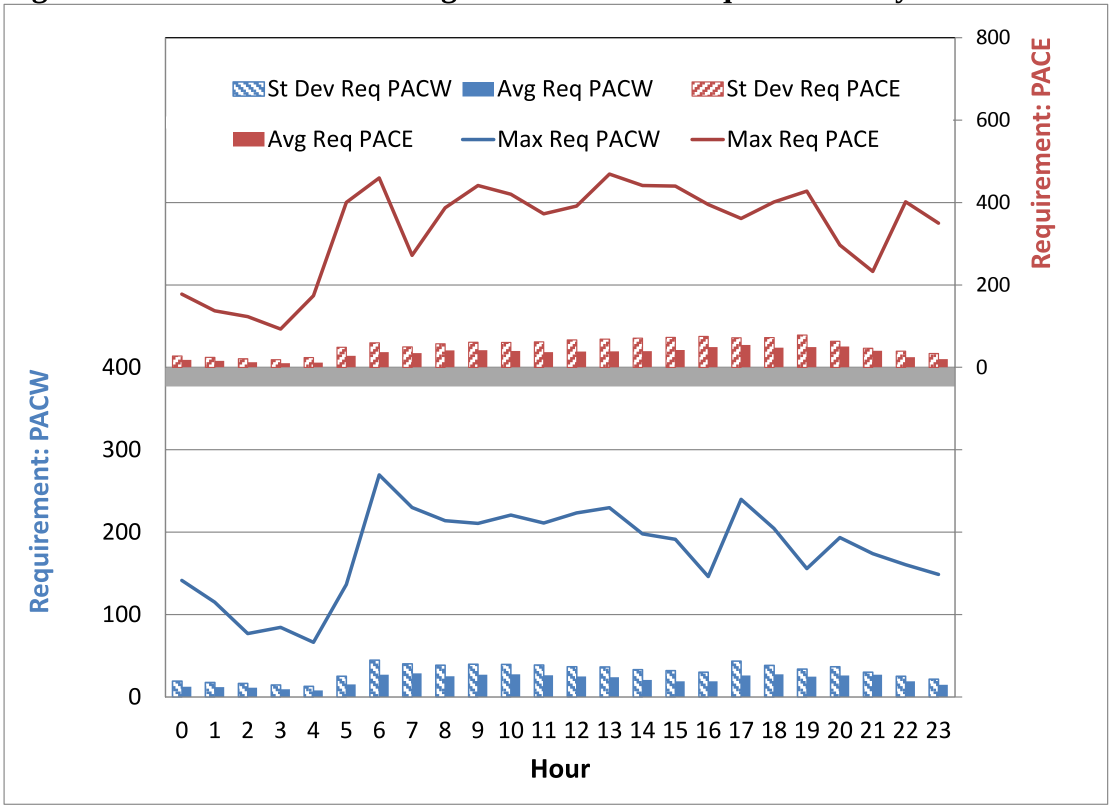
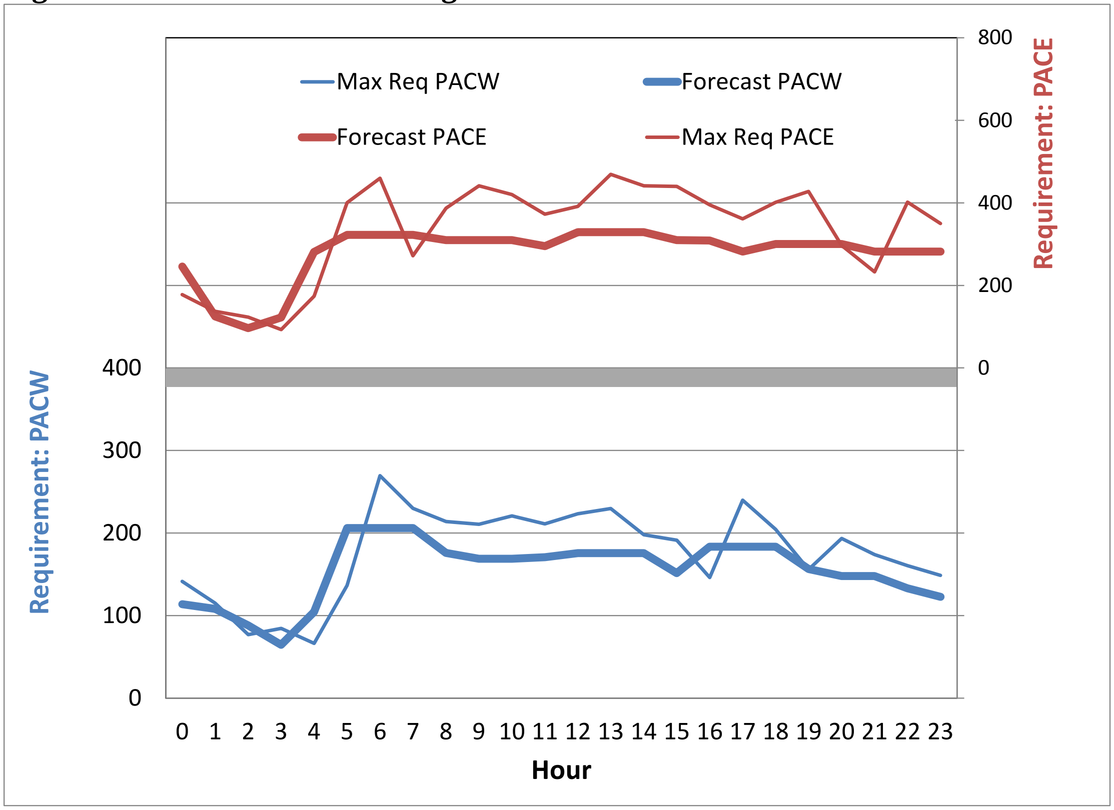


Figure 15 below presents the regulation reserve forecast for each hour of the day for PACE and PACW Load. The forecast is based on the rolling three-hour maximum of regulation reserve requirements from 2015. This produces a smoother forecast, reflecting realistic hourly variation rather than just aligning with the large events in the sampled data for 2015. The forecasted requirement is then reduced by a fixed percentage until it reaches the minimum level necessary to achieve the reliability target of 0.88 loss of Load hours per year. This forecast resulted in the possibility of reliability violations roughly 0.7 percent of the time in both PACW and PACE. Using a forecast based on the hour of the day results in a 2015 stand-alone regulation reserve requirement for Load of 433 MW, or approximately 4.5 percent of the 12CP. This forecast does not account for any diversity benefit from combining the reserve requirements for Load with the requirements of other classes.

Figure 15: Stand-alone Load Regulation Reserve Forecast



VI. Diversity, EIM, and Intra-Hour Scheduling Benefits

A. PacifiCorp System-Wide Portfolio Diversity Benefit

The EIM is a voluntary energy imbalance market service through the CAISO where market systems automatically balance supply and demand for electricity every fifteen minutes, dispatching the least-cost resources every five minutes.

PacifiCorp began full EIM operation on November 1, 2014. NV Energy began full operation in EIM on December 1, 2015. Puget Sound Energy and Arizona Public Service Company commenced EIM participation on October 1, 2016. Additionally, several other entities have announced their intention to begin participating over the next few years. PacifiCorp's participation in the EIM requires certain customer actions (further specified in PacifiCorp's OATT, Attachment T) necessary to realize the intra-hour operational enhancements that provide benefits to all PacifiCorp customer classes (Load, VERs, and Non-VERs). Therefore, because PacifiCorp's participation in the EIM results in increased intra-hour scheduling and system visibility, the EIM intra-hour benefit described in this Regulation Reserve Study is applied to all customer classes.

The EIM not only brings important benefits for customers, including reduced energy dispatch costs through automatic dispatch, enhanced reliability with improved situational awareness, better integration of renewable energy resources, and reduced curtailment of renewable energy resources, but also has effects related to regulation reserve requirements. First, as a result of EIM participation, PacifiCorp has improved granularity for data used in the analysis contained in this Regulation Reserve Study. Second, the EIM's intra-hour capabilities across the broader EIM footprint provide the opportunity to reduce the amount of regulation reserve necessary for PacifiCorp to hold, as further explained below.

The regulation reserve forecasts described in section V.C above (384 MW for VERs, 83 MW for Non-VERs, and 433 MW for Load) independently ensure that the probability of a reliability violation for each class remains within the reliability target; however, the largest deviations in each class tend not to occur simultaneously, and in some cases deviations will occur in offsetting directions. Because the deviations are not occurring at the same time, the regulation reserve held can cover the expected deviations for multiple classes at once and a reduced total quantity of reserve is sufficient to maintain the desired level of reliability. This reduction in the reserve requirement is the diversity benefit from holding a single pool of reserve to cover deviations in VERs, Non-VERs, and Load. As a result, the regulation reserve forecast for the portfolio can be reduced while still meeting the reliability target.

As shown in Table 3 below, the sum of the stand-alone forecasts for each class results in a cumulative LOLP of 0.03 hours per year. This is significantly less than the target of 0.88 hours per year as a result of the diversity among the different classes. PacifiCorp then calculated the proportional reduction to the standalone requirement—the diversity benefit shown in the second column of values in Table 3—that could be applied such that the PacifiCorp system just achieves the reliability target for the Study Term. A total portfolio requirement of 654 MW is sufficient to achieve the reliability target, resulting in diversity benefits equal to 118 MW for Load, 105 MW for VERs, and 23 MW for Non-VERs. The last column of Table 3 shows the regulation requirements for each class that incorporates the proportional allocation of portfolio diversity benefits. The diversity benefits result in a 27 percent reduction from the total standalone requirement of 900 MW.

Table 3: PacifiCorp Portfolio Diversity Benefits

Scenario	Stand-alone Regulation Forecast (aMW)	Stand-alone Rate (aMW)	Portfolio Regulation Forecast (aMW)
Non-VER	83	23	60
Load	433	118	315
VER - Wind	384	105	279
Total	900	246	654
Portfolio LOLP (hours/year)	0.03		0.88

B. EIM Intra-Hour Benefit

In addition to the direct benefits from EIM's increased system visibility and improved intra-hour operational performance described above, the participation of other entities in the broader EIM footprint—such as NV Energy, Puget Sound Energy, and Arizona Public Service Company—

provides the opportunity to further reduce the amount of regulation reserve PacifiCorp must hold.

By pooling variability in Load, wind, and solar output, EIM entities reduce the quantity of reserves required to meet flexibility needs. The EIM also facilitates procurement of flexible ramping capacity in the fifteen-minute market to address variability that may occur in the five-minute market. Because variability across different BAAs may happen in opposite directions, the flexible ramping requirement for the entire EIM footprint can be less than the sum of individual BAAs' requirements. This difference is known as the "flexible ramping procurement diversity savings" in the EIM. This intra-hour benefit reflects offsetting variability and lower combined uncertainty. These flexibility reserves are in addition to the spinning and supplemental reserves carried against generation or transmission system contingencies under the NERC standards.

The CAISO calculates the EIM intra-hour benefit by first calculating a flexible reserve requirement for each individual EIM BAA and then by comparing the sum of those requirements to the flexible reserve requirement for the entire EIM area. The latter amount is expected to be less than the sum of the flexible reserve requirements from the individual BAAs due to the portfolio diversification effect of forecasting a larger pool of Load and VERs using intra-hour scheduling and increased system visibility in the hypothetical, single-BAA EIM. Each EIM BAA is then credited with a share of the intra-hour benefit calculated by CAISO based on its share of the stand-alone requirement relative to the total requirement.

The EIM does not relieve participants of their reliability responsibilities. EIM entities are required to have sufficient resources to serve their Load on a standalone basis each hour before participating in the EIM. Thus, each EIM participant remains responsible for all reliability obligations. Despite these limitations, EIM imports from other participating BAAs can help balance PacifiCorp's Loads and resources within an hour, reducing the size of reserve shortfalls and the likelihood of a Balancing Authority ACE Limit violation. While substantial EIM imports do occur in some hours, it is only appropriate to rely on PacifiCorp's share of the intra-hour benefits associated with EIM, as these are derived from the structure of the EIM rather than resources contributed by other participants.

Under the current EIM operational structure, the calculated EIM intra-hour benefit is not known to PacifiCorp prior to its base schedule submission at T-55. The CAISO does not finalize the intra-hour benefit until T-40, therefore making it too late to incorporate any of the benefit into PacifiCorp's base schedule.

Table 4 below provides a numeric example of flexible reserve requirements for each EIM participating BAA and application of the calculated intra-hour benefit.

Table 4: EIM Intra-Hour Benefit Application Example

Sensitivity	CAISO req't before benefit (MW)	NEVP req't before benefit (MW)	PACE req't before benefit (MW)	PACW req't before benefit (MW)	Total req't before benefit (MW)	Total req't after benefit (MW)	Portfolio reserve benefit (MW)	PACE share (%)	PACE benefit (MW)	PACE req't after benefit (MW)
15-minute interval 1	550	110	165	100	925	583	342	17.8%	61	104
15-minute interval 2	600	110	165	100	975	636	339	16.9%	57	108
15-minute interval 3	650	110	165	110	1,035	689	346	15.9%	55	110
15-minute interval 4	667	120	180	113	1,080	742	338	16.7%	56	124

While the intra-hour benefit is uncertain, that uncertainty is not significantly different from the uncertainty in the Balancing Authority ACE Limit described in section V.B.3 above. PacifiCorp proposes crediting its regulation reserve forecast with a probability distribution of calculated EIM intra-hour benefits based on historical results. When a potential regulation shortfall occurs, the probability that the EIM intra-hour benefit would have exceeded that level can be calculated, and the LOLP associated with that event goes down. As a result, PacifiCorp's regulation reserve requirements can be reduced until the reliability target is again just achieved. While this Regulation Reserve Study considers regulation reserve requirements in 2015, the participation of NV Energy in the EIM starting in December 2015 has resulted in increased intra-hour benefits. To capture these additional benefits for this analysis, PacifiCorp has applied the probability distribution of EIM intra-hour benefits from January 2016 through June 2016 because it believes this period is a more reasonable representation of actual operations going forward.

The inclusion of EIM intra-hour benefits in the 2015 regulation reserve analysis reduces the probability of reserve shortfalls and, in doing so, reduces the overall regulation reserve requirement. This allows PacifiCorp's forecasted requirements to be reduced until the PacifiCorp system just achieves the reliability target for the 2015 Study Term. As shown in Table 5 below, the resulting regulation reserve requirement is 562 MW, a 38 percent reduction (including the portfolio diversity benefit) compared to the stand-alone requirement for each class. The average regulation reserve requirement is reduced by 92 MW relative to the PacifiCorp portfolio reserve requirement without the EIM intra-hour benefit. As noted above, this benefit accrues to all customers because of PacifiCorp's implementation of EIM and its attendant system-wide scheduling and visibility benefits.

Table 5: Results with PacifiCorp Portfolio Diversity and EIM Intra-Hour Benefit

Scenario	Stand-alone Regulation Forecast (aMW)	Stand-alone Rate (%)	Portfolio Regulation Forecast with EIM (aMW)	Portfolio Rate with EIM (%)	2015 Capacity (MW)	Rate Determinant
Non-VER	83	3.7%	52	2.3%	2,228	Nameplate
Load	433	4.5%	271	2.8%	9,696	12 CP
VER - Wind	384	14.8%	240	9.2%	2,588	Nameplate
Total	900		562			
Portfolio LOLP (hours/year)	0.03		0.88			
Reduction from Total, Stand-alone Regulation Forecast (%)			38%			

C. VER Discount for Committed Intra-Hour Scheduling

The power production forecasting, optimized intra-hour resource dispatch, and the regulation reserve intra-hour benefit from EIM participation provide benefits to all classes (Load, VERs, and Non-VERs). While the EIM intra-hour benefit is not directly tied to intra-hour *scheduling*, PacifiCorp considers the benefits accruing from EIM participation to be directly linked to intra-hour *operations*, and the fifteen-minute and five-minute information and system visibility EIM provides.

Intra-hour scheduling utilizing transmission schedules (or e-tags) on a fifteen-minute basis has the potential to reduce PacifiCorp's regulation reserve requirements by ensuring a better alignment of resources and requirements within the hour. Accurate scheduling for imports and exports can result in net reductions in deviations, and a resulting improvement in PacifiCorp's ACE.

Intra-hour scheduling offers two potential benefits compared to traditional use of hourly transmission schedules, which have the potential to reduce PacifiCorp's regulation reserve requirements. First, if generation is expected to change across an hour, schedules submitted for four, fifteen-minute intervals will be better able to match that expected variation and will send more accurate signals to PacifiCorp's balancing operations. Second, even if resource changes aren't anticipated in advance, forecasts become more accurate as the forecast horizon shrinks, and modifying schedules to account for more recent operational information can reduce deviations.

PacifiCorp's OATT allows for transmission scheduling on fifteen-minute intervals, so that timeframe is considered in this Regulation Reserve Study. For intra-hour scheduling to reduce PacifiCorp's regulating reserve requirements, the intra-hour schedules must result in a net reduction in interchange deviations, and an improvement in PacifiCorp's ACE. As a result, intra-hour scheduling adjustments for generation resources will not provide benefits unless those adjustments are also reflected in interchange schedules (for exporting generators), or the dispatch of other generation (for internal Load-serving generators).

Additionally, it is important to note that intra-hour scheduling can only be truly effective so long as adjacent transmission service providers have aligned practices and procedures to facilitate such scheduling intervals. For example, before the Bonneville Power Administration enabled intra-hour scheduling across its system, it was difficult for customers to meaningfully schedule on a sub-hourly basis.

Despite PacifiCorp's implementation of intra-hour scheduling in December 2009, very few of PacifiCorp's customers have made use of the intra-hour scheduling opportunity. For example, between August 2011 and April 2013 (shortly before PacifiCorp's 2013 Schedule 3 and 3A Study was filed), PacifiCorp had received only a small number of intra-hour schedules, representing less than 0.05 percent of total transmission schedules. A similar analysis of e-tags for calendar year 2014, indicated that the total number of intra-hour schedule requests was 1,411, representing 0.86 percent of total transmission schedule requests.[23] For calendar year 2015, the total number of intra-hour schedule requests was 1,533, representing 0.97 percent of total transmission schedule requests. While very limited intra-hour scheduling occurred on PacifiCorp's system in 2015, PacifiCorp recognizes its obligation to take intra-hour scheduling and forecasting reforms into account when developing and supporting differentiated rates for generator regulation service.

The number of intra-hour scheduling transactions has increased dramatically as a result of PacifiCorp's participation in EIM. As an illustration, for the time period from September 2015-February 2016, PacifiCorp processed 126,117 intra-hour requests, and 99.8% of them (or 125,864) were related to EIM transactions. The EIM incorporates updated VERs forecasts for the fifteen-minute market to improve the optimization of the resources. The shorter forecast horizon should have lower uncertainty and thus lower regulation requirements.

In addition, PacifiCorp believes it is important to recognize an intra-hour scheduling benefit in its rate proposal because, as part of EIM operations, VER owners are required by the OATT to submit operational forecasts at five- or fifteen-minute granularity, which must be updated at each applicable interval to improve the optimization in the CAISO's EIM fifteen-minute market. If these forecasts were used to update interchange or dispatchable resource schedules, the more granular interval and shorter forecast horizon from these forecasts should result in lower total deviations, as well as lower maximum deviations.

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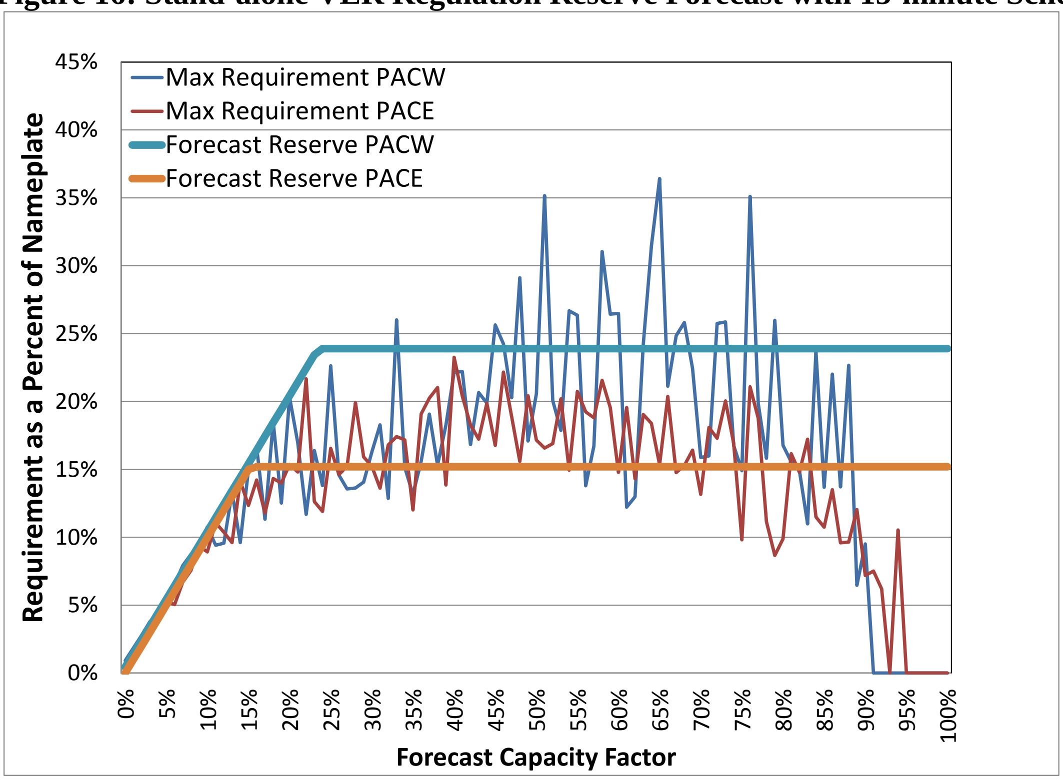
[23] The e-tag analysis performed for this study excludes all 15-minute schedules that are submitted at the California-Oregon Intertie (COI) by PacifiCorp's merchant to facilitate EIM Transfers between the CAISO and PacifiCorp's West BAA (PACW) because these e-tags are simply a tool being used to operationalize the EIM over the COI where the e-tags are necessary to provide operational visibility and control to the Bonneville Power Administration, which is the path operator for COI. In other words, 15-minute schedules at the COI are not being submitted by individual resources that are seeking to match actual resource output with their transmission schedules. The e-tag mechanism which facilitates EIM Transfers at the COI was approved by FERC. *See PacifiCorp*, 149 FERC ¶ 61,057 at P 32 (2014).

In order to incorporate an intra-hour scheduling and forecasting benefit in the Regulation Reserve Study results, PacifiCorp's fifteen-minute scheduling analysis uses the fifteen-minute market schedules for VERs from EIM, and the associated deviations from those schedules. The structure of the data and methodology used to determine the stand-alone regulating reserve requirements associated with VERs using fifteen-minute scheduling is the same as in PacifiCorp's primary analysis based on 60-minute scheduling, as previously described.

Figure 16 below presents the regulating reserve forecast for PACE and PACW VERs. As in the primary analysis, this is a fixed percentage of nameplate, but never more than the difference between minimum actual output and the base schedule. The fixed percentage of nameplate capacity necessary to achieve the reliability target is reduced relative to the primary analysis. For 2015, the stand-alone regulating reserve requirement for VERs using fifteen-minute scheduling is 331 MW, or approximately 12.8 percent of nameplate capacity. This is a reduction of 53 MW, or approximately 13.8 percent. The diversity adjustments related to the portfolio regulation requirement and EIM would also be applicable to VERs committing to provide balanced fifteen-minute schedules. PacifiCorp recognizes that VERs, with their unique operational characteristics, have an additional challenge to match schedules with actual generation in order to manage their regulation costs. By offering this proposed discount, PacifiCorp provides VERs with another tool to reduce their regulation burden and charges.

Figure 16: Stand-alone VER Regulation Reserve Forecast with 15-minute Scheduling



VII. Summary of Adjusted Regulation Reserve Requirements

Table 6 below summarizes the results of PacifiCorp's Regulation Reserve Study, after incorporating the benefits of the portfolio diversity of PacifiCorp's system and the diversity provided by PacifiCorp's participation in the EIM.

Table 6: 2016 Regulation Reserve Study Results

Scenario	Stand-alone Regulation Forecast (aMW)	Stand-alone Rate (%)	Portfolio Regulation Forecast with EIM (aMW)	Portfolio Rate with EIM (%)	2015 Capacity (MW)	Rate Determinant
Non-VER	83	3.7%	52	2.3%	2,228	Nameplate
Load	433	4.5%	271	2.8%	9,696	12 CP
VER - Wind	384	14.8%	240	9.2%	2,588	Nameplate
Total	900		562			
Portfolio LOLP (hours/year)	0.03		0.88			
Reduction from Total, Stand-alone Regulation Forecast (%)			38%			
Committed Intra-hour Scheduling						
VER - 15-Minute Wind	331	12.8%		8.0%	2,588	Nameplate

VIII. Appendix A - Definitions

Term	Definition
Base Schedule	Refers to a forecast and is the term PacifiCorp's OATT employs for this purpose since the implementation of the EIM.
Contingency	Refers to the "unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch or other electrical element." [24]
Contingency Reserve	Refers to capacity that PacifiCorp holds available to ensure compliance with the NERC regional reliability standard BAL-002-WECC-2.
Disturbance events	Refers to "(i) any perturbation to the electric system, or (ii) the unexpected change in ACE that is caused by the sudden loss of generation or interruption of load." [25]
Deviation from schedule	Refers to the measured difference in actual Load or generation values versus the forecasted values in the base schedule.
Diversity benefits	Refers to the reduction in total reserve requirement from the effect of offsetting deviations between different system actors (Load, VERs, and Non-VERs).
Non-spinning reserve	Refers to "that operating reserve not connected to the system but capable of serving demand within a specified time, or interruptible load that can be removed from the system in a specified time." [26]
Operating reserve	Refers to "capability above firm system demand required to provide for regulation, load-forecasting error, equipment forced and scheduled outages and local area protection. Operating reserve consists of spinning reserve and non-spinning reserve."[27]

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[24] NERC Glossary of Terms: http://www.nerc.com/files/glossary_of_terms.pdf, updated August 17, 2016.

[25] *Id.*, "WECC Regional Terms"; *see also*, NERC Gloss of Terms, "Contingency".

[26] *Id.* at "WECC Regional Terms."

[27] *Id.*

Regulating reserve	Refers to the "amount of reserve responsive to Automatic Generation Control, which is sufficient to provide normal regulating margin."[28]
Regulation reserve	Refers to capacity that PacifiCorp holds available to ensure compliance with the NERC regional reliability standard BAL-001-2. Regulating reserve is one component of operating reserve.
Spinning reserve	Refers to "unloaded generation which is synchronized and ready to serve additional demand. It consists of regulating reserve and contingency reserve."[29]

28 *Id*. at NERC Glossary of Terms.

29 *Id*. at "WECC Regional Terms."

IX. Appendix B – Generators Studied

Appendix Table 1 – VERs

Resource ID	Nameplate Capacity (MW)	BAA	Grouping
DUNLAP_6_UNIT	111.00	PACE	VER
FOOTECRE_7_UNITS	133.60	PACE	VER
FREEZOUT_6_UNIT	118.50	PACE	VER
GLENROCW_6_UNIT	138.00	PACE	VER
HINSHAW_7_UNITS	144.00	PACE	VER
HIPLAINS_7_UNITS	127.50	PACE	VER
HORSEBU_7_UNIT	57.60	PACE	VER
JOLLYHIL_1_GOSHEN	124.50	PACE	VER
LATIGO_6_UNIT	99.00	PACE	VER
MEADOWCR_6_UNIT	119.70	PACE	VER
MOONSHIN_7_UNITS	45.00	PACE	VER
MTWNDCOL_7_UNITS	140.70	PACE	VER
RAWHIDE_6_UNIT	16.50	PACE	VER
ROLLHILL_6_UNIT	99.00	PACE	VER
SPNFKWND_7_UNIT	18.90	PACE	VER
TOPWORLD_7_UNITS	200.20	PACE	VER
WOLVERIN_7_UNITS	64.50	PACE	VER
CAMPCOL_6_UNIT	98.90	PACW	VER
COMBINEH_6_UNIT	41.00	PACW	VER
DALREED_7_WIND	9.90	PACW	VER
GOODNOEH_7_UNIT	94.00	PACW	VER
HINKLE_6_UNIT	64.55	PACW	VER
LEANJNPR_7_UNIT	100.50	PACW	VER
MARENGO_6_UNITS	210.60	PACW	VER
NINEMIL_7_UNIT 1	210.00	PACW	VER
Total	**2587.65**		

Appendix Table 2 – Non-VERs

Transaction Point	Nameplate Capacity (MW)	BAA	Class
BONANZA_7_UNIT	458.00	PACE	Non-VER
DALTONU_7_UNIT	4.60	PACE	Non-VER
EXXON_7_UNITS	107.40	PACE	Non-VER
GEMSTATE_1_UNIT	23.40	PACE	Non-VER

MILLCRK_7_UNIT 1	40.00	PACE	Non-VER
MILLCRK_7_UNIT 2	40.00	PACE	Non-VER
NEBOPS_7_UNITS	140.00	PACE	Non-VER
PALISADI_7_UNIT 1	44.00	PACE	Non-VER
PALISADI_7_UNIT 2	44.00	PACE	Non-VER
PALISADI_7_UNIT 3	44.00	PACE	Non-VER
PALISADI_7_UNIT 4	44.00	PACE	Non-VER
SLENERGY_7_UNIT	3.20	PACE	Non-VER
SUNNYSIU_6_UNIT	53.00	PACE	Non-VER
TESORO_7_UNITS	25.00	PACE	Non-VER
USBRGATE_7_UNIT	4.50	PACE	Non-VER
WESTVALL_7_UNIT 1	40.00	PACE	Non-VER
WESTVALL_7_UNIT 2	40.00	PACE	Non-VER
WESTVALL_7_UNIT 3	40.00	PACE	Non-VER
WESTVALL_7_UNIT 4	40.00	PACE	Non-VER
WESTVALL_7_UNIT 5	40.00	PACE	Non-VER
BIOMAS_7_PACW	32.50	PACW	Non-VER
CAMASMI_7_UNIT	61.50	PACW	Non-VER
CLEARWA1_7_UNIT	17.90	PACW	Non-VER
CLEARWA2_7_UNIT	31.00	PACW	Non-VER
COID_7_UNITS	6.00	PACW	Non-VER
COLSTR_5_PACE	74.00	PACW	Non-VER
COLSTR_5_PACW	74.00	PACW	Non-VER
COPCO1_7_UNIT 1	14.00	PACW	Non-VER
COPCO1_7_UNIT 2	14.00	PACW	Non-VER
COPCO2_7_UNIT 1	17.00	PACW	Non-VER
COPCO2_7_UNIT 2	17.00	PACW	Non-VER
DALREED_7_BIO	4.80	PACW	Non-VER
EVERGBIO_6_BIO	10.00	PACW	Non-VER
FALLCREE_7_UNIT	2.00	PACW	Non-VER
FARMERS_6_UNIT	4.15	PACW	Non-VER
FISHCREO_7_UNIT	10.40	PACW	Non-VER
GRACE_7_UNIT 3	11.00	PACW	Non-VER
GRACE_7_UNIT 4	11.00	PACW	Non-VER
GRACE_7_UNIT 5	11.00	PACW	Non-VER
IRONGATE_7_UNIT	18.80	PACW	Non-VER
JCBOYLE_7_UNIT 1	40.00	PACW	Non-VER
JCBOYLE_7_UNIT 2	43.00	PACW	Non-VER
LEMOLO1_7_UNIT	32.00	PACW	Non-VER
LEMOLO2_7_UNIT	38.50	PACW	Non-VER
MERWIN_7_UNITS	150.00	PACW	Non-VER
OPALSPRI_7_UNIT	4.30	PACW	Non-VER
PELTONRE_7_UNIT	19.60	PACW	Non-VER

PENSTOCK_6_UNIT	5.00	PACW	Non-VER
PROSPEC2_7_UNIT 1	18.00	PACW	Non-VER
PROSPEC2_7_UNIT 2	18.00	PACW	Non-VER
PROSPEC3_7_UNIT	7.70	PACW	Non-VER
RFP_6_UNIT	10.00	PACW	Non-VER
ROSEBURL_7_LUMB	20.00	PACW	Non-VER
SLIDECRE_7_UNIT	18.00	PACW	Non-VER
SODA_7_UNIT 1	7.00	PACW	Non-VER
SODA_7_UNIT 2	7.00	PACW	Non-VER
SODASPRI_7_UNIT	11.60	PACW	Non-VER
TIETONHY_6_UNIT	13.80	PACW	Non-VER
TOKETEE_7_UNIT 1	15.00	PACW	Non-VER
TOKETEE_7_UNIT 2	15.00	PACW	Non-VER
TOKETEE_7_UNIT 3	15.00	PACW	Non-VER
WEBER_7_UNIT	2.00	PACW	Non-VER
Total	**2227.65**		

X. Appendix C – Load

Appendix Table 3 – 12 CP Load Billing Determinant

PacifiCorp

2015 Actual Load - Monthly Peaks

(Attachment 9b from the 2016 Annual Update of PacifiCorp's transmission formula rates)

			OATT (Part III - Network Service)														
Column			e	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10	f11	f12	f13	f
Customer			PacifiCorp	BPA Yakama	BPA Gazley	BPA Clarke PUD	BPA: Benton REA	BPA Oregon Wind	Tri-State	Noble Americas/ (Sempra)	Basin Electric	Black Hills	USBR	WAPA	Iberdrola	Exelon	
Class			NFS	NFO	NFO	NFO	NFO	NFO	NFO	NFO	NFO	NFO	NFO	NFO	NFO	NFO	Total NFO
RS / SA				SA 328	SA 229	SA 735	SA 539	SA 538	SA 628	SA 299	SA 505	SA 347	SA 506	SA 175	SA 742	SA 789	
Jan	2	18	8,309	4.55	3.36	25.21	1.40	0.35	25.82	16.47	0.29	43.89	0.01	0.00	5.14	3.07	130
Feb	23	8	8,038	5.81	3.17	26.38	1.17	0.35	45.86	15.18	0.38	47.78	0.01	0.00	11.63	2.86	161
March	4	8	7,837	6.12	3.01	27.31	1.19	0.35	27.59	14.99	1.03	47.76	0.01	-	6.38	2.76	139
April	15	8	7,417	5.07	3.19	24.54	0.73	-	24.31	16.85	0.26	36.27	0.17	1.67	7.76	0.54	121
May	31	18	7,491	4.06	3.20	12.80	0.28	0.42	16.39	18.62	0.25	33.73	0.34	0.72	7.69	2.16	101
Jun	29	16	10,618	5.40	3.42	13.75	0.37	0.29	39.67	21.96	0.23	57.49	0.18	3.47	8.59	4.00	159
Jul	2	16	10,481	5.07	3.73	15.64	0.38	0.03	32.12	22.43	0.21	48.63	0.61	3.28	8.56	3.03	144
Aug	13	16	9,603	6.66	3.11	12.60	0.34	0.25	29.09	20.79	0.24	57.19	0.62	3.02	9.21	2.91	146
Sept	1	16	8,712	6.43	2.85	10.07	0.32	-	24.68	20.33	0.20	50.72	0.51	2.72	9.39	2.65	131
Oct	1	17	7,824	4.90	2.79	10.17	0.28	0.42	16.86	19.35	0.67	32.10	0.27	1.98	10.43	2.50	103
Nov	30	18	8,550	5.49	2.98	26.51	1.05	0.36	26.91	17.74	0.28	46.65	0.01	0.00	11.60	2.30	142
Dec	28	18	8,290	5.43	3.27	25.34	1.49	0.34	29.55	15.50	0.26	44.74	0.00	0.01	11.78	2.40	140
Total			103,170	64.96	38.09	230.33	8.99	3.14	338.82	220.21	4.30	546.95	2.72	16.88	108.16	31.18	1,615
Ave 12CP			8,597.48	5.41	3.17	19.19	0.75	0.26	28.24	18.35	0.36	45.58	0.23	1.41	9.01	2.60	134.56
												(not included (telemetered))		(not included (telemetered))			

	Other Service					
Column	j1	j2	j3	j4	j5	j
Customer	UAMPS	UMPA	Deseret	Western Area Power Administration	APS	
Class	OS	OS	OS	OS	OS	Total OS
RS / SA	RS 297	RS 637	RS 280	RS 262/263	RS 436	
Jan	377.43	92.85	79.23	338	-	888
Feb	325.56	73.66	76.72	252	-	728
March	358.39	64.65	67.65	267	-	758
April	365.41	39.25	89.19	209	-	703
May	394.19	77.59	98.71	282	-	852
Jun	786.77	171.81	170.30	321	-	1,450
Jul	768.22	176.17	145.52	283	-	1,373
Aug	696.63	143.78	138.87	344	-	1,323
Sept	677.43	127.82	133.79	311	-	1,250
Oct	536.91	118.53	101.43	308	-	1,065
Nov	417.39	78.30	71.97	254	-	822
Dec	442.03	81.31	101.49	294	-	919
Total	6,146	1,246	1,275	3,463	-	12,130
Ave 12CP	512.20	103.81	106.24	288.58	-	1,010.83

Total load excluding telemetered exports (Sch 3 divisor) 9,695.88