



August 24, 2016

The Honorable Kimberly D. Bose  
Secretary  
Federal Energy Regulatory Commission  
888 First Street, NE  
Washington, D.C. 20426

## **INFORMATIONAL FILING-NO NOTICE REQUIRED**

**Re: California Independent System Operator Corporation  
Informational Readiness Certification for Puget Sound Energy's  
Participation in the Energy Imbalance Market  
Docket No. ER15-861-000**

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO) submits this informational filing in compliance with section 29.2(b)(6) of the CAISO tariff.<sup>1</sup> The CAISO, in consultation with Puget Sound Energy (PSE), has determined that, following market simulation and an adequate period of parallel operations, the CAISO and PSE have met all readiness criteria specified in section 29.2(b)(7). In support of this determination the CAISO hereby submits the sworn CAISO affidavit of Petar Ristanovic, Vice-President, Technology, and the sworn PSE affidavit of David Mills, Vice President of Energy Operations. This filing certifies the readiness of the CAISO and PSE to proceed with PSE's participation in the CAISO's Energy Imbalance Market (EIM) on October 1, 2016, without exception, consistent with the requirement to do so at least 30 days prior.

### **I. Background**

The EIM provides other balancing authority areas the opportunity to participate in the real-time market for imbalance energy that the CAISO operates in its own balancing authority area. PacifiCorp's balancing authorities were the first two balancing authorities to join the EIM beyond the CAISO balancing

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<sup>1</sup> The Commission has determined that readiness certifications are considered informational filings and will not be noticed for comment. *See Cal. Indep. Sys. Operator Corp.*, 153 FERC ¶ 61,205 at P 86 and n.173 (2015); *see also Cal. Indep. Sys. Operator Corp.*, 155 FERC ¶ 61,283 at P 8 (2016).

authority area. The CAISO's EIM tariff provisions went into effect on October 24, 2014, in time for the first trading day of November 1, 2014.<sup>2</sup> The second EIM entity, NV Energy, began participation in the EIM on December 1, 2015, and the Arizona Public Service Company (APS) balancing authority area will commence its participation on October 1, 2016, concurrently with the PSE balancing authority area.<sup>3</sup>

In a March 16, 2015 order,<sup>4</sup> the Commission concluded that certain readiness safeguards are necessary prior to activating a prospective EIM entity in the Energy Imbalance Market.<sup>5</sup> Accordingly, the Commission directed the CAISO to include provisions in its tariff to ensure the readiness of any new EIM entity. The Commission further required that the certification of market readiness include a sworn affidavit from an officer of the CAISO and an officer of the prospective EIM entity attesting that both have prepared and made ready the systems and processes for the new EIM entity to commence participation in the EIM.<sup>6</sup> Following two compliance filings, the Commission accepted the CAISO's proposed readiness criteria.<sup>7</sup> These criteria appear in section 29.2(b)(7) of the CAISO Tariff.

## **II. Readiness Reporting, Determination, and Attestations**

The CAISO and PSE ran market simulation from July 6, 2016 to July 29, 2016. Parallel (*i.e.*, financially nonbinding) operations, which began on August 1, 2016, will formally run through at least August 30, 2016 and, in any event, will continue to be supported and available to PSE until October 1, 2016. During market simulation and parallel operations the CAISO and PSE have engaged in daily discussions to track progress and confirm the status of each readiness criterion, and the CAISO has regularly reported on readiness status in market forum discussions and publicly posted a table or "dashboard," showing progress

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<sup>2</sup> See *Cal. Indep. Sys. Operator Corp.*, 147 FERC ¶ 61,231 (2014) (June 19 Order) (conditionally accepting tariff revisions to implement Energy Imbalance Market); *Cal. Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,058 (2014) (order denying requests for rehearing, granting in part and denying in part requests for clarification, and conditionally accepting tariff revisions on compliance with regard to order listed above); Commission Letter Order, 149 FERC ¶ 61,005 (Oct. 2, 2014) (order granting CAISO request to extend effective date of Energy Imbalance Market tariff revisions from September 23, 2014, to October 24, 2014, for trading day November 1, 2014).

<sup>3</sup> A separate filing that addresses the readiness of APS will be submitted.

<sup>4</sup> *Cal. Indep. Sys. Operator Corp.*, 150 FERC ¶ 61,191 (2015) (March 16 Order).

<sup>5</sup> March 16 Order at P 30.

<sup>6</sup> *Id.* n.85.

<sup>7</sup> *Cal. Indep. Sys. Operator Corp.*, 153 FERC ¶ 61,205 (2015).

towards meeting the readiness criteria.<sup>8</sup> The process of updating the readiness dashboard through this joint effort involved representatives from both organizations, including the senior officers who have attested that the parties' processes and systems are ready for PSE's participation in the EIM.

The market simulation confirmed system functionality and connectivity by identifying issues and software variances in advance of implementation that have since been resolved. In addition, market simulation permitted the CAISO and PSE to validate performance of the systems and processes under a variety of structured scenarios. Having achieved the benefits from market simulation, the CAISO and PSE transitioned to parallel operations testing on August 1, 2016.

The parallel operations phase is designed to test performance of the systems and processes in a non-binding environment using historical data and information from production systems to the maximum extent possible. The CAISO and PSE have engaged in parallel operations twenty-four hours a day in order to examine capabilities at different times and conditions (morning ramp, evening ramp, low load and peak load). Doing so has permitted PSE to understand the interaction between resource plans, base schedules, outage management, manual dispatch, and the CAISO full network model. This period has also allowed the CAISO to identify and resolve software issues. The market simulation dashboard dated August 9, 2016 demonstrated that the CAISO and PSE were ready to enter parallel operations. The updated dashboard dated August 16, 2016 showed the progress during initial parallel operations as additional readiness criteria were met.

The final dashboard, dated August 19, 2016, is included as Attachment A. The dashboard sets forth each of the readiness criteria in the tariff, the metrics by which the CAISO measures satisfaction of the criteria, and the actions or status that demonstrate PSE's compliance with criteria. The dashboard shows satisfaction of all readiness criteria.

Section 29(b)(6) requires that a senior officer of the CAISO and a prospective EIM entity attest (1) that the processes and systems of the prospective EIM Entity have satisfied or will have satisfied the readiness criteria set forth in section 29.2(b)(7) as of the Implementation Date; (2) to any known issues requiring resolution prior to the Implementation Date in accordance with section 29.2(b)(8); (3) to any exceptions from the established thresholds specified in the Business Practice Manuals, and that despite such exceptions the criteria were met or will be met as specified in 29.2(b)(7); and (4) that the Implementation Date is conditional on the resolution of the known issues

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<sup>8</sup> More information on the status of these other reports consistent with CAISO tariff section 29.2(b)(8) is available on the CAISO website under the EIM Entities APS and PSE entry at: <http://www.caiso.com/informed/Pages/ReleasePlanning/Default.aspx>.

identified in the certificates and any unforeseen issues that undermine the satisfaction of the readiness criteria. Attachments B and C, respectively, contain the sworn CAISO affidavit of Petar Ristanovic, Vice-President, Technology, and the sworn PSE affidavit of David Mills, Vice-President of Energy Operations, in satisfaction of this requirement.

The affidavits are based upon the engagement by these senior officers in assessing the readiness criteria as reported in the dashboard, including supporting documentation. The CAISO believes that the market simulation and parallel operations to date demonstrate that PSE is prepared to enter financially binding production EIM operations on October 1, 2016. As discussed the attached Market Quality Report, any issues identified in the parallel operations have been resolved or will be resolved. Neither the CAISO nor PSE has identified any exception to any of the readiness criteria.

### **III. Market Quality Report on Parallel Operations**

Parallel operations allowed the CAISO and PSE to identify and resolve numerous input, process, and software issues prior to the commencement of financially binding operations.<sup>9</sup> The CAISO and PSE worked diligently during parallel operations to identify the cause of the infeasibilities that arose during parallel operations. The attached Market Quality Report demonstrates that the majority of the power balance infeasibilities identified during the period of parallel operations associated with the readiness determination were caused by input data issues, some of which are unique to the parallel operations environment and software issues, all of which have been or will be resolved by the implementation date.

The need to reflect Bonneville Power Administration (BPA) transmission system rate of change constraints associated with the use of PSE's transmission rights in the EIM is an important consideration with respect to PSE parallel operations.<sup>10</sup> These rate of change constraints limit the 5-minute flow impact on certain BPA flowgates modeled in the market.<sup>11</sup> In production, the rate of change constraints will limit the five-minute dispatch changes of the combined set of PacifiCorp West (PACW) and PSE participating resources. In parallel operations the PACW resources actual movement is streamed from the production system

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<sup>9</sup> The market quality report on parallel operations explains how each of these issues impacted the market results and how they were resolved by the CAISO and PSE.

<sup>10</sup> This consideration was not present for APS in parallel operations.

<sup>11</sup> The rate of change constraints on BPA's transmission system are within the BPA balancing authority area. *See Cal. Indep. Sys. Operator Corp.*, 148 FERC ¶ 61,243 (2014) (describing BPA's dynamic transfer constraint on the California-Oregon Intertie). The CAISO and BPA continue to coordinate with respect to the exchange of information and limits associated with modeling and managing BPA flowgates.

that doesn't include PSE. Therefore, PSE resources are dispatched in parallel operations to meet the combined flow limit given the actual movement of PACW resources from production. This puts more stringent constraints on the 5-minute dispatch changes of PSE resources in parallel operations compared to what will happen when both PACW and PSE resources are in production. In production, the responsibility to meet the flow impact limit will be distributed among the combined set of PACW and PSE resources. Therefore, the CAISO and PSE expect that constraints associated with these flowgates will bind much less frequently in production than parallel operations might suggest.

Notwithstanding these differences and challenges, the CAISO validated both prices and schedules based on the data input to the market systems throughout the first 11 days of parallel operations. This validation demonstrates that the market solution produced is as expected and consistent with the market rules as designed based on the input data. The analysis conducted for the report accounts for the fact that input data may be influenced by limitations inherent in the parallel operations environment and these limitations may affect the quality of the solution. When factors affecting the input data are controlled for, the numerical quality of the market solution is good and indicates that the systems and processes of PSE are ready to operate in production.

## **V. Attachments**

Attachment A:	Readiness Dashboard Report
Attachment B:	Affidavit of Petar Ristanovic
Attachment C:	Affidavit of David Mills
Attachment D:	Parallel Operations Market Quality Review

## **VI. Conclusion**

The CAISO respectfully requests that the Commission accept this certification as consistent with section 29.2(b)(6) of the CAISO tariff. The CAISO or PSE will notify the Commission in the event of any subsequent determination that the implementation of PSE into the EIM on October 1, 2016 should be delayed, the reason for the delay, the new implementation date if it can be determined, and whether a portion or all of this certification needs to be reissued.

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Respectfully submitted,

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ATTACHMENT A  
*Readiness Dashboard Report*

Readiness Criterion Identifier	Readiness Category	Criteria	Measurable Elements	Threshold	Status	Evidence	Tariff Mapping
1	Prospective EIM Entity Full Network Model Integration	Generation, Interchange and Load comparison	Load, EIM Internal Intertie and EIM External Interties, and Generating Unit definition in the Full Network Model is consistent with the Load, EIM Internal Intertie and EIM External Interties, and Generating Unit definition in the exported prospective EIM Entity network model file that it delivered to the CAISO.	Data matches within 10%, measured in MW capacity to start parallel operation, and within 5% before full activation. Discrepancies, if any, are accounted for in terms of imbalance adjustment.	Complete	<p>Email evidence provided by ISO Project Sponsor. Data for August 2, 2016 indicates Load, EIM Internal Intertie and EIM External Interties, and Generating Unit definition in the Full Network Model is consistent with the Load, EIM Internal Intertie and EIM External Interties, and Generating Unit definition in the exported prospective EIM Entity network model file that it delivered to the CAISO.</p> <p>Data matches within 10%, measured in MW capacity to start parallel operation, and within 5% before full activation. Discrepancies, if any, are accounted for in terms of imbalance adjustment.</p>	<a href="#">Tariff section 29.2(b)(7)(A)(i)</a>
2	Prospective EIM Entity Full Network Model Integration	Comparison of SCADA measurement	SCADA measurements used in prospective EIM Entity EMS model match the measurements observed by the CAISO through the CAISO EMS model.	Critical and used SCADA measurements match 90% to start parallel operation and 95% before full activation, measured in MW, outside of any exception in EMS model.	Complete	<p>Data reviewed from August 1 through August 9, 2016. Email evidence provided by ISO Project Sponsor. SCADA measurements used in PSEI EMS model match the measurements observed by the CAISO through the CAISO EMS model and ICCP link between PSEI and CAISO.</p> <p>Critical and used SCADA measurements match 90% to start parallel operation and 95% before full activation, measured in MW, outside of any exception in EMS model.</p>	<a href="#">Tariff section 29.2(b)(7)(A)(ii)</a>
3	Prospective EIM Entity Full Network Model Integration	State Estimator solution	CAISO state estimator solution is equivalent or superior to the prospective EIM Entity state estimator solution for its Balancing Authority Area.	State Estimator solutions converge >90% of the time in two days before parallel operation and three days before full activation. Solution differences within 10% before parallel operation and 5% before full activation measured in MW or justified due to different external BAA modeling.	Complete	<p>Data reviewed from August 1 through August 9, 2016. Email evidence provided by ISO Project Sponsor. CAISO state estimator solution is equivalent or superior to the prospective EIM Entity state estimator solution for its Balancing Authority Area.</p> <p>State Estimator solutions converge &gt;99% of the time in two days before parallel operation and three days before full activation. Solution differences within 10% before parallel operation and 5% before full activation measured in MW or justified due to different external BAA modeling.</p>	<a href="#">Tariff section 29.2(b)(7)(A)(iii)</a>
4	Prospective EIM Entity Full Network Model Integration	Non-Conforming Load, Behind-the-Meter Generation, Pseudo Ties, and Dynamic Schedules	Physical representation of the prospective EIM Entity's network matches the Base Market Model that accounts for non-conforming load, behind-the-meter generation, pseudo-ties, and dynamic schedules, and third party transmission service provider and path operator information that supports EIM Transfers and Real-Time Dispatch in the Energy Imbalance Market, as applicable.	Prospective EIM Entity major non-conforming loads > 5% of prospective EIM Entity total actual load in MW are modeled separately from conforming load in market model.	Complete	There are no non-conforming loads in Puget Sound BAA.	<a href="#">Tariff section 29.2(b)(7)(A)(iv)</a>



Readiness Criterion Identifier	Readiness Category	Criteria	Measurable Elements	Threshold	Status	Evidence	Tariff Mapping
5	Agreements	Execution of Necessary Agreements	The prospective EIM Entity has executed all necessary agreements.	The prospective EIM Entity will execute all agreements, as outlined in Section 5 of the EIM BPM within the required timelines outlined in Section 5.	Complete	Puget Sound Energy has executed all agreements, as outlined in Section 5 of the EIM BPM within the required timelines.	<a href="#">Tariff section 29.2(b)(7)(K)(i)</a>
6	Operations Training	Completion of mandatory training courses	Prospective EIM Entity operators who will have responsibility for EIM operations, transactions and settlements, will complete CAISO training modules.	Prospective EIM Entity operators will complete training and close-of-training assessment in the appropriate timeframes as outlined in <ul style="list-style-type: none"> <li>· “100 series”– an introduction to Energy Imbalance Market training</li> <li>· “200 series”– the specific hourly and daily tasks and duties for normal operation training module; and</li> <li>· “300 series”– the assessment of market results and response to contingencies and abnormal situations training module.</li> </ul>	Complete	<p>Puget Sound Energy confirms full completion of all training series and knowledge testing with minimum required score for all Puget Sound Energy operators.</p> <p>Puget Sound Energy followed the CAISO Training paradigm:</p> <ul style="list-style-type: none"> <li>• Identified subject matter experts in each of the EIM roles in which PSE is involved.</li> <li>• Subject matter experts: <ul style="list-style-type: none"> <li>- attended CAISO and PCI provided training,</li> <li>- participated in EIM testing,</li> <li>- participated in procedure development, and</li> <li>- participated in end user training.</li> </ul> </li> </ul>	<a href="#">Tariff section 29.2(b)(7)(B)</a>
7	Forecasting Capability	Load forecast capability	Definition of EIM demand forecast boundaries based on the conforming and non-conforming load characteristics, as applicable <ul style="list-style-type: none"> <li>· Accuracy of the CAISO forecast of EIM demand based on historical actual load data for the defined EIM demand forecast boundaries.</li> <li>· Identification of weather station(s) locations used in forecasting, if applicable.</li> </ul>	All Plant Information (PI) tags and historical data for defined load area(s), and non-conforming load, if applicable, compared with load forecasts provided from CAISO (if CAISO load forecast used).	Complete	<p>CAISO reviewed the Load forecasts accuracy for Puget Sound Energy for the period July 14, 2016 through August 14, 2016.</p> <p>All plant information and historical data for Puget Sound Energy have been defined. Full compliance with threshold metric for all intervals during parallel operations: Average Load forecast error for T-60 is 1.11%;Average Load forecast error for T-40 is .91%; Average Load forecast error for the 15-minute is 0.53%;Average Load forecast error for the 5-minute is 0.57%;</p>	<a href="#">Tariff sections 29.2(b)(7)(C)(i)-(iii)</a>
8	Forecasting Capability	Variable Energy Resource (VER) forecast capability	Identification of the source of VER forecasts. (If a participating wind or solar unit requires a CAISO forecast, then BPM and Tariff requirements apply.) <ul style="list-style-type: none"> <li>· Accuracy of the CAISO forecast of EIM demand based on historical actual load data for the defined EIM demand forecast boundaries.</li> </ul>	Forecasting entity must demonstrate delivery of Unit MW forecast at 5 min intervals for at least three hours ahead. Forecasting entity must also provide base schedule by T-75, T-55 and T-40. EIM Entity provides to CAISO real-time MW production PI tags.	Complete	Full compliance with threshold metric. Puget Sound Energy forecasting entity has demonstrated delivery of VER forecasts. VER forecasts are provided in parallel operations and ready to move to production. In addition, Puget Sound Energy has also successfully submitted corresponding base schedules within appropriate timeframes.	<a href="#">Tariff section 29.2(b)(7)(C)(iv)</a>

Readiness Criterion Identifier	Readiness Category	Criteria	Measurable Elements	Threshold	Status	Evidence	Tariff Mapping
9	Forecasting Capability	Flexible capacity requirements	CAISO has established flexible capacity requirements for the prospective EIM Entity Balancing Authority Area and the combined EIM Area including the prospective EIM Entity	The CAISO has received and stored all historical data from the prospective EIM Entity necessary and sufficient for the CAISO to perform the flexible ramp requirement.	Complete	Full compliance with threshold metric. CAISO has established flexible capacity requirements based on received and stored data from Puget Sound Energy. The data feeding into CAISO are of good quality and appropriate. Puget Sound Energy is able to consistently pass the flex ramp sufficiency test.	<a href="#">Tariff section 29.2(b)(7)(K)(iv)</a>
10	Balanced Schedules	Base schedule balancing capability	The prospective EIM Entity Scheduling Coordinator demonstrates its ability to balance EIM demand and EIM supply for the prospective EIM Entity's Balancing Authority Area.	90% or greater of base schedules balance tests during monitored hours are within 10% average imbalance of load forecast over one day period before parallel operation, and 5% average over five full days before full activation. The CAISO will provide examples of MW thresholds for each prospective EIM Entity to indicate a reasonable threshold as it applies to a given EIM Entity and indicate the potential implications of a swing from 5% over to 5% under forecast in one hour to the next.	Complete	Full compliance with threshold metric met prior to parallel operations. Full compliance with threshold metric during parallel operations on the following 5 days: 8/3, 8/4, 8/5, 8/6, 8/7.	<a href="#">Tariff section 29.2(b)(7)(D)(i)</a>
11	Balanced Schedules	Flexible ramping sufficiency test capability	The prospective EIM Entity \ Scheduling Coordinator demonstrates its ability to pass the flexible ramping sufficiency test.	Passes 90% of the time or greater over monitored hours of one day before parallel operation and five non-consecutive days before full activation.	Complete	Full compliance with threshold metric met prior to parallel operations. Full compliance with threshold metric. Puget Sound Energy successfully met flexible capacity requirements on trade dates 7/13 before parallel operations. Puget Sound Energy successfully met flexible capacity requirements on the following trade dates during parallel operations; 8/2 - 8/11.	<a href="#">Tariff section 29.2(b)(7)(D)(iii)</a>
12	Balanced Schedules	Capacity test capability	The prospective EIM Entity Scheduling Coordinator demonstrates its ability to pass capacity test	Passes 90% of the time or greater over monitored hours of one day before parallel operation and five non-consecutive days before full activation. The CAISO will explain the implications of any potential issues with the reliability of an EIM Entity to meet its capacity requirements.	Complete	Full compliance with threshold metric met prior to parallel operations. Full compliance with threshold metric. Puget Sound Energy successfully met capacity test capability of at least 90% over monitored hours.	<a href="#">Tariff section 29.2(b)(7)(D)(ii)</a>
13	Operating Procedures	CAISO operating procedures (relevant to EIM operations)	The prospective EIM Entity signs CAISO non-disclosure agreement and receives appropriate CAISO "public" and "restricted" operating procedures	Operating procedures NDA signed by the prospective EIM Entity.  The prospective EIM Entity receives CAISO operating procedures four months prior to the parallel operations date.	Complete	NDA signed - February 22, 2016. Puget Sound Energy received operating procedures four months prior to parallel operations.	<a href="#">Tariff section 29.2(b)(7)(K)(i)</a>

Readiness Criterion Identifier	Readiness Category	Criteria	Measurable Elements	Threshold	Status	Evidence	Tariff Mapping
14	Operating Procedures	Prospective EIM Entity operating procedures	The prospective EIM Entity operating procedures are defined, updated, and tested for the EIM Entity Scheduling Coordinator	The prospective EIM Entity operating procedures are updated tested and implemented prior to parallel operations date.	Complete	Puget Sound Energy confirms all required operating procedures are updated, tested and validated as of August 10, 2016.	<a href="#">Tariff section 29.2(b)(7)(K)(ii)</a>
15	System Readiness & Integration	Functional Testing	The prospective EIM Entity and the CAISO will test the functional and system elements in accordance with functional and system testing documentation posted on the CAISO website	All tasks identified in the functional and system testing documentation are completed and will not have any issues deemed significant.  Any exceptions will be explained or have an interim solution that is functionally equivalent.	Complete	Confirmation of successful completion of all functional and system tests. Puget Sound Energy provided a completed EIM Testing Timeline Summary noting all functionality was successfully tested.	<a href="#">Tariff section 29.2(b)(7)(E)(i)</a>
16	System Readiness & Integration	System Integration	The prospective EIM Entity and CAISO will test system integration testing in accordance with the system integration testing documentation posted on the CAISO website	All tasks identified in the system integration testing documentation are completed and will not have any issues deemed significant.  Any exceptions will be explained or have an interim solution that is functionally equivalent.	Complete	All system integration tests completed successfully in CAISO simulation environment. Puget Sound Energy provided a completed EIM Testing Timeline Summary noting all interfaces were successfully tested.	<a href="#">Tariff section 29.2(b)(7)(E)(ii)</a>
17	System Readiness & Integration	The prospective EIM Entity system access complete	All prospective EIM Entity employees who require system access to perform EIM-related job functions identified and have necessary certificates.	All prospective EIM Employees performing job functions for EIM market are identified. All CASIO issued certificates are requested within the appropriate timeframes. All identified employees provided the necessary EIM system access certificates.	Complete	All functional tests completed successfully in CAISO simulation environment. Puget Sound Energy provided a completed EIM Testing Timeline Summary noting all functionality was successfully tested.	<a href="#">Tariff section 29.2(b)(7)(E)(iii)</a>
18	System Readiness & Integration	ISO - prospective EIM Entity interfaces	Data interfaces between prospective EIM Entity's systems and CAISO systems are tested	ISO and prospective EIM Entity identify significant data interface issues. EIM Entity and CAISO executives to approve exceptions.	Complete	Confirmation of successful completion of all data interfaces. Puget Sound Energy provided a completed EIM Testing Timeline Summary noting all data interfaces were successfully tested.	<a href="#">Tariff section 29.2(b)(7)(E)(i)</a>
19	Market Simulation	Day in the life simulation	The prospective EIM Entity operators are able to meet the market timelines	The prospective EIM Entity grid operations staff complete end-to-end daily market workflow with no critical defects.	Complete	Confirmation of successful completion of end to end workflow. Puget Sound Energy provided a completed EIM Day in the Life Readiness worksheet noting that all workflows and EIM functionality were successfully tested.	<a href="#">Tariff section 29.2(b)(7)(I)(ii)</a>
20	Market Simulation	Structured scenarios simulation	The prospective EIM Entity operators execute and pass all structured scenarios provided by CAISO	All significant issues resolved or have an interim solution that is functionally equivalent.	Complete	CAISO and Puget Sound Energy confirms completion of all market simulation structured scenarios including Puget Sound Energy validation of settlements statements.	<a href="#">Tariff section 29.2(b)(7)(I)(iii)</a>
21	Market Simulation	Unstructured scenarios simulation	The prospective EIM Entity operators execute and pass all unstructured scenarios provided by prospective EIM Entity	All significant issues resolved or have an interim solution that is functionally equivalent.	Complete	Puget Sound Energy confirms completion of all related unstructured scenarios in simulation environment.	<a href="#">Tariff section 29.2(b)(7)(I)(iv)</a>

Readiness Criterion Identifier	Readiness Category	Criteria	Measurable Elements	Threshold	Status	Evidence	Tariff Mapping
22	Market Simulation	Market results reports	Market results are appropriate based on inputs	The prospective EIM Entity and CAISO executive project sponsors approve the market results reports during market simulation	Complete	CAISO and Puget Sound Energy executive project sponsors have approved the market results reports during market simulation.	Tariff section 29.2(b)(7)(I)(v)
23a	Market Simulation	MS Market quality review	Prices are validated based on input data	Market simulation prices and MWs schedules/dispatches are validated by CAISO market quality team for entry into parallel operation	Complete	CAISO confirms validation of market prices and MWs schedules/dispatches observed during market simulation exercises.	Tariff section 29.2(b)(7)(I)(vi)
23b	Parallel Operations	PO Market quality review	Prices are validated based on input data	Parallel operations prices and MWs schedules/dispatches are validated by the CAISO market quality team	Complete	Market solution in general, including prices are being validated for parallel operations; there have been data quality, set-up and functionality issues identified, which have been and are being resolved.	Tariff section 29.2(b)(7)(I)(vi)
24	Market Simulation	The prospective EIM Entity Identification	Validation of SCID's and Resource ID's	The CAISO has established and the prospective EIM Entity has tested all necessary SCIDs and Resource IDs established for the prospective EIM Entity's Balancing Authority Area	Complete	CAISO and Puget Sound Energy confirms that all necessary SCIDs and Resource IDs have been established for the Puget Sound Energy Balancing Authority Area. Puget Sound Energy provided a final Schedule 1 with all production planned resources on July 14, 2016.	
25	Settlements	ISO Settlement Statements and Invoices published to the prospective EIM Entity and EIM Participating Resources	The CAISO Settlement statements and invoices match the operational data published to stakeholders or fed into settlement system and the resulting calculations correspond to the formulas defined in ISO's tariff and BPMs	Monthly settlement statement and invoice with corresponding daily statements produced during market simulation and parallel operations are verifiably accurate against available data.	Complete	Puget Sound Energy verified settlement statements and invoices during market simulation and parallel operations. Successful verification of criteria during market simulation testing for trade date July 31, 2016. CAISO published initial statements for trade date August 2, 2016 in parallel operations, monthly statement posted on August 8, 2016.	Tariff section 29.2(b)(7)(F)(i)
26	Settlements	The prospective EIM Entity settlement statements and invoices reflect accurate allocations to the prospective EIM Entity customers prior to financially binding operations.	Verification that settlement statements and invoices accurately reflects system and market data	The prospective EIM Entity settlement statements and invoices that allocate charges and credits to its customers accurately reflect system and market data during parallel operations.	Complete	Puget Sound Energy prepared settlement statements and invoices that allocate the associated charges and credit to their customers and accurately reflects system and market data for trade date August 2, 2016 parallel operation.	Tariff section 29.2(b)(7)(F)(ii)
27	Monitoring	Data monitoring	Sufficient and adequate data is available to the CAISO and the Department of Market Monitoring	All required market monitoring data is available during testing and during post go-live for the key metrics (any exceptions will be addressed).  CAISO will provide a market report that will provide publicly available information to all market participants.	Complete	CAISO provided daily market monitoring reports throughout Parallel Operations.	Tariff section 29.2(b)(7)(K)(v)

Readiness Criterion Identifier	Readiness Category	Criteria	Measurable Elements	Threshold	Status	Evidence	Tariff Mapping
28	Parallel Operations Plan	Deployment plan	Parallel operations run consistently and in accordance with the timeframe set forth in the prospective EIM Entity specific parallel operation plan	Parallel operations runs consistently within normal production CAISO Market disruption tolerances.	Complete	Parallel operations plan posted on July 29, 2016. CAISO verified parallel operations ran consistently within normal CAISO disruption tolerances. During parallel operations the availability of RTD, RTPD, STUC are 99% and above for the whole day and 100% availability during the monitored hours of the day.	<a href="#">Tariff section 29.2(b)(7)(J)</a>
29	Outage Management System	Transmission and generation outage submittal and retrieval	The prospective EIM Entity will verify its ability to submit and retrieve outage information with the CAISO	The prospective EIM Entity validate their ability to submit and retrieve transmission out-of-service outages, generation Pmax derates, generation Pmin rerates, and generation out-of-service outage tickets within the required timelines.	Complete	Puget Sound Energy verifies its ability to submit and retrieve outage information with CAISO.	<a href="#">Tariff section 29.2(b)(7)(G)</a>
30	Communications between the CAISO and the prospective EIM Entity	Voice and/or electronic messaging	Implemented process and procedures used for voice and/or electronic messaging	The process and procedures are incorporated into the prospective EIM Entities business processes before the start of market simulation.	Complete	Puget Sound Energy confirms that voice and electronic messaging communication processes and procedures have been incorporated into the Puget Sound Energy business processes.	<a href="#">Tariff section 29.2(b)(7)(H)(i)</a>
31	Communications between the CAISO and the prospective EIM Entity	Communication tools	Staff are trained on communication procedures and tools	The prospective EIM Entity operations staff who will have responsibility for EIM operations, transactions and settlements are trained on the relevant operating procedures and tools used for EIM related communications before the start of parallel operations	Complete	NV Energy confirms completion of training on communication procedures and tools for staff who will have responsibility for EIM operations, transactions and settlements.	<a href="#">Tariff section 29.2(b)(7)(H)(ii)</a>
32	Communications between the CAISO and the prospective EIM Entity	3 <sup>rd</sup> party transmission service provider	The third party transmission service provider information that supports EIM Transfers and Real-Time Dispatch included in the Full Network Model is available during parallel operations	The CAISO provides third party transmission service provider and path operator information to the prospective EIM Entity through parallel operations	Complete	CAISO, Bonneville Power Administration and Puget Sound Energy collaborated to define and implement rate of change of constraints limit the flow impact of the 5-min EIM market dispatches of the PSEI participating resources. Four additional flowgates were added based on BPA and PSE agreement.	<a href="#">Tariff section 29.2(b)(7)(H)(iii)</a>
33	EIM Available Balancing Capacity	Identification of EIM Available Balancing Capacity	Participating resources and non-participating resources for EIM Available Balancing Capacity.	The prospective EIM Entity has identified EIM participating resources and non-participating resources that it intends to designate in the EIM Resource Plan as EIM Available Balancing Capacity	Complete	Puget Sound Energy designated EIM participating resources and/or non-participating resources in the EIM Resource Plan as EIM Available Balancing Capacity.	<a href="#">Tariff section 29.2(b)(7)(K)(iii)</a>

ATTACHMENT B  
*Affidavit of Petar Ristanovic*

Affidavit of Petar Ristanovic Certifying Readiness of  
Puget Sound Energy (PSE) to Operate as an EIM Entity

I, Petar Ristanovic, Vice President of Technology for the California Independent System Operator Corporation (CAISO), hereby certify as follows:

1. As the Vice President of Technology, I am responsible for the systems and processes that support and enable the Energy Imbalance Market and, as such, I have overall responsibility for the implementation of PSE into that market.
2. I have reviewed the readiness dashboard and find that it is accurate and complete. All readiness criteria set forth in the CAISO's tariff and business practice manual have been satisfied.
3. Based on the readiness dashboard and other materials prepared for me or for those that report directly to me and my own review of relevant information and direct involvement with readiness efforts, including testing, market simulation, training and parallel operations, and barring unforeseen developments, the systems and processes of the CAISO and PSE will be ready to implement PSE into the Energy Imbalance Market on October 1, 2016.
4. I will ensure that the CAISO maintains resource commitments necessary to sustain readiness through October 1, 2016 and address any unexpected conditions that may arise before October 1, 2016 that could undermine grid operation or market operation within the existing EIM Area. I will continue to monitor progress and resolve any unexpected conditions that may arise.
5. Actual implementation of PSE on October 1, 2016 is conditioned upon the lack of any unexpected and unresolved issues that could undermine grid operation or market operation within the existing EIM Area. I will update this certification in the event any unexpected issues are not resolved as of October 1, 2016.

I hereby declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief:



Petar Ristanovic, Vice President of Technology

August 19, 2016

ATTACHMENT C  
*Affidavit of David Mills*

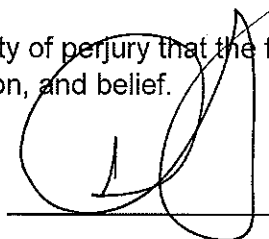


Affidavit of David Mills Certifying Readiness of  
Puget Sound Energy, Inc. (PSE) to Operate as an EIM Entity

I, David Mills, Vice President Energy Operations of PSE, hereby certify as follows:

1. As the Vice President of Energy Operations, I am responsible for the systems and processes that support and enable the Energy Imbalance Market for PSE, as well as the operations that relate to keeping PSE's Balancing Authority Area in balance. As such, I have overall responsibility for the implementation of PSE's entry into that market.
2. I have reviewed the readiness dashboard and find that it is accurate and complete. All readiness criteria set forth in the CAISO's tariff and business practice manual have been satisfied.
3. Based on the readiness dashboard and other materials prepared for me or for those that report directly to me and my own review of relevant information and direct involvement with readiness efforts, including testing, market simulation, training and parallel operations, and barring unforeseen developments, the systems and processes of the CAISO and PSE will be ready to implement PSE into the Energy Imbalance Market on October 1, 2016.
4. I will ensure that PSE maintains resource commitments necessary to sustain readiness through October 1, 2016 and address any unexpected conditions that may arise before October 1, 2016 that could undermine grid operation or market operation within the existing EIM Area. I will continue to monitor progress and resolve any unexpected conditions that may arise.
5. Actual implementation of PSE on October 1, 2016 is conditioned upon the lack of any unexpected and unresolved issues that could undermine grid operation or market operation within the existing EIM Area. I will update this certification in the event any unexpected issues are not resolved as of October 1, 2016.

I hereby declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.



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David Mills, Vice President Energy Operations

August 19, 2016

ATTACHMENT D  
*Parallel Operations Market Quality Review*



California ISO

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# **Market Validation of Parallel Operations for PSE EIM Entity**

**August 18, 2016**

## Contents

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## Executive Summary

Parallel operations of the Energy Imbalance Market (EIM) started on August 1, 2016 for purposes of evaluating the readiness of PSE (Puget Sound Energy), the prospective EIM Entity. The readiness criteria requires the ISO to provide a market performance report for the period of parallel operations carried out for the integration of the PSE balancing authority area (BAA) in the real-time energy imbalance market. This report fulfills that requirement and summarizes the main findings of market validation carried out by the ISO with an emphasis on the EIM results for the PSE Balancing authority area (BAA). This report encompasses both the fifteen and five-minute real-time markets.

The ISO validated both prices and schedules based on input data that was fed through the market systems parallel operations from August 1 through August 11. This validation demonstrates that the market solution produced is as expected and consistent with the market rules as designed, recognizing that the input data may be influenced by limitations inherent in the parallel operating environment and these limitations may affect the quality of the solution. When factors affecting the input data are controlled for, the quality of the market solutions are good and indicate that the systems and processes of PSE are capable of operating in production.

## Background and Scope

The intent of parallel operations is to run the market to simulate as close as possible to actual operating conditions of the system, and to provide PSE with an opportunity to go over specific day-to-day processes and activities required for the operation of the EIM. This set-up provides PSE and the ISO with an opportunity to test their systems and procedures in advance of financially binding market operations.

Although closely resembling actual operations, parallel operations has some limitations that need to be considered when evaluating market results, including the following:

- i) The real time market requires a set of data inputs to run. In actual real-time market operations, many of these inputs are dynamic, dependent on the participants' resources actual performance, and following of instructions. For example, in an actual operating environment, telemetry received from resources gives the information to the ISO system of the operating status of the units, which are changing dynamically and interact with the market systems as the conditions change. During parallel operations this iterative and interactive data processes are limited because the resources of the prospective EIM entity are not yet required to follow their five-minute dispatch instruction. Similarly, if telemetry from actual production is used, there may be a potential for mismatches between what the actual system is running with versus what the market is projecting due to units potentially not following closely the market instructions. Therefore, the information regarding the resource's performance fed back to the market systems may or may not be related to the dispatch instruction issues through the parallel operations environment.
- ii) In actual operations, intertie resources require a closed loop for the market system to fully reflect the system and market conditions and intertie schedules eventually need to be tagged in order to reflect the system data flows. For parallel operations, it is not possible to replicate fully the actual tagging process, which may pose an additional challenge based on the data that is fed into the market system.
- iii) During parallel operations, the market participant is still defining its resources' data including characteristics and bids, which consist of three-part bids used for generation resources that require careful consideration of start-up, minimum load and energy bid costs. During this period, the participant is also learning the impacts of the resources constraints on the actual operations of the market.
- iv) The five-minute rate of change constraints limit the 5-min flow impact of EIM market flow on certain third-party transmission provider internal flowgates (in case of PSE, it is BPA transmission). In actual operations, the rate of change constraints limit the five-minute dispatch changes of the combined set of PacifiCorp West (PACW) and PSE participating resources. In parallel operations the PACW resources actual movement is streamed from the production system based on the actual production system condition that doesn't include PSE as an active EIM entity. Therefore, PSE resources are dispatched in parallel operations to meet the combined flow limit given the actual movement of PACW resources from production. This puts more stringent constraints on the 5-min dispatch changes of PSE resources in parallel operations compared to what the actual operations situation will be when both PACW and PSE resources are under the same rate of change constraint. In

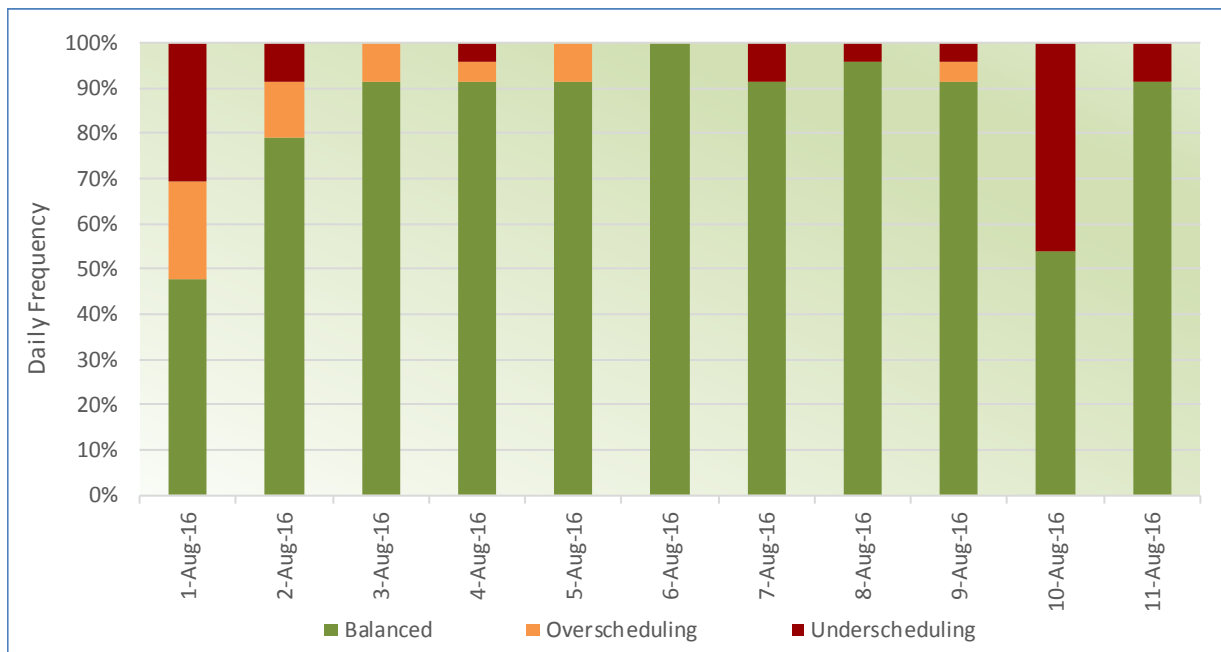
production the responsibility to meet the flow impact limit will be distributed among the combined set of resources.

These factors, among others, have an effect on the market results and the quality of the solution. Therefore, conclusions on the quality of the market results must consider the input data and the inherent set-up for parallel operations to avoid misleading conclusions about the actual functionality and robustness of the market.

## Market Trends

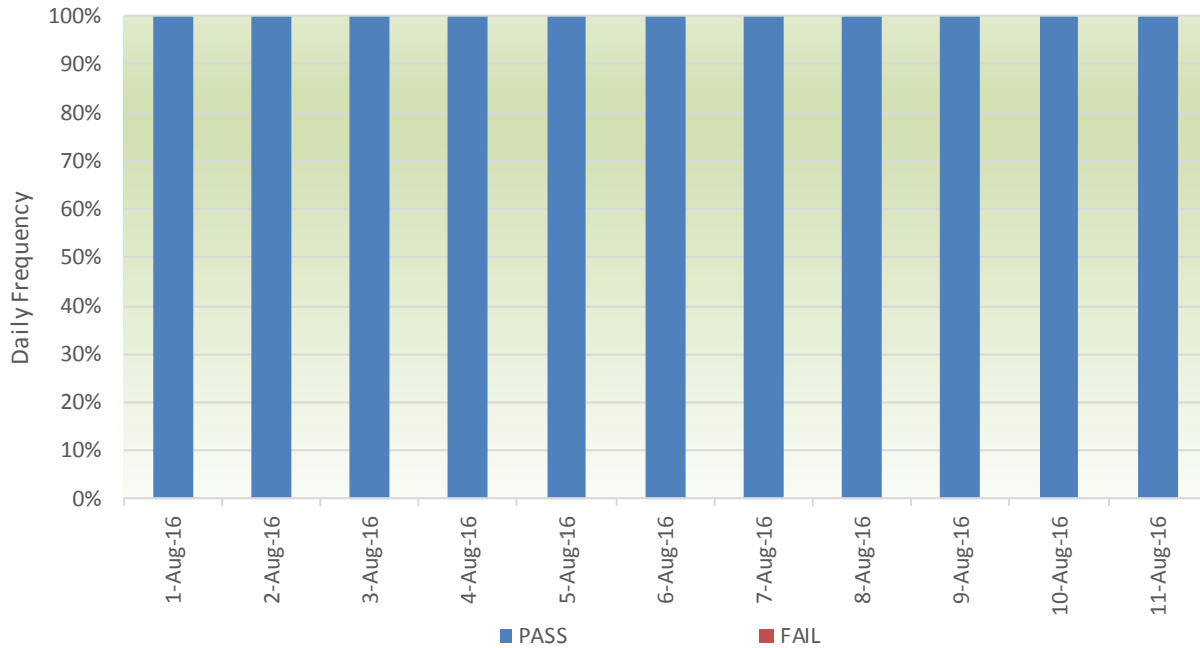
Figure 1 shows the percentage of hours failing the balancing test required under section 29.34(k) of the ISO tariff. The ISO calculated the frequency for each day, by dividing by 24 hours the number of hours where the prospective EIM entity failed the balancing test. The figures below present the results for both under-schedule and over-schedule cases. The balancing test provides a reference of how well balanced (energy supply and demand defined by the hourly base schedules and forecast respectively) the EIM BAA is going to come into the real-time energy imbalance market. Having a large percentage of positive imbalance means the real-time market will be the last resort to incrementally balance the area. The incremental balancing of supply will come from the bid-in capacity made available in the market in addition to the base schedule or EIM transfers between the participating EIM entities' BAAs. For the period of parallel operations, the PSE area passed the balancing test in 84 percent of the hours. On August 1, and August 10, PSE was balanced for less than 60 % of the hours and on August 2, PSE was balanced for less than 80 percent of the hours. On August 10, the failures on the balancing test were driven by an incorrect outage on a unit which had 400 MW of base schedules for first 13 hours of the day. Due to this outage, the market application disqualified the base schedules on this unit that caused balancing failures. On all the eight remaining days, PSE was balanced for more than 90% of the hours.

**Figure 1: Daily frequency of power balancing test failures**



A second test carried out prior to running the real-time market is the capacity test. For this period, PSE passed the capacity test for all hours, as shown in Figure 2.



**Figure 2: Daily frequency of capacity test failures**


A third test carried out prior to running the real-time market (which includes the EIM) is the flexible ramp sufficiency test as required by section 27.34 (m) of the ISO tariff. The flexibility test evaluates whether the EIM entity has sufficient flexible capacity based on submitted energy at the time. Figure 3 shows the daily frequency of test failures observed in the first 11 days of parallel operation for the PSE BAA. For this period, the PSE passed the flex ramp test for all hours.

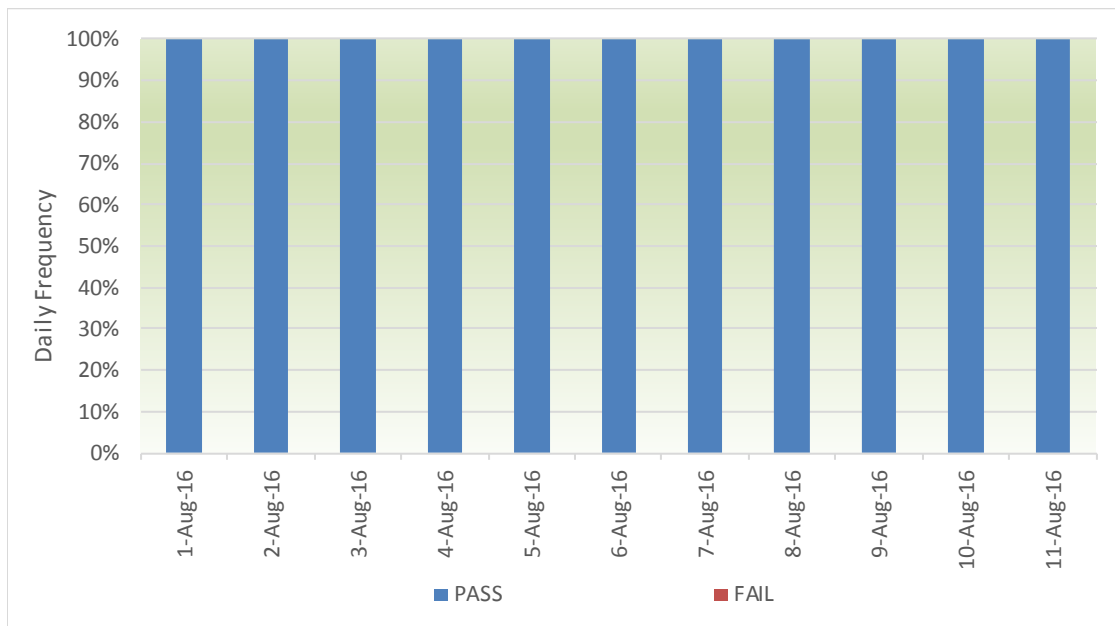
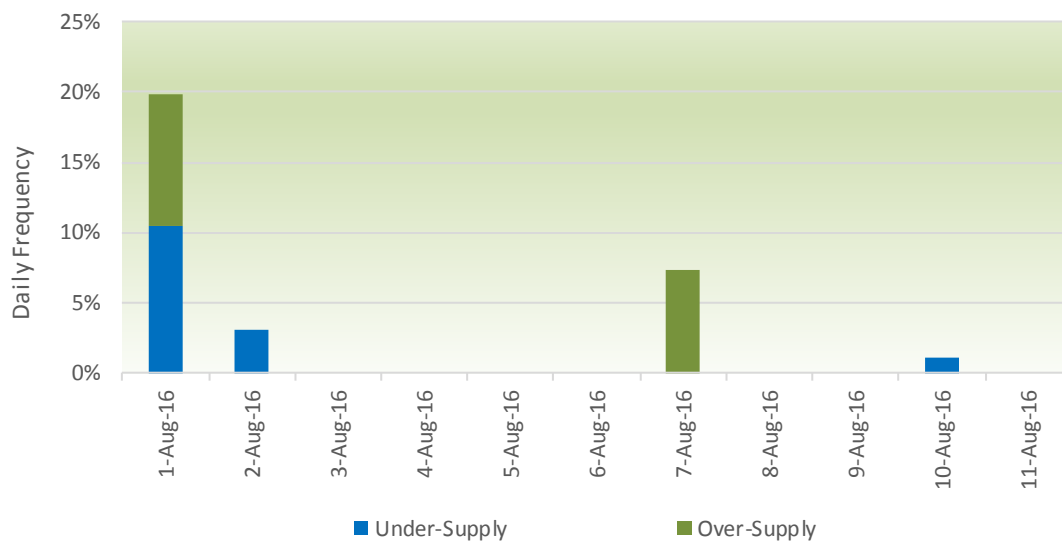
**Figure 3: Daily frequency of flexible ramp capacity test failures**


Figure 4 and 5 shows the frequency of power balance infeasibilities for under-generation conditions in both markets. The power balance constraint infeasibilities are pegged to the corresponding penalty prices of \$1000/MWh for under-supply infeasibilities, and about -\$150/MWh for over-supply infeasibilities. However, during parallel operations, the EIM market for PSE has been set-up to run under the conditions reflecting the price discovery mechanism that is in effect for the transitional measurement period (this will be in effect for the first six months in production). Under this functionality, when a power balance constraint is infeasible, the market will reflect the last economical signal instead of the penalty prices. The first six months transition period pricing is based on the FERC Order in Docket ER15-2565-000<sup>1</sup>, which grants the prospective EIM entity the time to re-adjust and fine tune its systems, processes, and procedures to avoid conditions that leads to trigger administrative penalty prices due to false under-supply or over-supply conditions. The transition pricing period also shields the prospective EIM entity from getting administrative penalty prices during the first six month of gaining production experience for the timely response to inform the market about operators’ manual actions that are taken or decided outside the market to maintain the EIM BAA reliability or balancing needs such as deployment of operating reserve in response to forced outage.

**Figure 4: Daily frequency of supply infeasibilities in the fifteen-minute market**

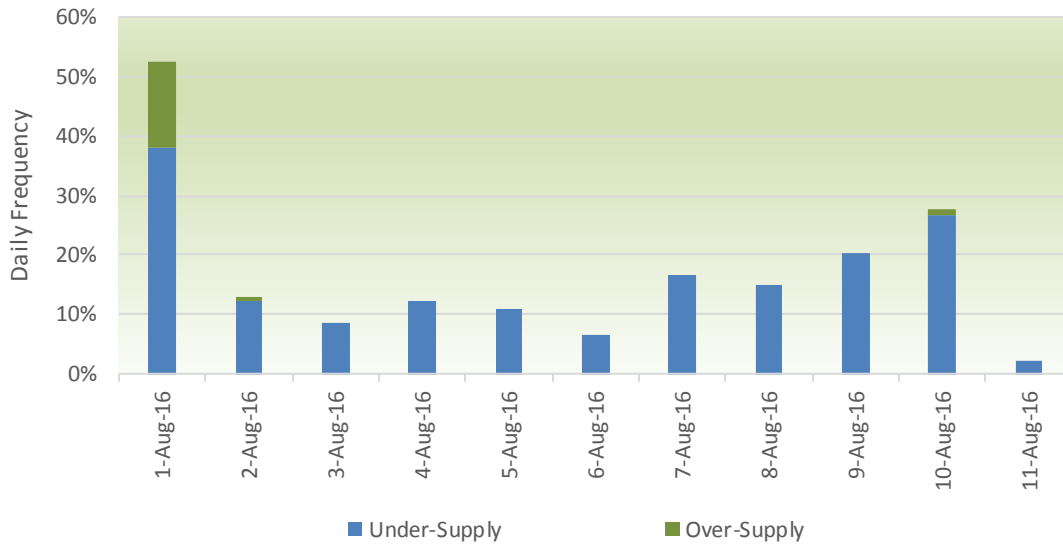


From figure 4, it can be seen that PSE had infeasibilities in 10% of the time on August 1 and 5% of the time on August 2. With the transition to parallel operations, these first days are more exposed to transitory issues related to stabilizing the parallel operations environment, such as i) maintaining orchestration and continuing the input data streams from actual production, ii) fixing data flow timings related to bid submission and movement, iii) merging of accepted bids from production to the parallel operations environment after production market close, and iv) fixing many system connectivity and certificate

<sup>1</sup> *Cal. Ind. System Op.*, 153 FERC ¶ 61,104 (2015).

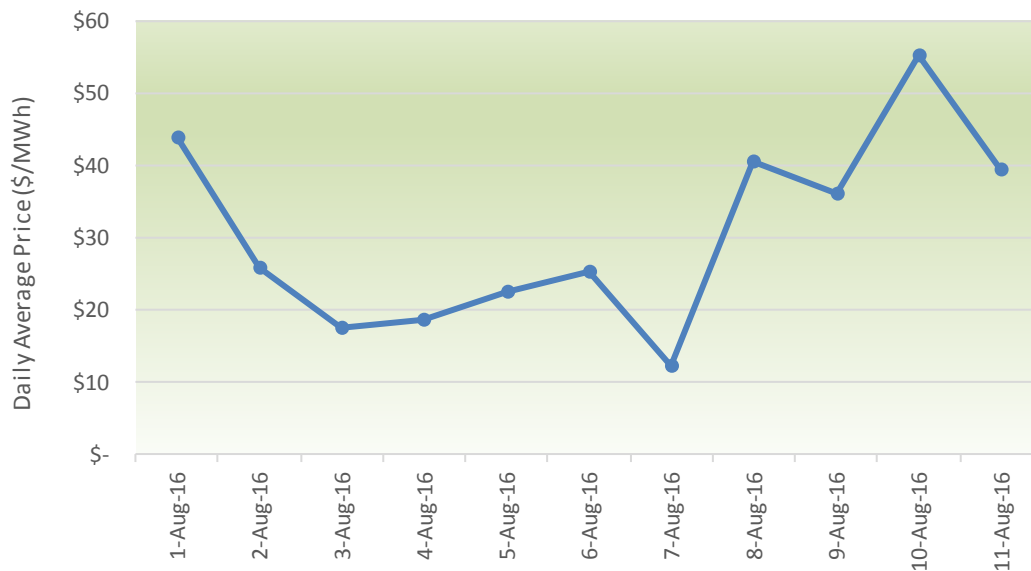
provisioning system access issues. For subsequent days, the fifteen-minute market shows few under-supply infeasibilities, which is an important signal of the depth of available flexible capacity in the market.

**Figure 5: Daily frequency of supply infeasibilities in the five-minute market**



For August 1 and 2 the real-time interval dispatch market saw higher infeasibilities, as shown in Figure 5, which can be attributed to stabilization of systems in parallel operation environment. However, RTD market continued to observe infeasibilities in the range of 5 to 25% from August 3 through August 11. Further validation was performed on these instances, which is presented in subsequent sections.

**Figure 6: Daily average of fifteen-minute prices**



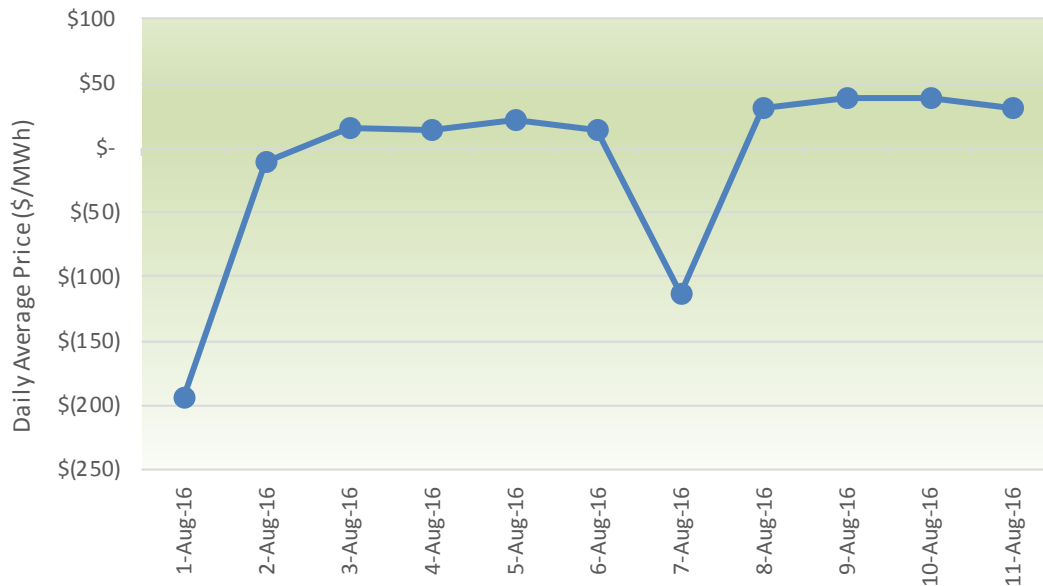
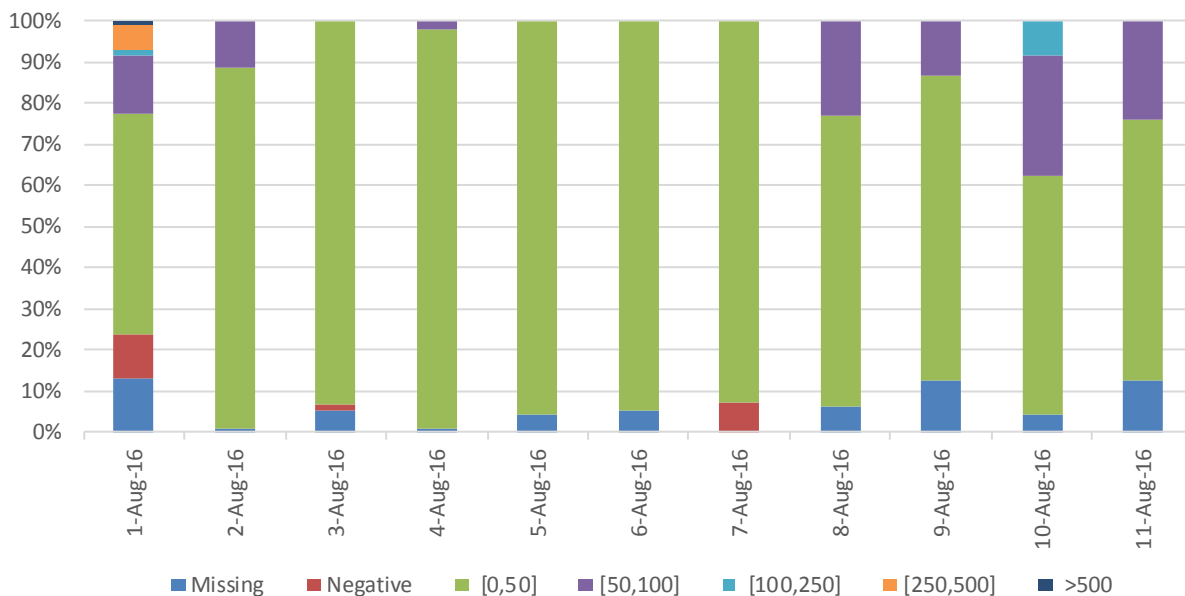
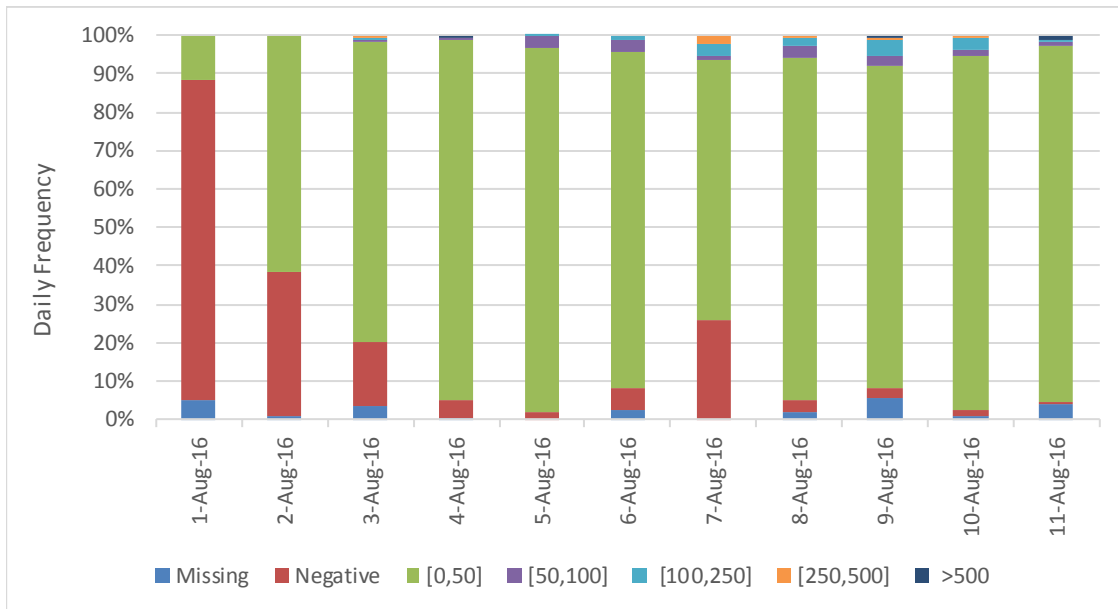
**Figure 7: Daily average of five-minute prices**


Figure 6 and 7 show the daily average ELAP LMPs for the fifteen minute market and the five minute markets. On average, daily prices from August 1 through August 11 in the fifteen market were between \$10 and \$60 with the lowest average price for August 7 and highest price for August 10. The average five minute price was between -\$200 and \$40. Figure 8 shows the five minute ELAP LMPs classified by price bins and figure 9 shows the five minute ELAP LMPs classified by the same price bins.

**Figure 8: Daily frequency of fifteen-minute prices organized by price ranges**


**Figure 9: Daily frequency of five-minute prices organized by price ranges**


The price bin in green shows the frequency of prices in the range of \$0/MWh to \$50/MWh and the price bin in purple shows prices in the range of \$50 and \$100. In the fifteen-minute market over 90 percent of prices in the fifteen- and five-minute markets, respectively, fall between \$0 and \$100/MWh between August 2, and August 11. Compared to the five-minute market, the fifteen minute market saw more spread on prices; for instance, on August 7, 26% prices were negative. On all other days, about 80% to 90% of the prices were between \$0 and \$100.

## Market Validation Items

For the period of August 1 through August 11, the ISO analyzed and validated EIM market results in parallel operations by selecting cases to perform in-depth analysis of resource dispatch and prices.

### 1. Difference in NSI between base schedule and RTD

Type of issue: Set-up related to parallel operations.

Status: closed but under monitoring

Mitigation: PSE to ensure that majority of tags needs to come before T-55' and late tags before T-40'.

Starting from August 5, PSE saw an increase in RTD under-generation infeasibilities because their net schedule inter-change (imports less exports) values in RTD were coming in lower than what was submitted as hourly base schedule. Based on feedback from PSE, this issue was driven by the fact that there were some inter-tie tags submitted by PSE and its third party customers that come in late such that they were considered in either the base schedules or the fifteen-minute markets. In some of the RTD cases analyzed, PSE had internal generation to meet this incremental demand but due to the interplay with congestion on the rate of change constraints the incremental dispatch on these resources to resolve the MW infeasibilities could not be materialized. The analysis for congestion on rate of change constraint is provided below.

### 2. Congestion on five-minute Rate of Change constraint

Type of issue: Set-up related to parallel operations.

Status: Fixed by adjusting the flowgate definition and limits true up

Mitigation: N/A.

Through analysis of power balance constraint infeasibilities it was found that instances of under-generation infeasibilities in PSE area were driven by an interplay with the rate of change constraints. These constraints are in place to limit the flow changes that may happen between 5-minute intervals in certain transmission elements associated with PSE and BPA areas. Generally, the management of this constraint

may conflict with the power balance constraint because in order to meet the power balance constraint, resources need to increase their output, but such an increase may negatively impact the rate of change constraint. Thus, in certain conditions, the market will result in power balance constraint infeasibilities. For instance, in one of the RTD case analyzed, one resource in PACW area was operating 120 MW above its FMM dispatch which was pushing flows on the rate of change constraint. The performance of the PACW resource is driven by actual telemetry coming from the actual production operation. A resource in PSE was dispatched below its FMM dispatch in parallel operations to manage congestion on the rate of change constraint. This dispatch helped relieve congestion on the rate of change constraint but it resulted in power balance infeasibility for PSE. In this case, it was economical to relax the power balance constraint in PSE instead of relaxing the rate of change constraint.

During parallel operations, the rate of change constraints in PSE were binding frequently. After review of these constraints, a mistake in the definition of one of the newly added BPA flowgates was identified. BPA also provided updated limits for the four new added constraints in addition to the existing eleven flowgates already active when PACW joined the EIM. The updated definition and limits were implemented on August 11 and forward on the parallel operation system. The results from August 11 forward accurately reflect the rate of change constraints that will be in production.

3. Loss of VER forecast, and VER telemetry deviations from base schedule.

Type of issue: Set-up related to parallel operations

Status: Fixed

Mitigation: keep monitoring

For the period of August 7 through August 8, the VER forecast payload stopped coming to the market. Absent VER forecast, a couple of VER resources were dispatched based on their telemetry, which is much higher than their corresponding base schedule resulting in a little over 200MW showing in the 5-min market compared to 15-min market leading to many over-supply 5-min intervals.

4. Load forecast accuracy at T-40' compared to 5' RTD load forecast

Type of issue: Set-up related to parallel operations

Status: fixed

Mitigation: created on-going daily graph monitor to track PSE load forecast accuracy.

There was large mismatch between the T-40' PSE load forecast and the 5-min forecast. The 5-min values are closer to actual loads. Some parameters of the PSE load forecasting model were tuned to

increase weight on actual load measurement which resulted in improved load forecast accuracy. The accuracy issue was found during the first few days of parallel operations. The team has created a monitor to track of the different forecasts accuracy against actual. At this point there are no reported issues regarding this item. This issue impacted RTD infeasibilities on August 4, and 5.

5. Discrepancy between base schedule and unit outage tickets

Type of issue: input data discrepancy

Status: PSE interface from outage management system to adjust base schedule submission is fixed.

Mitigation: Re-inforce training to look at the unit viewer display to identify discrepancies

On August 10, the failures on the balancing test were driven by an incorrect outage on a unit which had 400 MW of base schedules for first 13 hours of the day. Due to this outage, market application disqualified the base schedules on this unit that caused balancing failures. This also resulted in the highest number of RTD infeasibilities in a single day due to the time it took to resolve the discrepancy in this automated submission interface.



## CERTIFICATE OF SERVICE

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

Dated at Folsom, CA this 24th day of August, 2016.

*Anna M. Pascuzzo*

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Folsom, CA 95630